Detailed Member Calculations

Units: N&mm

Regulation: ASCE 41-17
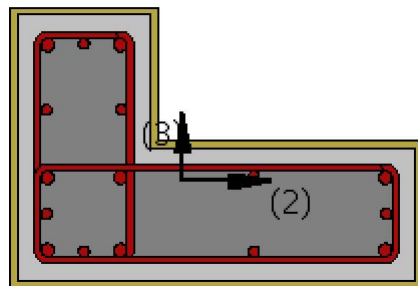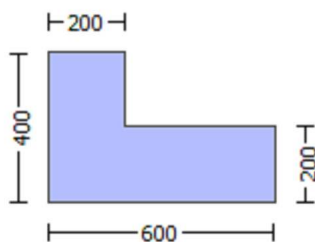
Calculation No. 1

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 LC1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rclcs

Constant Properties

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

Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
###
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.2956E+007
Shear Force, Va = -4291.279
EDGE -B-
Bending Moment, Mb = 80283.485
Shear Force, Vb = 4291.279
BOTH EDGES
Axial Force, F = -6361.069
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2890.265
     -Compression: Asl,com = 829.3805
          -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 18.18182

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 379285.941
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 379285.941
   VCol = 379285.941
   knl = 1.00
       displacement_ductility_demand = 0.00913711

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

     = 1 (normal-weight concrete)
   fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 4.00

Mu = 1.2956E+007
Vu = 4291.279
d = 0.8*h = 480.00
Nu = 6361.069
Ag = 120000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 502654.825
where:
Vs1 = 125663.706 is calculated for section web, with:
  d = 160.00
  Av = 157079.633
  fy = 500.00
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.625
Vs2 = 376991.118 is calculated for section flange, with:
  d = 480.00
  Av = 157079.633
  fy = 500.00
  s = 100.00
Vs2 is multiplied by   Col2 = 1.00
  s/d = 0.20833333
Vf ((11-3)-(11.4), ACI 440) = 293495.545
  f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where   is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1:   1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 557.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
     with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 318865.838
  bw = 200.00

----
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   = 0.00010359
 y = (My*Ls/3)/Eleff = 0.01133749 ((4.29),Biskinis Phd))
 My = 4.5015E+008
 Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 3019.222
 From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 3.9959E+013
   factor = 0.30
     Ag = 160000.00
     fc' = 33.00
     N = 6361.069
   Ec*Ig = 1.3320E+014

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
 y = Min(y_ten, y_com)
 y_ten = 4.9172287E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^ 2/3) = 311.2112
   d = 557.00

```
        y = 0.43186761
     A = 0.03718321
     B = 0.02864736
      with pt = 0.02594493
         pc = 0.00744507
         pv = 0.00360973
         N = 6361.069
         b = 200.00
          " = 0.07719928
    y_comp = 9.2351909E-006
  with fc* (12.3, (ACI 440)) = 33.28275
     fc = 33.00
     fl = 0.73070932
     b = bmax = 600.00
     h = hmax = 400.00
     Ag = 160000.00
        g = pt + pc + pv = 0.03699973
       rc = 40.00
       Ae/Ac = 0.27772029
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
     effective strain from (12.5) and (12.12), efe = 0.004
      fu = 0.01
     Ef = 64828.00
    Ec = 26999.444
      y = 0.431356
     A = 0.03687106
     B = 0.02846388
      with Es = 200000.00
---------------------------------------------------------
---------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
---------------------------------------------------------
End Of Calculation of Shear Capacity for element: column LC1 of floor 1
At local axis: 2
Integration Section: (a)

---------------------------------------------------------
```
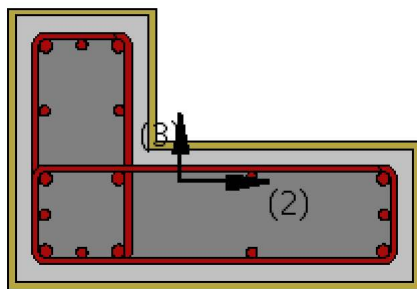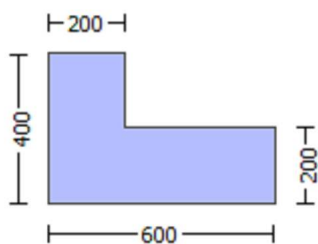
Calculation No. 2

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 LC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -0.00026803
EDGE -B-
Shear Force, Vb = 0.00026803

BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 0.00
   -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 829.3805
   -Compression: Asl,com = 1746.726
    -Middle: Asl,mid = 1545.664

Calculation of Shear Capacity ratio , Ve/Vr = 0.71033407
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 206445.557
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0967E+008
  Mu1+ = 1.8333E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
  Mu1- = 3.0967E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.0967E+008
  Mu2+ = 1.8333E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
  Mu2- = 3.0967E+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 = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
  b = 600.00
  d = 357.00
  d' = 43.00
  v = 0.0008621
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01306815
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
    where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ----
      fy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00

From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
effective stress from (A.35), ff,e = 768.6287

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
  v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
 b = 540.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
  cc (5A.5, TBDY) = 0.00260287
    c = confinement factor = 1.06029
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
  2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
  v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
 u = su (4.1) = 1.7539345E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 2.4056447E-005
Mu = 3.0967E+008
----
with full section properties:
 b = 200.00
 d = 357.00
 d' = 43.00
 v = 0.00258631
   N = 6093.866
 fc = 33.00
  co (5A.5, TBDY) = 0.002

Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.01306815
    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
  where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
  ----
    fx = 0.0528506
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.22333333
  with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
    bmax = 600.00
    hmax = 400.00
    From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
      bw = 200.00
    effective stress from (A.35), ff,e = 768.6287
  ----
    fy = 0.0528506
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.22333333
  with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
    bmax = 600.00
    hmax = 400.00
    From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
      bw = 200.00
    effective stress from (A.35), ff,e = 768.6287

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    fu,f = 1055.00
    Ef = 64828.00
     u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
      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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00471239
  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) = 0.00471239
      Lstir (Length of stirrups along Y) = 1360.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00
  ----
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
      Lstir (Length of stirrups along X) = 960.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00
  ----
      s = 100.00
      fywe = 694.45
      fce = 33.00
    From ((5.A5), TBDY), TBDY: cc = 0.00260287
        c = confinement factor = 1.06029
  y1 = 0.00140044
  sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
  su1 = 0.00512

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
  v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
  b = 140.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
    cc (5A.5, TBDY) = 0.00260287
      c = confinement factor = 1.06029
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
  2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
  v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
  u =   su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2+

Calculation of ultimate curvature ϕu according to 4.1, Biskinis/Fardis 2013:
  ϕu = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
  b = 600.00
  d = 357.00
  d' = 43.00
  ν = 0.0008621
   N = 6093.866
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01306815
      ωwe ((5.4c), TBDY) = αse* ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      ωfy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).

psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fsv = fs = 389.0139

with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
    v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
  b = 540.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
      c = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
    v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
  u = su (4.1) = 1.7539345E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.4056447E-005
Mu = 3.0967E+008
----
with full section properties:
  b = 200.00
  d = 357.00
  d' = 43.00
  v = 0.00258631
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01306815
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
       bmax = 600.00
       hmax = 400.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
         bw = 200.00
       effective stress from (A.35), ff,e = 768.6287
    ----
      fy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
       bmax = 600.00

hmax = 400.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
effective stress from (A.35), ff,e = 768.6287

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fs2 = fs = 389.0139
 with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/ld = 0.30
 suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
 From table 5A.1, TBDY: esuv_nominal = 0.08,
 considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
 For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
 characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fsv = fs = 389.0139
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
 b = 140.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
 cc (5A.5, TBDY) = 0.00260287
 c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
 u =   su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 290631.642

Calculation of Shear Strength at edge 1, Vr1 = 290631.642
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
 VCol0 = 290631.642
 knl = 1 (zero step-static loading)

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

  = 1 (normal-weight concrete)
 fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

M/Vd = 4.00
   Mu = 11.70883
   Vu = 0.00026803
d = 0.8*h = 320.00
Nu = 6093.866
Ag = 80000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
where:
Vs1 = 279254.914 is calculated for section web, with:
  d = 320.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.3125
Vs2 = 139627.457 is calculated for section flange, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by   Col2 = 1.00
  s/d = 0.625
Vf ((11-3)-(11.4), ACI 440) = 188111.148
  ψ_f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot + cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 244232.638
  bw = 200.00

Calculation of Shear Strength at edge 2, Vr2 = 290631.642
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 290631.642
  knl = 1 (zero step-static loading)

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

  = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 4.00
   Mu = 11.914
   Vu = 0.00026803
d = 0.8*h = 320.00
Nu = 6093.866
Ag = 80000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
where:
Vs1 = 279254.914 is calculated for section web, with:
  d = 320.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.3125
Vs2 = 139627.457 is calculated for section flange, with:

d = 160.00
Av = 157079.633
fy = 555.56
s = 100.00
Vs2 is multiplied by   Col2 = 1.00
s/d = 0.625
Vf ((11-3)-(11.4), ACI 440) = 188111.148
f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1:   1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
fe = 0.004, from (11.6a), ACI 440
with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 244232.638
bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rclcs

Constant Properties

Knowledge Factor, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016

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

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00069415
EDGE -B-
Shear Force, Vb = -0.00069415
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
    -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 2890.265
    -Compression: Asl,com = 829.3805
      -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 1.00732
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 438835.425
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.5825E+008
   Mu1+ = 6.5825E+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- = 2.1740E+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-) = 6.5825E+008
   Mu2+ = 6.5825E+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- = 2.1740E+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 = 1.4829616E-005
Mu = 6.5825E+008
----
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  v = 0.00165765
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.01306815
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05721847
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----

fx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333
   bmax = 600.00
   hmax = 400.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
     bw = 200.00
   effective stress from (A.35), ff,e = 768.6287
----
  fy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
   bmax = 600.00
   hmax = 400.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
     bw = 200.00
   effective stress from (A.35), ff,e = 768.6287

  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
   ----
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
   ----
    s = 100.00
   fywe = 694.45
   fce = 33.00
  From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
 y1 = 0.00140044
sh1 = 0.00448141
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
b = 140.00
d = 527.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
cc (5A.5, TBDY) = 0.00260287
c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
u = su (4.1) = 1.4829616E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 1.0664224E-005
Mu = 2.1740E+008
----
with full section properties:
  b = 400.00
  d = 557.00
  d' = 43.00
  v = 0.00082883
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01306815
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05721847
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ----
      fy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00471239
    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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00

Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00

----

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
Lstir (Length of stirrups along X) = 960.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00

----

s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
c = confinement factor = 1.06029
εy1 = 0.00140044
εsh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
εsu1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
    εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and εy1, εsh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    εy1, εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
εy2 = 0.00140044
εsh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
εsu2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
    εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and εy2, εsh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    εy1, εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
εyv = 0.00140044
εshv = 0.0044814
ftv = 466.8167
fyv = 389.0139
εsuv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
    εsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and εyv, εshv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    εy1, εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
b = 340.00

```
    d = 527.00
    d' = 13.00
   fcc (5A.2, TBDY) = 34.98946
     cc (5A.5, TBDY) = 0.00260287
        c = confinement factor = 1.06029
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
     2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
     v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
  u =    su (4.1) = 1.0664224E-005
------------------------------------------------------------

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

----------------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
  u = 1.4829616E-005
Mu = 6.5825E+008
----------------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  v = 0.00165765
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01306815
       we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,    fy) = 0.05721847
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----------------------------------------------------------------
       fx = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
        effective stress from (A.35), ff,e = 768.6287
     ----------------------------------------------------------------
       fy = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
        effective stress from (A.35), ff,e = 768.6287
        ----------------------------------------------------------------
        R = 40.00
```

Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
    ----
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
        Lstir (Length of stirrups along X) = 960.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
    ----
    s = 100.00
    fywe = 694.45
    fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00

yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
  2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
  b = 140.00
  d = 527.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
     c = confinement factor = 1.06029
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
  v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
 u =   su (4.1) = 1.4829616E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.0664224E-005
Mu = 2.1740E+008
----
with full section properties:
  b = 400.00
  d = 557.00
  d' = 43.00
  v = 0.00082883
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01306815

we ((5.4c), TBDY) = ase* $\omega_{sh,min}$*fywe/fce+Min(ωfx, ωfy) = 0.05721847
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333
    bmax = 600.00
    hmax = 400.00
    From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
    effective stress from (A.35), ff,e = 768.6287

ωfy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
    bmax = 600.00
    hmax = 400.00
    From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
    effective stress from (A.35), ff,e = 768.6287

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    fu,f = 1055.00
    Ef = 64828.00
    εu,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to b_{i}^{2}/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
----
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
        Lstir (Length of stirrups along X) = 960.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
----
        s = 100.00
    fywe = 694.45
    fce = 33.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00260287
        λc = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00

lo/lou,min = lb/ld = 0.30
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
  2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
  v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
  b = 340.00
  d = 527.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
      c = confinement factor = 1.06029
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
   2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
   v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
 u =   su (4.1) = 1.0664224E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

```
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 435646.093
--------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 435646.093
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 435646.093
  knl = 1 (zero step-static loading)
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 44.9328
     Vu = 0.00069415
  d = 0.8*h = 480.00
  Nu = 6093.866
  Ag = 120000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 139627.457 is calculated for section web, with:
    d = 160.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
    s/d = 0.625
  Vs2 = 418882.372 is calculated for section flange, with:
    d = 480.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
    s/d = 0.20833333
  Vf ((11-3)-(11.4), ACI 440) = 293495.545
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where    is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf(  ,  ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,   =45° and  =-45° to take into consideration the cyclic seismic loading.
  orientation 1:   1 = b1 +  90° = 90.00
  Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 557.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
      with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 366348.956
    bw = 200.00
------------------------------------------------------------
--------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 435646.093
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 435646.093
  knl = 1 (zero step-static loading)
------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
```

M/Vd = 4.00
   Mu = 44.60048
   Vu = 0.00069415
d = 0.8*h = 480.00
Nu = 6093.866
Ag = 120000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
where:
Vs1 = 139627.457 is calculated for section web, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by Col1 = 1.00
  s/d = 0.625
Vs2 = 418882.372 is calculated for section flange, with:
  d = 480.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by Col2 = 1.00
  s/d = 0.20833333
Vf ((11-3)-(11.4), ACI 440) = 293495.545
  f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 557.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 366348.956
  bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rclcs

Constant Properties

Knowledge Factor, = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00

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

Stepwise Properties

Bending Moment, M = -160913.077
Shear Force, V2 = -4291.279
Shear Force, V3 = 77.5414
Axial Force, F = -6361.069
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 829.3805
     -Compression: Asl,com = 1746.726
         -Middle: Asl,mid = 1545.664
Mean Diameter of Tension Reinforcement, DbL = 18.66667

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta_{u,R}$ = 1.0* θ_u = 0.00655562
  θ_u = θ_y + θ_p = 0.00655562

 - Calculation of θ_y -

 θ_y = (My*Ls/3)/Eleff = 0.00655562 ((4.29),Biskinis Phd))
  My = 1.3306E+008
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 2075.189
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 1.4040E+013
     factor = 0.30
        Ag = 160000.00
        fc' = 33.00
        N = 6361.069
     Ec*Ig = 4.6799E+013

Calculation of Yielding Moment My

Calculation of θ_y and My according to Annex 7   -

Assuming neutral axis within flange (ξ_y < t/d, compression zone rectangular) with:
flange width, b = 600.00
web width, bw = 200.00
flange thickness, t = 200.00

  ξ_y = Min(ξ_y_ten, ξ_y_com)
  ξ_y_ten = 5.8026993E-006

with ((10.1), ASCE 41-17) $fy = Min(fy, 1.25*fy*(lb/ld)^{2/3}) = 311.2112$
   d = 357.00
    y = 0.24884964
   A = 0.01933805
   B = 0.00899219
    with pt = 0.00387199
      pc = 0.00815465
      pv = 0.00721598
      N = 6361.069
      b = 600.00
       " = 0.12044818
  y_comp = 2.5091791E-005
with fc* (12.3, (ACI 440)) = 33.29607
    fc = 33.00
    fl = 0.73070932
    b = bmax = 600.00
    h = hmax = 400.00
    Ag = 160000.00
      g = pt + pc + pv = 0.01924262
     rc = 40.00
     Ae/Ac = 0.29079753
     Effective FRP thickness, $tf = NL*t*Cos(b1) = 1.016$
    effective strain from (12.5) and (12.12), efe = 0.004
     fu = 0.01
   Ef = 64828.00
   Ec = 26999.444
    y = 0.24780539
   A = 0.01917573
   B = 0.00889677
    with Es = 200000.00
CONFIRMATION: y = 0.24825313 < t/d

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

 - Calculation of p -

From table 10-8: p = 0.00
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
  shear control ratio VyE/VCol0E = 0.71033407
  d = 357.00
  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 = 960.00, 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 = 6361.069
   Ag = 160000.00
   f'cE = 33.00
   fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.01924262
  b = 600.00
  d = 357.00
  f'cE = 33.00

End Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 2
Integration Section: (a)

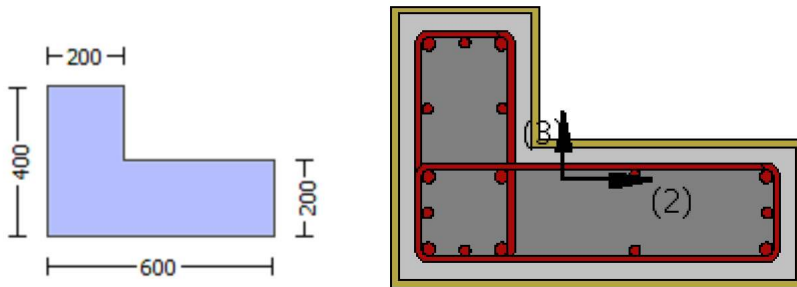
Calculation No. 3

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 LC1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00

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

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -160913.077
Shear Force, Va = 77.5414
EDGE -B-
Bending Moment, Mb = -70821.725
Shear Force, Vb = -77.5414
BOTH EDGES
Axial Force, F = -6361.069
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 829.3805
     -Compression: Asl,com = 1746.726
        -Middle: Asl,mid = 1545.664
Mean Diameter of Tension Reinforcement, DbL,ten = 18.66667

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 253066.566
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 253066.566
   VCol = 253066.566
  knl = 1.00
      displacement_ductility_demand = 0.00633935

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

    = 1 (normal-weight concrete)
  fc' = 25.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 160913.077
     Vu = 77.5414
  d = 0.8*h = 320.00
  Nu = 6361.069
  Ag = 80000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 376991.118
  where:
  Vs1 = 251327.412 is calculated for section web, with:
    d = 320.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00

```
    s/d = 0.3125
  Vs2 = 125663.706 is calculated for section flange, with:
    d = 160.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
    s/d = 0.625
  Vf ((11-3)-(11.4), ACI 440) = 188111.148
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where   is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
  orientation 1:  1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 357.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
       with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 212577.225
    bw = 200.00
-----------------------------------------------------------


-----------------------------------------------------------
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    = 4.1558319E-005
 y = (My*Ls/3)/EIeff = 0.00655562 ((4.29),Biskinis Phd))
  My = 1.3306E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 2075.189
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 1.4040E+013
    factor = 0.30
      Ag = 160000.00
      fc' = 33.00
      N = 6361.069
    Ec*Ig = 4.6799E+013
-----------------------------------------------------------
-----------------------------------------------------------

Calculation of Yielding Moment My
-----------------------------------------------------------
Calculation of  y and My according to Annex 7  -
-----------------------------------------------------------
Assuming neutral axis within flange ( y < t/d, compression zone rectangular) with:
flange width, b = 600.00
web width, bw = 200.00
flange thickness, t = 200.00
-----------------------------------------------------------
  y = Min( y_ten,  y_com)
  y_ten = 5.8026993E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
    d = 357.00
     y = 0.24884964
    A = 0.01933805
    B = 0.00899219
    with pt = 0.00387199
       pc = 0.00815465
       pv = 0.00721598
       N = 6361.069
       b = 600.00
```

```
        " = 0.12044818
  y_comp = 2.5091791E-005
with fc* (12.3, (ACI 440)) = 33.29607
     fc = 33.00
     fl = 0.73070932
     b = bmax = 600.00
     h = hmax = 400.00
    Ag = 160000.00
        g = pt + pc + pv = 0.01924262
      rc = 40.00
      Ae/Ac = 0.29079753
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    effective strain from (12.5) and (12.12), efe = 0.004
     fu = 0.01
   Ef = 64828.00
   Ec = 26999.444
    y = 0.24780539
   A = 0.01917573
   B = 0.00889677
    with Es = 200000.00
CONFIRMATION:   y = 0.24825313 < t/d
```


Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

End Of Calculation of Shear Capacity for element: column LC1 of floor 1
At local axis: 3
Integration Section: (a)

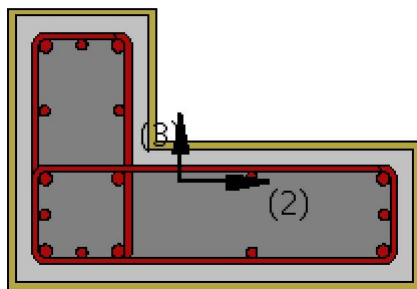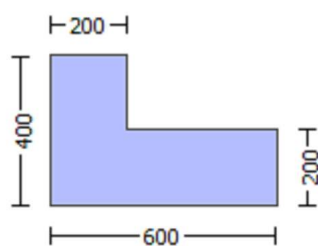

Calculation No. 4

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 LC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -0.00026803
EDGE -B-
Shear Force, Vb = 0.00026803

BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
   -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 829.3805
   -Compression: Asl,com = 1746.726
      -Middle: Asl,mid = 1545.664

Calculation of Shear Capacity ratio , Ve/Vr = 0.71033407
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 206445.557
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0967E+008
   Mu1+ = 1.8333E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
   Mu1- = 3.0967E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.0967E+008
   Mu2+ = 1.8333E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
   Mu2- = 3.0967E+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 = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
   b = 600.00
   d = 357.00
   d' = 43.00
   v = 0.0008621
      N = 6093.866
   fc = 33.00
     co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.01306815
        we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ----
        fx = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
        effective stress from (A.35), ff,e = 768.6287
      ----
        fy = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 600.00
        hmax = 400.00

From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
　　bw = 200.00
effective stress from (A.35), ff,e = 768.6287

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
　　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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
　　Lstir (Length of stirrups along Y) = 1360.00
　　Astir (stirrups area) = 78.53982
　　Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
　　Lstir (Length of stirrups along X) = 960.00
　　Astir (stirrups area) = 78.53982
　　Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
　　c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fs2 = fs = 389.0139
 with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fsv = fs = 389.0139
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
b = 540.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
cc (5A.5, TBDY) = 0.00260287
c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
u = su (4.1) = 1.7539345E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
u = 2.4056447E-005
Mu = 3.0967E+008
----
with full section properties:
b = 200.00
d = 357.00
d' = 43.00
v = 0.00258631
N = 6093.866
fc = 33.00
co (5A.5, TBDY) = 0.002

Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01306815
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
   where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   ----
   fx = 0.0528506
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.22333333
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
         bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
   ----
   fy = 0.0528506
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.22333333
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
         bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   fu,f = 1055.00
   Ef = 64828.00
    u,f = 0.015
   ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
      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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
   psh,min = Min(psh,x , psh,y) = 0.00471239
   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) = 0.00471239
      Lstir (Length of stirrups along Y) = 1360.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00
   ----
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
      Lstir (Length of stirrups along X) = 960.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00
   ----
      s = 100.00
      fywe = 694.45
      fce = 33.00
   From ((5.A5), TBDY), TBDY: cc = 0.00260287
      c = confinement factor = 1.06029
  y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
fy1 = 389.0139
  su1 = 0.00512

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
  v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
  b = 140.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
    c = confinement factor = 1.06029
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
   2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
   v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
 u =   su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
 φu = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
  b = 600.00
  d = 357.00
  d' = 43.00
  ν = 0.0008621
    N = 6093.866
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01306815
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      ωfy = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).

psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
   Lstir (Length of stirrups along Y) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00

----

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
   Lstir (Length of stirrups along X) = 960.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00

----

s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
  c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fsv = fs = 389.0139

```
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
    v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
  b = 540.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
      c  = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
    v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
  u =    su (4.1) = 1.7539345E-005
-----------------------------------------------------------

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

--------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.4056447E-005
Mu = 3.0967E+008
--------------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 357.00
  d' = 43.00
  v = 0.00258631
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:  cu* = shear_factor * Max( cu,  cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01306815
     we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05721847
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
     fx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
       bmax = 600.00
       hmax = 400.00
       From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
          bw = 200.00
       effective stress from (A.35), ff,e = 768.6287
    ----------------------------------------------------------------
     fy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
       bmax = 600.00
```

hmax = 400.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
          bw = 200.00
       effective stress from (A.35), ff,e = 768.6287

       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
       fu,f = 1055.00
       Ef = 64828.00
        u,f = 0.015
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
          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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
       psh,min = Min(psh,x , psh,y) = 0.00471239
    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) = 0.00471239
          Lstir (Length of stirrups along Y) = 1360.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 160000.00
    ----
       psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
          Lstir (Length of stirrups along X) = 960.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 160000.00
    ----
        s = 100.00
       fywe = 694.45
       fce = 33.00
    From ((5.A5), TBDY), TBDY: cc = 0.00260287
        c = confinement factor = 1.06029
  y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs1 = fs = 389.0139
      with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
  v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
 b = 140.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
  cc (5A.5, TBDY) = 0.00260287
    c = confinement factor = 1.06029
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
  2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
  v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
 u =   su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 290631.642

Calculation of Shear Strength at edge 1, Vr1 = 290631.642
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
 VCol0 = 290631.642
 knl = 1 (zero step-static loading)

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

    = 1 (normal-weight concrete)
 fc' = 33.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)

M/Vd = 4.00
   Mu = 11.70883
   Vu = 0.00026803
d = 0.8*h = 320.00
Nu = 6093.866
Ag = 80000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
where:
Vs1 = 279254.914 is calculated for section web, with:
  d = 320.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by Col1 = 1.00
  s/d = 0.3125
Vs2 = 139627.457 is calculated for section flange, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by Col2 = 1.00
  s/d = 0.625
Vf ((11-3)-(11.4), ACI 440) = 188111.148
  ψ_f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 244232.638
  bw = 200.00

Calculation of Shear Strength at edge 2, Vr2 = 290631.642
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
 VCol0 = 290631.642
 knl = 1 (zero step-static loading)

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

  = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 4.00
   Mu = 11.914
   Vu = 0.00026803
d = 0.8*h = 320.00
Nu = 6093.866
Ag = 80000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
where:
Vs1 = 279254.914 is calculated for section web, with:
  d = 320.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by Col1 = 1.00
  s/d = 0.3125
Vs2 = 139627.457 is calculated for section flange, with:

d = 160.00
Av = 157079.633
fy = 555.56
s = 100.00
Vs2 is multiplied by   Col2 = 1.00
s/d = 0.625
Vf ((11-3)-(11.4), ACI 440) = 188111.148
f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, = 45° and = -45° to take into consideration the cyclic seismic loading.
orientation 1:   1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
fe = 0.004, from (11.6a), ACI 440
with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 244232.638
bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rclcs

Constant Properties

Knowledge Factor, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016

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

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00069415
EDGE -B-
Shear Force, Vb = -0.00069415
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
    -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 2890.265
     -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 1.00732
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 438835.425
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.5825E+008
   Mu1+ = 6.5825E+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- = 2.1740E+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-) = 6.5825E+008
   Mu2+ = 6.5825E+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- = 2.1740E+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 = 1.4829616E-005
Mu = 6.5825E+008
----
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  v = 0.00165765
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.01306815
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05721847
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----

fx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333
   bmax = 600.00
   hmax = 400.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
     bw = 200.00
   effective stress from (A.35), ff,e = 768.6287
----
  fy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
   bmax = 600.00
   hmax = 400.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
     bw = 200.00
   effective stress from (A.35), ff,e = 768.6287

  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
   ----
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
   ----
    s = 100.00
   fywe = 694.45
   fce = 33.00
  From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
 y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
  2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
  b = 140.00
  d = 527.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
     c = confinement factor = 1.06029
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
   2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
 u =   su (4.1) = 1.4829616E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.0664224E-005
Mu = 2.1740E+008
----
with full section properties:
  b = 400.00
  d = 557.00
  d' = 43.00
  ν = 0.00082883
    N = 6093.866
  fc = 33.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01306815
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      ωfy = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
      εu,f = 0.015
    αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00471239
    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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00

```
           Astir (stirrups area) = 78.53982
           Asec (section area) = 160000.00
    ------------------------------------------------------------------
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
           Lstir (Length of stirrups along X) = 960.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 160000.00
    ------------------------------------------------------------------
           s = 100.00
         fywe = 694.45
         fce  = 33.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00260287
           c = confinement factor = 1.06029
    y1 = 0.00140044
   sh1 = 0.0044814
  ft1 = 466.8167
  fy1 = 389.0139
   su1 = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
       su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
       with fs1 = fs = 389.0139
       with Es1 = Es = 200000.00
    y2 = 0.00140044
   sh2 = 0.0044814
  ft2 = 466.8167
  fy2 = 389.0139
   su2 = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.30
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
       with fs2 = fs = 389.0139
       with Es2 = Es = 200000.00
    yv = 0.00140044
   shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
   suv = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
       with fsv = fs = 389.0139
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
    v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
  b = 340.00
```

```
   d = 527.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.98946
    cc (5A.5, TBDY) = 0.00260287
       c = confinement factor = 1.06029
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
     2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
     v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
  u =    su (4.1) = 1.0664224E-005
------------------------------------------------------------

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

---------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.4829616E-005
Mu = 6.5825E+008
---------------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  v = 0.00165765
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01306815
       we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05721847
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----------------------------------------------------------------
       fx = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
          bw = 200.00
        effective stress from (A.35), ff,e = 768.6287
     ----------------------------------------------------------------
       fy = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
          bw = 200.00
        effective stress from (A.35), ff,e = 768.6287
     ----------------------------------------------------------------
        R = 40.00
```

Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max((($A_{conf,max}$-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
       Lstir (Length of stirrups along Y) = 1360.00
       Astir (stirrups area) = 78.53982
       Asec (section area) = 160000.00
    ----
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
       Lstir (Length of stirrups along X) = 960.00
       Astir (stirrups area) = 78.53982
       Asec (section area) = 160000.00
    ----
       s = 100.00
      fywe = 694.45
      fce = 33.00
    From ((5.A5), TBDY), TBDY: cc = 0.00260287
       c = confinement factor = 1.06029
  y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00

yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
b = 140.00
d = 527.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
cc (5A.5, TBDY) = 0.00260287
c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
u = su (4.1) = 1.4829616E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
u = 1.0664224E-005
Mu = 2.1740E+008
----
with full section properties:
b = 400.00
d = 557.00
d' = 43.00
v = 0.00082883
N = 6093.866
fc = 33.00
co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: cu = 0.01306815

we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
----
 fx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333
  bmax = 600.00
  hmax = 400.00
  From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
  effective stress from (A.35), ff,e = 768.6287
----
 fy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
  bmax = 600.00
  hmax = 400.00
  From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
  effective stress from (A.35), ff,e = 768.6287

 R = 40.00
 Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
 fu,f = 1055.00
 Ef = 64828.00
  u,f = 0.015
 ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
   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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
 psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
     Lstir (Length of stirrups along Y) = 1360.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 160000.00
----
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
     Lstir (Length of stirrups along X) = 960.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 160000.00
----
    s = 100.00
   fywe = 694.45
   fce = 33.00
 From ((5.A5), TBDY), TBDY: cc = 0.00260287
     c = confinement factor = 1.06029
 y1 = 0.00140044
 sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00

lo/lou,min = lb/ld = 0.30
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs1 = fs = 389.0139
      with Es1 = Es = 200000.00
   y2 = 0.00140044
   sh2 = 0.0044814
  ft2 = 466.8167
  fy2 = 389.0139
   su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs2 = fs = 389.0139
      with Es2 = Es = 200000.00
   yv = 0.00140044
   shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
   suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fsv = fs = 389.0139
      with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
   v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
  b = 340.00
  d = 527.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
      c = confinement factor = 1.06029
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
   2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
   v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
  u =   su (4.1) = 1.0664224E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

```
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 435646.093
--------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 435646.093
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 435646.093
  knl = 1 (zero step-static loading)
----------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
----------------------------------------------------------------
     = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 44.9328
     Vu = 0.00069415
  d = 0.8*h = 480.00
  Nu = 6093.866
  Ag = 120000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 139627.457 is calculated for section web, with:
    d = 160.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.625
  Vs2 = 418882.372 is calculated for section flange, with:
    d = 480.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.20833333
  Vf ((11-3)-(11.4), ACI 440) = 293495.545
     f = 0.95, for fully-wrapped sections
    wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where    is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,   =45° and   =-45° to take into consideration the cyclic seismic loading.
  orientation 1:   1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 557.00
  ffe ((11-5), ACI 440) = 259.312
     Ef = 64828.00
      fe = 0.004, from (11.6a), ACI 440
        with  fu = 0.01
   From (11-11), ACI 440: Vs + Vf <= 366348.956
     bw = 200.00
----------------------------------------------------------------
----------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 435646.093
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 435646.093
  knl = 1 (zero step-static loading)
----------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
----------------------------------------------------------------
     = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
```

M/Vd = 4.00
   Mu = 44.60048
   Vu = 0.00069415
d = 0.8*h = 480.00
Nu = 6093.866
Ag = 120000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
where:
Vs1 = 139627.457 is calculated for section web, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by Col1 = 1.00
  s/d = 0.625
Vs2 = 418882.372 is calculated for section flange, with:
  d = 480.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by Col2 = 1.00
  s/d = 0.20833333
Vf ((11-3)-(11.4), ACI 440) = 293495.545
  f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 557.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 366348.956
  bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rclcs

Constant Properties

Knowledge Factor, = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00

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

Stepwise Properties

Bending Moment, M = -1.2956E+007
Shear Force, V2 = -4291.279
Shear Force, V3 = 77.5414
Axial Force, F = -6361.069
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2890.265
     -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL = 18.18182

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta u,R$ = 1.0* θu = 0.01133749
 θu = θy + θp = 0.01133749

 - Calculation of θy -

 θy = (My*Ls/3)/EIeff = 0.01133749 ((4.29),Biskinis Phd))
  My = 4.5015E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 3019.222
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 3.9959E+013
     factor = 0.30
        Ag = 160000.00
        fc' = 33.00
        N = 6361.069
     Ec*Ig = 1.3320E+014

Calculation of Yielding Moment My

Calculation of θy and My according to Annex 7 -

 θy = Min(θy_ten, θy_com)
 θy_ten = 4.9172287E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
    d = 557.00
     ξy = 0.43186761
    A = 0.03718321
    B = 0.02864736

with pt = 0.02594493
            pc = 0.00744507
            pv = 0.00360973
            N = 6361.069
            b = 200.00
            " = 0.07719928
    y_comp = 9.2351909E-006
  with fc* (12.3, (ACI 440)) = 33.28275
      fc = 33.00
      fl = 0.73070932
      b = bmax = 600.00
      h = hmax = 400.00
      Ag = 160000.00
        g = pt + pc + pv = 0.03699973
        rc = 40.00
        Ae/Ac = 0.27772029
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      effective strain from (12.5) and (12.12), efe = 0.004
        fu = 0.01
      Ef = 64828.00
      Ec = 26999.444
        y = 0.431356
      A = 0.03687106
      B = 0.02846388
      with Es = 200000.00

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

 - Calculation of   p -

From table 10-8:   p = 0.00
with:
- Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
  shear control ratio VyE/VColOE = 1.00732
  d = 557.00
  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 = 6361.069
    Ag = 160000.00
    f'cE = 33.00
    fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.03699973
  b = 200.00
  d = 557.00
    f'cE = 33.00

End Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 3
Integration Section: (a)

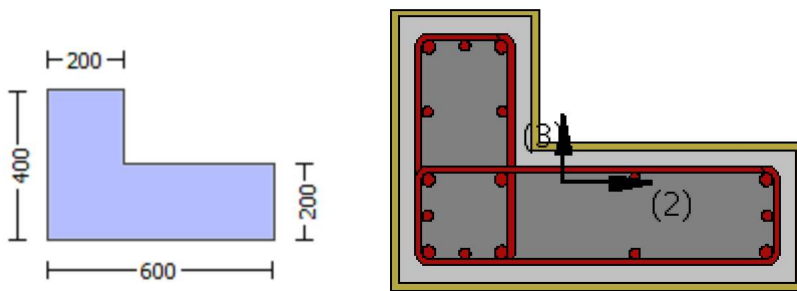
Calculation No. 5

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 LC1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)

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

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.2956E+007
Shear Force, Va = -4291.279
EDGE -B-
Bending Moment, Mb = 80283.485
Shear Force, Vb = 4291.279
BOTH EDGES
Axial Force, F = -6361.069
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2890.265
      -Compression: Asl,com = 829.3805
         -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 18.18182

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 439706.044
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 439706.044
   VCol = 439706.044
   knl = 1.00
      displacement_ductility_demand = 0.04395531

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

    = 1 (normal-weight concrete)
  fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.00
     Mu = 80283.485
     Vu = 4291.279
  d = 0.8*h = 480.00
  Nu = 6361.069
  Ag = 120000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 502654.825
  where:
  Vs1 = 125663.706 is calculated for section web, with:
   d = 160.00
   Av = 157079.633
   fy = 500.00
   s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.625
  Vs2 = 376991.118 is calculated for section flange, with:
   d = 480.00
   Av = 157079.633
   fy = 500.00

s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
      s/d = 0.20833333
   Vf ((11-3)-(11.4), ACI 440) = 293495.545
     f = 0.95, for fully-wrapped sections
   wf/sf = 1 (FRP strips adjacent to one another).
   In (11.3) sin + cos   is replaced with (cot +cota)sina which is more a generalised expression,
   where   is the angle of the crack direction (see KANEPE).
   This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
   as well as for 2 crack directions, =45° and   =-45° to take into consideration the cyclic seismic loading.
   orientation 1:   1 = b1 + 90° = 90.00
   Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
   total thickness per orientation, tf1 = NL*t/NoDir = 1.016
   dfv = d (figure 11.2, ACI 440) = 557.00
   ffe ((11-5), ACI 440) = 259.312
      Ef = 64828.00
       fe = 0.004, from (11.6a), ACI 440
         with fu = 0.01
    From (11-11), ACI 440: Vs + Vf < = 318865.838
      bw = 200.00

----
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   = 4.9517037E-005
 y = (My*Ls/3)/EIeff = 0.00112653 ((4.29),Biskinis Phd))
  My = 4.5015E+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 = 3.9959E+013
     factor = 0.30
        Ag = 160000.00
        fc' = 33.00
        N = 6361.069
     Ec*Ig = 1.3320E+014

Calculation of Yielding Moment My

Calculation of   y and My according to Annex 7   -
----
  y = Min(y_ten, y_com)
  y_ten = 4.9172287E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^ 2/3) = 311.2112
     d = 557.00
      y = 0.43186761
     A = 0.03718321
     B = 0.02864736
      with pt = 0.02594493
         pc = 0.00744507
         pv = 0.00360973
         N = 6361.069
         b = 200.00
          " = 0.07719928
   y_comp = 9.2351909E-006
  with fc* (12.3, (ACI 440)) = 33.28275
      fc = 33.00
      fl = 0.73070932
      b = bmax = 600.00
      h = hmax = 400.00
      Ag = 160000.00
         g = pt + pc + pv = 0.03699973
      rc = 40.00

```
     Ae/Ac = 0.27772029
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  effective strain from (12.5) and (12.12), efe = 0.004
    fu = 0.01
  Ef = 64828.00
 Ec = 26999.444
  y = 0.431356
 A = 0.03687106
 B = 0.02846388
  with Es = 200000.00
```


Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

End Of Calculation of Shear Capacity for element: column LC1 of floor 1
At local axis: 2
Integration Section: (b)

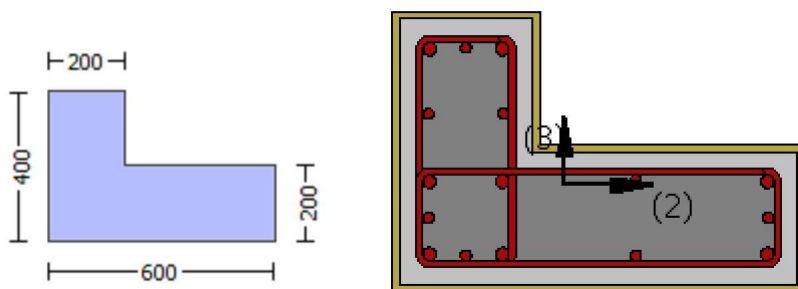
Calculation No. 6

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 LC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rclcs

Constant Properties

Knowledge Factor, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -0.00026803
EDGE -B-
Shear Force, Vb = 0.00026803
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 829.3805
     -Compression: Asl,com = 1746.726
        -Middle: Asl,mid = 1545.664

Calculation of Shear Capacity ratio , Ve/Vr = 0.71033407
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 206445.557
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0967E+008
   Mu1+ = 1.8333E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
   Mu1- = 3.0967E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination

Mpr2 = Max(Mu2+ , Mu2-) = 3.0967E+008
   Mu2+ = 1.8333E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
   Mu2- = 3.0967E+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 = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
  b = 600.00
  d = 357.00
  d' = 43.00
  v = 0.0008621
     N = 6093.866
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.01306815
        we ((5.4c), TBDY) = αse* ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
     where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

        ωfx = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
        effective stress from (A.35), ff,e = 768.6287

        ωfy = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
        effective stress from (A.35), ff,e = 768.6287

        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
        fu,f = 1055.00
        Ef = 64828.00
         $\varepsilon u,f$ = 0.015
        αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
           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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00471239

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) = 0.00471239
   Lstir (Length of stirrups along Y) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00

----

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
   Lstir (Length of stirrups along X) = 960.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00

----

   s = 100.00
  fywe = 694.45
  fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
   c = confinement factor = 1.06029
$y1$ = 0.00140044
$sh1$ = 0.0044814
$ft1$ = 466.8167
$fy1$ = 389.0139
$su1$ = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  $su1$ = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
$y2$ = 0.00140044
$sh2$ = 0.0044814
$ft2$ = 466.8167
$fy2$ = 389.0139
$su2$ = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
  $su2$ = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fsv = fs = 389.0139
  with Esv = Es = 200000.00

```
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
    v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
  b = 540.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
      c  = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
    v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
  u =    su (4.1) = 1.7539345E-005
-----------------------------------------------------------

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

-----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.4056447E-005
Mu = 3.0967E+008
-----------------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 357.00
  d' = 43.00
  v = 0.00258631
     N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01306815
        we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05721847
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ---------------------------------------------------------------
        fx = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
        effective stress from (A.35), ff,e = 768.6287
     ---------------------------------------------------------------
        fy = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 600.00
        hmax = 400.00
```

From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
  bw = 200.00
effective stress from (A.35), ff,e = 768.6287

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
   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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
   Lstir (Length of stirrups along Y) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
   Lstir (Length of stirrups along X) = 960.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00
----
    s = 100.00
    fywe = 694.45
    fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
  v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
  b = 140.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
     c = confinement factor = 1.06029
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
  2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
  v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
 u =   su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
  b = 600.00
  d = 357.00
  d' = 43.00
  v = 0.0008621
    N = 6093.866

fc = 33.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01306815
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
    where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ----
      fy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00471239
    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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
    ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
        Lstir (Length of stirrups along X) = 960.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
    ----
        s = 100.00
      fywe = 694.45
      fce = 33.00
    From ((5.A5), TBDY), TBDY: cc = 0.00260287
        c = confinement factor = 1.06029
  y1 = 0.00140044
  sh1 = 0.0044814
ft1 = 466.8167

fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
 2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
 v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
 b = 540.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
 cc (5A.5, TBDY) = 0.00260287
  c = confinement factor = 1.06029
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
 2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
 v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
 u = su (4.1) = 1.7539345E-005

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


----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 2.4056447E-005
Mu = 3.0967E+008
----------------------------------------------------------------------
with full section properties:
   b = 200.00
   d = 357.00
   d' = 43.00
   v = 0.00258631
     N = 6093.866
   fc = 33.00
    co (5A.5, TBDY) = 0.002
   Final value of  cu:  cu* = shear_factor * Max( cu,  cc) = 0.01306815
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY:  cu = 0.01306815
        we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05721847
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ---------------------------------------------------------------
        fx = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
         bmax = 600.00
         hmax = 400.00
         From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
         effective stress from (A.35), ff,e = 768.6287
      ---------------------------------------------------------------
        fy = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
         bmax = 600.00
         hmax = 400.00
         From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
         effective stress from (A.35), ff,e = 768.6287
      ---------------------------------------------------------------
        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
        fu,f = 1055.00
        Ef = 64828.00
         u,f = 0.015
        ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
           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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
```

psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
     Lstir (Length of stirrups along Y) = 1360.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 160000.00

----

   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
     Lstir (Length of stirrups along X) = 960.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 160000.00

----

    s = 100.00
   fywe = 694.45
   fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
   c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fsv = fs = 389.0139

with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
    v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
  b = 140.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
      c = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
    v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
  u =   su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 290631.642

Calculation of Shear Strength at edge 1, Vr1 = 290631.642
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 290631.642
  knl = 1 (zero step-static loading)

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

     = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 11.70883
     Vu = 0.00026803
  d = 0.8*h = 320.00
  Nu = 6093.866
  Ag = 80000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
  where:
  Vs1 = 279254.914 is calculated for section web, with:
    d = 320.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.3125
  Vs2 = 139627.457 is calculated for section flange, with:
    d = 160.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.625

Vf ((11-3)-(11.4), ACI 440) = 188111.148
   f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
   Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
     with fu = 0.01
 From (11-11), ACI 440: Vs + Vf <= 244232.638
   bw = 200.00

Calculation of Shear Strength at edge 2, Vr2 = 290631.642
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 290631.642
  knl = 1 (zero step-static loading)

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

   = 1 (normal-weight concrete)
 fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
   Mu = 11.914
   Vu = 0.00026803
 d = 0.8*h = 320.00
 Nu = 6093.866
 Ag = 80000.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
 where:
 Vs1 = 279254.914 is calculated for section web, with:
  d = 320.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
 Vs1 is multiplied by Col1 = 1.00
  s/d = 0.3125
 Vs2 = 139627.457 is calculated for section flange, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
 Vs2 is multiplied by Col2 = 1.00
  s/d = 0.625
 Vf ((11-3)-(11.4), ACI 440) = 188111.148
   f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
   Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
     with fu = 0.01
 From (11-11), ACI 440: Vs + Vf <= 244232.638

bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00069415
EDGE -B-
Shear Force, Vb = -0.00069415
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
    -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)

```
        -Tension: Asl,ten = 2890.265
      -Compression: Asl,com = 829.3805
          -Middle: Asl,mid = 402.1239
```


Calculation of Shear Capacity ratio , Ve/Vr = 1.00732
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 438835.425
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.5825E+008
   Mu1+ = 6.5825E+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- = 2.1740E+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-) = 6.5825E+008
   Mu2+ = 6.5825E+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- = 2.1740E+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 = 1.4829616E-005
Mu = 6.5825E+008
----
with full section properties:
   b = 200.00
   d = 557.00
   d' = 43.00
   v = 0.00165765
      N = 6093.866
   fc = 33.00
    εco (5A.5, TBDY) = 0.002
   Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: εcu = 0.01306815
        ωwe ((5.4c), TBDY) = αse*$\rho sh,min$*fywe/fce+Min(ωfx, ωfy) = 0.05721847
      where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

        ωfx = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      αf = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
         bmax = 600.00
         hmax = 400.00
         From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
         effective stress from (A.35), ff,e = 768.6287

        ωfy = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      αf = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
         bmax = 600.00
         hmax = 400.00
         From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
         effective stress from (A.35), ff,e = 768.6287

        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
```

fu,f = 1055.00
        Ef = 64828.00
         u,f = 0.015
       ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
          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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
       psh,min = Min(psh,x , psh,y) = 0.00471239
    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) = 0.00471239
          Lstir (Length of stirrups along Y) = 1360.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 160000.00
       --------------------------------------------------------------------------
       psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
          Lstir (Length of stirrups along X) = 960.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 160000.00
       --------------------------------------------------------------------------
         s = 100.00
        fywe = 694.45
        fce = 33.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00260287
         c = confinement factor = 1.06029
   y1 = 0.00140044
   sh1 = 0.0044814
  ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.30
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs1 = fs = 389.0139
      with Es1 = Es = 200000.00
   y2 = 0.00140044
   sh2 = 0.0044814
  ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.30
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs2 = fs = 389.0139
      with Es2 = Es = 200000.00
   yv = 0.00140044

shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
   2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
   v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
  b = 140.00
  d = 527.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
      c = confinement factor = 1.06029
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
   2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
 u =    su (4.1) = 1.4829616E-005
------------------------------------------------------------

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

--------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.0664224E-005
Mu = 2.1740E+008
--------------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 557.00
  d' = 43.00
  v = 0.00082883
    N = 6093.866
  fc = 33.00
  co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01306815
     we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min( fx, fy) = 0.05721847

where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
------------------------------------------------------------------
   fx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333
   bmax = 600.00
   hmax = 400.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
      bw = 200.00
   effective stress from (A.35), ff,e = 768.6287
------------------------------------------------------------------
   fy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
   bmax = 600.00
   hmax = 400.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
      bw = 200.00
   effective stress from (A.35), ff,e = 768.6287
------------------------------------------------------------------
   R = 40.00
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   fu,f = 1055.00
   Ef = 64828.00
    u,f = 0.015
   ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
      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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
   psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
      Lstir (Length of stirrups along Y) = 1360.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00
------------------------------------------------------------------
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
      Lstir (Length of stirrups along X) = 960.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00
------------------------------------------------------------------
   s = 100.00
   fywe = 694.45
   fce  = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00260287
    c  = confinement factor = 1.06029
 y1 = 0.00140044
 sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
 su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30

su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
  2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
  v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
 b = 340.00
 d = 527.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
  cc (5A.5, TBDY) = 0.00260287
    c  = confinement factor = 1.06029
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
  2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
  v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
 u =   su (4.1) = 1.0664224E-005
-------------------------------------------------------------

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

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

---------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.4829616E-005
Mu = 6.5825E+008
---------------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  ν = 0.00165765
    N = 6093.866
  fc = 33.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01306815
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
      ωfx = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2 + (hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ----------------------------------------------------------------
      ωfy = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2 + (hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
      εu,f = 0.015
    αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00471239
    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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00

```
                  Astir (stirrups area) = 78.53982
                  Asec (section area) = 160000.00
            ---------------------------------------------------------------
               psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
                  Lstir (Length of stirrups along X) = 960.00
                  Astir (stirrups area) = 78.53982
                  Asec (section area) = 160000.00
            ---------------------------------------------------------------
                  s = 100.00
                fywe = 694.45
                fce  = 33.00
            From ((5.A5), TBDY), TBDY:  cc = 0.00260287
                  c = confinement factor = 1.06029
        y1 = 0.00140044
       sh1 = 0.0044814
      ft1 = 466.8167
      fy1 = 389.0139
       su1 = 0.00512
          using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
          and also multiplied by the shear_factor according to 15.7.1.4, with
          Shear_factor = 1.00
          lo/lou,min = lb/ld = 0.30
           su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
          From table 5A.1, TBDY: esu1_nominal = 0.08,
          For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
          characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
           y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
           with fs1 = fs = 389.0139
           with Es1 = Es = 200000.00
        y2 = 0.00140044
       sh2 = 0.0044814
      ft2 = 466.8167
      fy2 = 389.0139
       su2 = 0.00512
          using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
          and also multiplied by the shear_factor according to 15.7.1.4, with
          Shear_factor = 1.00
          lo/lou,min = lb/lb,min = 0.30
           su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
          From table 5A.1, TBDY: esu2_nominal = 0.08,
          For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
          characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
           y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
           with fs2 = fs = 389.0139
           with Es2 = Es = 200000.00
        yv = 0.00140044
       shv = 0.0044814
      ftv = 466.8167
      fyv = 389.0139
       suv = 0.00512
          using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
          and also multiplied by the shear_factor according to 15.7.1.4, with
          Shear_factor = 1.00
          lo/lou,min = lb/ld = 0.30
           suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
          From table 5A.1, TBDY: esuv_nominal = 0.08,
          considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
          For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
          characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
           y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
           with fsv = fs = 389.0139
           with Esv = Es = 200000.00
        1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
        2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
        v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
   b = 140.00
```

```
   d = 527.00
   d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
       c = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
 u =   su (4.1) = 1.4829616E-005
------------------------------------------------------------

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

---------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.0664224E-005
Mu = 2.1740E+008
---------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 557.00
  d' = 43.00
  v = 0.00082883
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01306815
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05721847
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    -----------------------------------------------------------------
      fx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    -----------------------------------------------------------------
      fy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
```

```
----------------------------------------------------------------
    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    fu,f = 1055.00
    Ef = 64828.00
     u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00471239
   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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
    ----------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
        Lstir (Length of stirrups along X) = 960.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
    ----------------------------------------------------------------
       s = 100.00
       fywe = 694.45
       fce  = 33.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00260287
       c  = confinement factor = 1.06029
  y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
```

```
        with fs2 = fs = 389.0139
        with Es2 = Es = 200000.00
    yv = 0.00140044
   shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
   suv = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.30
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fsv = fs = 389.0139
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
    v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
   b = 340.00
   d = 527.00
   d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
    cc (5A.5, TBDY) = 0.00260287
       c  = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
    2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
    v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
  u =    su (4.1) = 1.0664224E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 435646.093
----------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 435646.093
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 435646.093
   knl = 1 (zero step-static loading)
---------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
---------------------------------------------------------------
     = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 44.9328
     Vu = 0.00069415
  d = 0.8*h = 480.00
  Nu = 6093.866
  Ag = 120000.00
```

From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
where:
Vs1 = 139627.457 is calculated for section web, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by Col1 = 1.00
  s/d = 0.625
Vs2 = 418882.372 is calculated for section flange, with:
  d = 480.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by Col2 = 1.00
  s/d = 0.20833333
Vf ((11-3)-(11.4), ACI 440) = 293495.545
  ψf = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sinα + cosα is replaced with (cotθ+cotα)sinα which is more a generalised expression,
where θ is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(θ, α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
orientation 1: α1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, α1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 557.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
  εfe = 0.004, from (11.6a), ACI 440
   with εfu = 0.01
 From (11-11), ACI 440: Vs + Vf <= 366348.956
  bw = 200.00

Calculation of Shear Strength at edge 2, Vr2 = 435646.093
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
 VCol0 = 435646.093
 knl = 1 (zero step-static loading)

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

  λ = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 4.00
  Mu = 44.60048
  Vu = 0.00069415
d = 0.8*h = 480.00
Nu = 6093.866
Ag = 120000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
where:
Vs1 = 139627.457 is calculated for section web, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by Col1 = 1.00
  s/d = 0.625
Vs2 = 418882.372 is calculated for section flange, with:
  d = 480.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by Col2 = 1.00
  s/d = 0.20833333

Vf ((11-3)-(11.4), ACI 440) = 293495.545
   f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
 In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
 where   is the angle of the crack direction (see KANEPE).
 This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
 as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
 orientation 1:   1 = b1 + 90° = 90.00
 Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
 total thickness per orientation, tf1 = NL*t/NoDir = 1.016
 dfv = d (figure 11.2, ACI 440) = 557.00
 ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
      with fu = 0.01
  From (11-11), ACI 440: Vs + Vf < = 366348.956
    bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

Bending Moment, M = -70821.725
Shear Force, V2 = 4291.279
Shear Force, V3 = -77.5414
Axial Force, F = -6361.069
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 0.00
  -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 829.3805
  -Compression: Asl,com = 1746.726
    -Middle: Asl,mid = 1545.664
Mean Diameter of Tension Reinforcement, DbL = 18.66667

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = 1.0* θu = 0.00288528
 θu = θy + θp = 0.00288528

 - Calculation of θy -

 θy = (My*Ls/3)/EIeff = 0.00288528 ((4.29),Biskinis Phd))
 My = 1.3306E+008
 Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 913.3408
 From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 1.4040E+013
   factor = 0.30
    Ag = 160000.00
    fc' = 33.00
    N = 6361.069
   Ec*Ig = 4.6799E+013

Calculation of Yielding Moment My

Calculation of θy and My according to Annex 7 -

Assuming neutral axis within flange (ξy < t/d, compression zone rectangular) with:
flange width, b = 600.00
web width, bw = 200.00
flange thickness, t = 200.00

 ϕy = Min(ϕy_ten, ϕy_com)
 ϕy_ten = 5.8026993E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
   d = 357.00
    ξy = 0.24884964
   A = 0.01933805
   B = 0.00899219
    with pt = 0.00387199
      pc = 0.00815465
      pv = 0.00721598
      N = 6361.069
      b = 600.00
       " = 0.12044818
  ϕy_comp = 2.5091791E-005
 with fc* (12.3, (ACI 440)) = 33.29607
    fc = 33.00
    fl = 0.73070932
    b = bmax = 600.00
    h = hmax = 400.00
    Ag = 160000.00
      ρg = pt + pc + pv = 0.01924262
     rc = 40.00
     Ae/Ac = 0.29079753
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016

effective strain from (12.5) and (12.12), efe = 0.004
  fu = 0.01
 Ef = 64828.00
 Ec = 26999.444
  y = 0.24780539
 A = 0.01917573
 B = 0.00889677
  with Es = 200000.00
CONFIRMATION: y = 0.24825313 < t/d

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

 - Calculation of p -

From table 10-8: p = 0.00
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
  shear control ratio VyE/VCol0E = 0.71033407
  d = 357.00
  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 = 960.00, 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 = 6361.069
   Ag = 160000.00
   f'cE = 33.00
   fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.01924262
  b = 600.00
  d = 357.00
   f'cE = 33.00

End Of Calculation of Chord Rotation Capacity for element: column LC1 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 LC1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of   y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00

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

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -160913.077
Shear Force, Va = 77.5414
EDGE -B-
Bending Moment, Mb = -70821.725
Shear Force, Vb = -77.5414
BOTH EDGES
Axial Force, F = -6361.069
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
    -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 829.3805
    -Compression: Asl,com = 1746.726
        -Middle: Asl,mid = 1545.664
Mean Diameter of Tension Reinforcement, DbL,ten = 18.66667

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 269320.945
Vn ((10.3), ASCE 41-17) = knl*VColO = 269320.945
  VCol = 269320.945
  knl = 1.00
    displacement_ductility_demand = 1.6212221E-005

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

    = 1 (normal-weight concrete)
  fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.85419
    Mu = 70821.725
    Vu = 77.5414
  d = 0.8*h = 320.00
  Nu = 6361.069
  Ag = 80000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 376991.118
  where:
  Vs1 = 251327.412 is calculated for section web, with:
    d = 320.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
  Vs1 is multiplied by Col1 = 1.00
    s/d = 0.3125
  Vs2 = 125663.706 is calculated for section flange, with:
    d = 160.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
  Vs2 is multiplied by Col2 = 1.00
    s/d = 0.625
  Vf ((11-3)-(11.4), ACI 440) = 188111.148
    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 β 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, θ =45° and θ =-45° to take into consideration the cyclic seismic loading.
orientation 1: β1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, β1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
  ϵfe = 0.004, from (11.6a), ACI 440
    with ϵfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 212577.225
  bw = 200.00

----
displacement_ductility_demand is calculated as μ / μy

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

From analysis, chord rotation θ = 4.6776878E-008
 θy = (My*Ls/3)/Eleff = 0.00288528 ((4.29),Biskinis Phd))
 My = 1.3306E+008
 Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 913.3408
 From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 1.4040E+013
    factor = 0.30
      Ag = 160000.00
      fc' = 33.00
      N = 6361.069
    Ec*Ig = 4.6799E+013

Calculation of Yielding Moment My

Calculation of ϕy and My according to Annex 7 -

Assuming neutral axis within flange (ξy < t/d, compression zone rectangular) with:
flange width, b = 600.00
web width, bw = 200.00
flange thickness, t = 200.00

 ϕy = Min(ϕy_ten, ϕy_com)
 ϕy_ten = 5.8026993E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
    d = 357.00
    ξy = 0.24884964
    A = 0.01933805
    B = 0.00899219
     with pt = 0.00387199
        pc = 0.00815465
        pv = 0.00721598
        N = 6361.069
        b = 600.00
        " = 0.12044818
 ϕy_comp = 2.5091791E-005
with fc* (12.3, (ACI 440)) = 33.29607
    fc = 33.00
    fl = 0.73070932
    b = bmax = 600.00
    h = hmax = 400.00
    Ag = 160000.00
       ρg = pt + pc + pv = 0.01924262
       rc = 40.00
       Ae/Ac = 0.29079753
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016

effective strain from (12.5) and (12.12), efe = 0.004
    fu = 0.01
   Ef = 64828.00
   Ec = 26999.444
    y = 0.24780539
   A = 0.01917573
   B = 0.00889677
   with Es = 200000.00
CONFIRMATION: y = 0.24825313 < t/d

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

End Of Calculation of Shear Capacity for element: column LC1 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 LC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00

Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -0.00026803
EDGE -B-
Shear Force, Vb = 0.00026803
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 829.3805
     -Compression: Asl,com = 1746.726
        -Middle: Asl,mid = 1545.664

Calculation of Shear Capacity ratio , Ve/Vr = 0.71033407
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 206445.557
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0967E+008
   Mu1+ = 1.8333E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
   Mu1- = 3.0967E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.0967E+008

Mu2+ = 1.8333E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
Mu2- = 3.0967E+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 = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
 b = 600.00
 d = 357.00
 d' = 43.00
 v = 0.0008621
   N = 6093.866
 fc = 33.00
  εco (5A.5, TBDY) = 0.002
 Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: εcu = 0.01306815
     ωwe ((5.4c), TBDY) = αse* ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
   where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

     ωfx = 0.0528506
   Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
   αf = 0.22333333
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
     bmax = 600.00
     hmax = 400.00
     From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
       bw = 200.00
     effective stress from (A.35), ff,e = 768.6287

     ωfy = 0.0528506
   Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
   αf = 0.22333333
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
     bmax = 600.00
     hmax = 400.00
     From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
       bw = 200.00
     effective stress from (A.35), ff,e = 768.6287

     R = 40.00
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
     fu,f = 1055.00
     Ef = 64828.00
      εu,f = 0.015
     αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
     ρsh,min = Min(ρsh,x , ρsh,y) = 0.00471239
   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) = 0.00471239
   Lstir (Length of stirrups along Y) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
   Lstir (Length of stirrups along X) = 960.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00
----
   s = 100.00
   fywe = 694.45
   fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
   c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442

2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
           v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
     b = 540.00
     d = 327.00
     d' = 13.00
    fcc (5A.2, TBDY) = 34.98946
      cc (5A.5, TBDY) = 0.00260287
        c = confinement factor = 1.06029
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
      2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
      v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
  u =   su (4.1) = 1.7539345E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 2.4056447E-005
Mu = 3.0967E+008
----
with full section properties:
     b = 200.00
     d = 357.00
     d' = 43.00
     v = 0.00258631
        N = 6093.866
    fc = 33.00
      co (5A.5, TBDY) = 0.002
    Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
        The Shear_factor is considered equal to 1 (pure moment strength)
        From (5.4b), TBDY: cu = 0.01306815
           we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05721847
        where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
        ----
           fx = 0.0528506
        Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
        af = 0.22333333
        with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
           bmax = 600.00
           hmax = 400.00
           From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
              bw = 200.00
           effective stress from (A.35), ff,e = 768.6287
        ----
           fy = 0.0528506
        Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
        af = 0.22333333
        with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
           bmax = 600.00
           hmax = 400.00
           From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016

bw = 200.00
        effective stress from (A.35), ff,e = 768.6287

        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
        fu,f = 1055.00
        Ef = 64828.00
        u,f = 0.015
        ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
            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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00471239
     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) = 0.00471239
            Lstir (Length of stirrups along Y) = 1360.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 160000.00
        ----
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
            Lstir (Length of stirrups along X) = 960.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 160000.00
        ----
        s = 100.00
        fywe = 694.45
        fce = 33.00
     From ((5.A5), TBDY), TBDY: cc = 0.00260287
        c = confinement factor = 1.06029
   y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs1 = fs = 389.0139
      with Es1 = Es = 200000.00
   y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered

characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fs2 = fs = 389.0139
 with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/ld = 0.30
 suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
 From table 5A.1, TBDY: esuv_nominal = 0.08,
 considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
 For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
 characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fsv = fs = 389.0139
 with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
 2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
 v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
 b = 140.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
 cc (5A.5, TBDY) = 0.00260287
 c = confinement factor = 1.06029
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
 2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
 v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
 u = su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
 b = 600.00
 d = 357.00
 d' = 43.00
 v = 0.0008621
 N = 6093.866
 fc = 33.00

co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.01306815
    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
  where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
----
  fx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
  bmax = 600.00
  hmax = 400.00
  From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
  effective stress from (A.35), ff,e = 768.6287
----
  fy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
  bmax = 600.00
  hmax = 400.00
  From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
  effective stress from (A.35), ff,e = 768.6287

  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
  u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
  psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
    s = 100.00
  fywe = 694.45
  fce = 33.00
  From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139

su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
b = 540.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
  cc (5A.5, TBDY) = 0.00260287
   c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
u = su (4.1) = 1.7539345E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.4056447E-005
Mu = 3.0967E+008
----
with full section properties:
  b = 200.00
  d = 357.00
  d' = 43.00
  v = 0.00258631
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01306815
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05721847
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ----
      fy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00471239

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) = 0.00471239
     Lstir (Length of stirrups along Y) = 1360.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 160000.00

----
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
     Lstir (Length of stirrups along X) = 960.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 160000.00

----
    s = 100.00
   fywe = 694.45
   fce = 33.00
 From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
$y1$ = 0.00140044
$sh1$ = 0.0044814
$ft1$ = 466.8167
$fy1$ = 389.0139
$su1$ = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  $su1$ = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
$y2$ = 0.00140044
$sh2$ = 0.0044814
$ft2$ = 466.8167
$fy2$ = 389.0139
$su2$ = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
  $su2$ = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fsv = fs = 389.0139
  with Esv = Es = 200000.00

$1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833$
$2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259$
$v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255$
and confined core properties:
  b = 140.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
     c = confinement factor = 1.06029
   $1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996$
   $2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459$
   $v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673$
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
  u =   su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 290631.642

Calculation of Shear Strength at edge 1, Vr1 = 290631.642
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 290631.642
  knl = 1 (zero step-static loading)

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

    = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 11.70883
     Vu = 0.00026803
  d = 0.8*h = 320.00
  Nu = 6093.866
  Ag = 80000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
  where:
  Vs1 = 279254.914 is calculated for section web, with:
    d = 320.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.3125
  Vs2 = 139627.457 is calculated for section flange, with:
    d = 160.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.625
  Vf ((11-3)-(11.4), ACI 440) = 188111.148

f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where   is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1:   1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
   Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
      with fu = 0.01
 From (11-11), ACI 440: Vs + Vf <= 244232.638
   bw = 200.00

Calculation of Shear Strength at edge 2, Vr2 = 290631.642
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 290631.642
  knl = 1 (zero step-static loading)

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

   = 1 (normal-weight concrete)
 fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
    Mu = 11.914
    Vu = 0.00026803
 d = 0.8*h = 320.00
 Nu = 6093.866
 Ag = 80000.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
 where:
 Vs1 = 279254.914 is calculated for section web, with:
   d = 320.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
 Vs1 is multiplied by Col1 = 1.00
   s/d = 0.3125
 Vs2 = 139627.457 is calculated for section flange, with:
   d = 160.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
 Vs2 is multiplied by Col2 = 1.00
   s/d = 0.625
 Vf ((11-3)-(11.4), ACI 440) = 188111.148
   f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where   is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1:   1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
   Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
      with fu = 0.01
 From (11-11), ACI 440: Vs + Vf <= 244232.638
   bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00069415
EDGE -B-
Shear Force, Vb = -0.00069415
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
    -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2890.265

-Compression: Asl,com = 829.3805
          -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 1.00732
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 438835.425
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.5825E+008
   Mu1+ = 6.5825E+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- = 2.1740E+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-) = 6.5825E+008
   Mu2+ = 6.5825E+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- = 2.1740E+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 = 1.4829616E-005
Mu = 6.5825E+008
----
with full section properties:
   b = 200.00
   d = 557.00
   d' = 43.00
   v = 0.00165765
      N = 6093.866
   fc = 33.00
    co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.01306815
        we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ----
        fx = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333
         bmax = 600.00
         hmax = 400.00
         From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
            bw = 200.00
         effective stress from (A.35), ff,e = 768.6287
      ----
        fy = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
         bmax = 600.00
         hmax = 400.00
         From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
            bw = 200.00
         effective stress from (A.35), ff,e = 768.6287

        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
        fu,f = 1055.00

Ef = 64828.00
  u,f = 0.015
ase = Max((($A_{conf,max}$-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
      Lstir (Length of stirrups along Y) = 1360.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00

    ----
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
      Lstir (Length of stirrups along X) = 960.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00

    ----
     s = 100.00
    fywe = 694.45
    fce = 33.00
  From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814

ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
  2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
  b = 140.00
  d = 527.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
     c = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
  u = su (4.1) = 1.4829616E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 1.0664224E-005
Mu = 2.1740E+008
----
with full section properties:
  b = 400.00
  d = 557.00
  d' = 43.00
  v = 0.00082883
   N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01306815
     we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05721847
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

----
    fx = 0.0528506
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.22333333
   with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
----
    fy = 0.0528506
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.22333333
   with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
         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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00471239
   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) = 0.00471239
         Lstir (Length of stirrups along Y) = 1360.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 160000.00
----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
         Lstir (Length of stirrups along X) = 960.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 160000.00
----
      s = 100.00
      fywe = 694.45
      fce = 33.00
    From ((5.A5), TBDY), TBDY: cc = 0.00260287
        c = confinement factor = 1.06029
   y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.30
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu1_nominal = 0.08,
 For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
 characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
 2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
 v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
 b = 340.00
 d = 527.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
  cc (5A.5, TBDY) = 0.00260287
    c = confinement factor = 1.06029
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
 2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
 v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
 u =   su (4.1) = 1.0664224E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.4829616E-005
Mu = 6.5825E+008
----
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  v = 0.00165765
    N = 6093.866
  fc = 33.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.01306815
       ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ρfx, ρfy) = 0.05721847
     where ρf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

       ρfx = 0.0528506
     Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
     αf = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
       bmax = 600.00
       hmax = 400.00
       From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
          bw = 200.00
       effective stress from (A.35), ff,e = 768.6287

       ρfy = 0.0528506
     Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
     αf = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
       bmax = 600.00
       hmax = 400.00
       From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
          bw = 200.00
       effective stress from (A.35), ff,e = 768.6287

       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
       fu,f = 1055.00
       Ef = 64828.00
        εu,f = 0.015
       αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
          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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
       ρsh,min = Min(ρsh,x , ρsh,y) = 0.00471239
     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) = 0.00471239
          Lstir (Length of stirrups along Y) = 1360.00
          Astir (stirrups area) = 78.53982

```
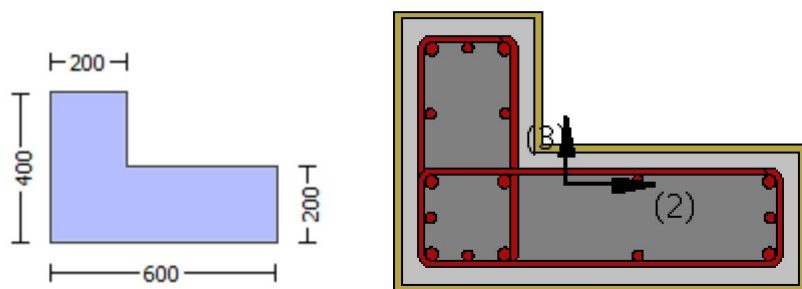        Asec (section area) = 160000.00
     --------------------------------------------------------------
     psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
        Lstir (Length of stirrups along X) = 960.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
     --------------------------------------------------------------
        s = 100.00
       fywe = 694.45
       fce = 33.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00260287
        c  = confinement factor = 1.06029
  y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
   2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
   v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
  b = 140.00
  d = 527.00
```

d' = 13.00
fcc (5A.2, TBDY) = 34.98946
cc (5A.5, TBDY) = 0.00260287
c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
u = su (4.1) = 1.4829616E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
u = 1.0664224E-005
Mu = 2.1740E+008
----
with full section properties:
b = 400.00
d = 557.00
d' = 43.00
v = 0.00082883
N = 6093.866
fc = 33.00
co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: cu = 0.01306815
we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
----
fx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
bmax = 600.00
hmax = 400.00
From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
bw = 200.00
effective stress from (A.35), ff,e = 768.6287
----
fy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
bmax = 600.00
hmax = 400.00
From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
bw = 200.00
effective stress from (A.35), ff,e = 768.6287

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
   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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
      Lstir (Length of stirrups along Y) = 1360.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00
   ----
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
      Lstir (Length of stirrups along X) = 960.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00
   ----
      s = 100.00
      fywe = 694.45
      fce = 33.00
   From ((5.A5), TBDY), TBDY: cc = 0.00260287
      c = confinement factor = 1.06029
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs2 = fs = 389.0139

with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
   v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
  b = 340.00
  d = 527.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
    cc (5A.5, TBDY) = 0.00260287
       c = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
    2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
    v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
 u =   su (4.1) = 1.0664224E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 435646.093

Calculation of Shear Strength at edge 1, Vr1 = 435646.093
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 435646.093
   knl = 1 (zero step-static loading)

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

     = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 44.9328
     Vu = 0.00069415
  d = 0.8*h = 480.00
  Nu = 6093.866
  Ag = 120000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829

where:
Vs1 = 139627.457 is calculated for section web, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by Col1 = 1.00
  s/d = 0.625
Vs2 = 418882.372 is calculated for section flange, with:
  d = 480.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by Col2 = 1.00
  s/d = 0.20833333
Vf ((11-3)-(11.4), ACI 440) = 293495.545
  ϕf = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) $\sin + \cos$ is replaced with (cot $+$cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, $=45°$ and $=-45°$ to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 557.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 366348.956
  bw = 200.00

Calculation of Shear Strength at edge 2, Vr2 = 435646.093
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 435646.093
  knl = 1 (zero step-static loading)

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

   = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
   Mu = 44.60048
   Vu = 0.00069415
  d = 0.8*h = 480.00
  Nu = 6093.866
  Ag = 120000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 139627.457 is calculated for section web, with:
   d = 160.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
  Vs1 is multiplied by Col1 = 1.00
   s/d = 0.625
  Vs2 = 418882.372 is calculated for section flange, with:
   d = 480.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
  Vs2 is multiplied by Col2 = 1.00
   s/d = 0.20833333
  Vf ((11-3)-(11.4), ACI 440) = 293495.545

f = 0.95, for fully-wrapped sections

wf/sf = 1 (FRP strips adjacent to one another).

In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,

where is the angle of the crack direction (see KANEPE).

This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,

as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.

orientation 1: 1 = b1 + 90° = 90.00

Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:

total thickness per orientation, tf1 = NL*t/NoDir = 1.016

dfv = d (figure 11.2, ACI 440) = 557.00

ffe ((11-5), ACI 440) = 259.312

  Ef = 64828.00

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

    with fu = 0.01

From (11-11), ACI 440: Vs + Vf <= 366348.956

  bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1

At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1

At local axis: 3

Integration Section: (b)

Section Type: rclcs

Constant Properties

Knowledge Factor, = 1.00

Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.

Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17

Consequently:

New material of Secondary Member: Concrete Strength, fc = fcm = 33.00

New material of Secondary Member: Steel Strength, fs = fsm = 555.56

Concrete Elasticity, Ec = 26999.444

Steel Elasticity, Es = 200000.00

Max Height, Hmax = 400.00

Min Height, Hmin = 200.00

Max Width, Wmax = 600.00

Min Width, Wmin = 200.00

Cover Thickness, c = 25.00

Element Length, L = 3000.00

Secondary Member

Ribbed Bars

Ductile Steel

Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)

Longitudinal Bars With Ends Lapped Starting at the End Sections

Inadequate Lap Length with lb/ld = 0.30

FRP Wrapping Data

Type: Carbon

Cured laminate properties (design values)

Thickness, t = 1.016

Tensile Strength, ffu = 1055.00

Tensile Modulus, Ef = 64828.00

Elongation, efu = 0.01

Number of directions, NoDir = 1

Fiber orientations, bi: 0.00°

Number of layers, NL = 1

Radius of rounding corners, R = 40.00

Stepwise Properties

Bending Moment, M = 80283.485

Shear Force, V2 = 4291.279
Shear Force, V3 = -77.5414
Axial Force, F = -6361.069
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 0.00
  -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 2890.265
  -Compression: Asl,com = 829.3805
    -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL = 18.18182

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta_{u,R} = 1.0^* \theta_u = 0.00112653$
$\theta_u = \theta_y + \theta_p = 0.00112653$

- Calculation of θ_y -

$\theta_y = (My^*Ls/3)/EIeff = 0.00112653$ ((4.29),Biskinis Phd))
My = 4.5015E+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 = 3.9959E+013
  factor = 0.30
    Ag = 160000.00
    fc' = 33.00
    N = 6361.069
  Ec*Ig = 1.3320E+014

Calculation of Yielding Moment My

Calculation of θ_y and My according to Annex 7 -

$\theta_y = Min(\theta_{y\_ten}, \theta_{y\_com})$
$\theta_{y\_ten} = 4.9172287E-006$
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
  d = 557.00
   y = 0.43186761
  A = 0.03718321
  B = 0.02864736
  with pt = 0.02594493
    pc = 0.00744507
    pv = 0.00360973
    N = 6361.069
    b = 200.00
    " = 0.07719928
$\theta_{y\_comp} = 9.2351909E-006$
with fc* (12.3, (ACI 440)) = 33.28275
  fc = 33.00
  fl = 0.73070932
  b = bmax = 600.00
  h = hmax = 400.00
  Ag = 160000.00
    g = pt + pc + pv = 0.03699973
   rc = 40.00
   Ae/Ac = 0.27772029
   Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  effective strain from (12.5) and (12.12), efe = 0.004
   fu = 0.01
  Ef = 64828.00
  Ec = 26999.444
   y = 0.431356
  A = 0.03687106

```
      B = 0.02846388
        with Es = 200000.00
-----------------------------------------------------------
-----------------------------------------------------------

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


-----------------------------------------------------------
 - Calculation of  p -
-----------------------------------------------------------
From table 10-8:  p = 0.00
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VColOE = 1.00732
   d = 557.00
   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 = 6361.069
     Ag = 160000.00
     f'cE = 33.00
     fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.03699973
   b = 200.00
   d = 557.00
     f'cE = 33.00
-----------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 3
Integration Section: (b)


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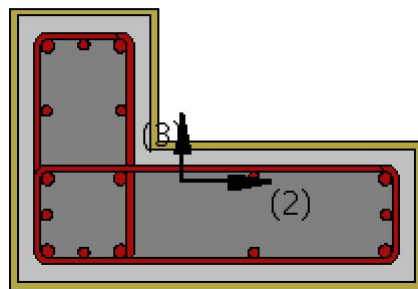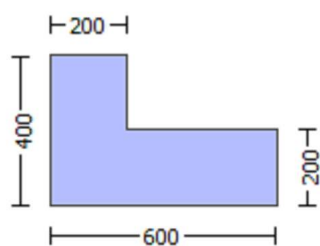```

## 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 LC1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rclcs

Constant Properties
-----------------------------------------------------------
Knowledge Factor,    = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
#########################################################
Note: Especially for the calculation of   y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
#########################################################
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi:  0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-----------------------------------------------------------

Stepwise Properties
-----------------------------------------------------------
EDGE -A-
Bending Moment, Ma = -1.5643E+007
Shear Force, Va = -5181.087

EDGE -B-
Bending Moment, Mb = 96939.725
Shear Force, Vb = 5181.087
BOTH EDGES
Axial Force, F = -6416.475
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2890.265
     -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 18.18182
-------------------------------------------------------------
-------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 379291.423
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 379291.423
  VCol = 379291.423
  knl = 1.00
     displacement_ductility_demand = 0.01102969
-------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------------
    = 1 (normal-weight concrete)
 fc' = 25.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
    Mu = 1.5643E+007
    Vu = 5181.087
 d = 0.8*h = 480.00
 Nu = 6416.475
 Ag = 120000.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 502654.825
 where:
 Vs1 = 125663.706 is calculated for section web, with:
    d = 160.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
 Vs1 is multiplied by  Col1 = 1.00
    s/d = 0.625
 Vs2 = 376991.118 is calculated for section flange, with:
    d = 480.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
 Vs2 is multiplied by  Col2 = 1.00
    s/d = 0.20833333
 Vf ((11-3)-(11.4), ACI 440) = 293495.545
    f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
 In (11.3) sin + cos  is replaced with (cot +cota)sina which is more a generalised expression,
 where   is the angle of the crack direction (see KANEPE).
 This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
 as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
 orientation 1:  1 = b1 + 90° = 90.00
 Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
 total thickness per orientation, tf1 = NL*t/NoDir = 1.016
 dfv = d (figure 11.2, ACI 440) = 557.00
 ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
     fe = 0.004, from (11.6a), ACI 440
      with  fu = 0.01
 From (11-11), ACI 440: Vs + Vf < = 318865.838
    bw = 200.00

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

---------------------------------------------------------------
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   = 0.00012505
 y = (My*Ls/3)/Eleff = 0.01133777 ((4.29),Biskinis Phd))
  My = 4.5016E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 3019.223
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 3.9959E+013
     factor = 0.30
        Ag = 160000.00
        fc' = 33.00
        N = 6416.475
     Ec*Ig = 1.3320E+014
---------------------------------------------------------------
---------------------------------------------------------------

Calculation of Yielding Moment My
---------------------------------------------------------------
Calculation of  y and My according to Annex 7  -
---------------------------------------------------------------
  y = Min( y_ten,  y_com)
  y_ten = 4.9173110E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^ 2/3) = 311.2112
    d = 557.00
     y = 0.43187711
    A = 0.03718481
    B = 0.02864896
     with pt = 0.02594493
        pc = 0.00744507
        pv = 0.00360973
        N = 6416.475
        b = 200.00
         " = 0.07719928
  y_comp = 9.2350821E-006
 with fc* (12.3, (ACI 440)) = 33.28275
    fc = 33.00
    fl = 0.73070932
    b = bmax = 600.00
    h = hmax = 400.00
    Ag = 160000.00
       g = pt + pc + pv = 0.03699973
     rc = 40.00
     Ae/Ac = 0.27772029
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    effective strain from (12.5) and (12.12), efe = 0.004
     fu = 0.01
    Ef = 64828.00
   Ec = 26999.444
    y = 0.43136109
   A = 0.03686994
   B = 0.02846388
    with Es = 200000.00
---------------------------------------------------------------
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
---------------------------------------------------------------
End Of Calculation of Shear Capacity for element: column LC1 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 LC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rclcs

Constant Properties
---------------------------------------------------------------
Knowledge Factor, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##############################################################
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member

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

Stepwise Properties
------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = -0.00026803
EDGE -B-
Shear Force, Vb = 0.00026803
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 0.00
    -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 829.3805
    -Compression: Asl,com = 1746.726
       -Middle: Asl,mid = 1545.664
------------------------------------------------------------
------------------------------------------------------------


Calculation of Shear Capacity ratio , Ve/Vr  =  0.71033407
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 206445.557
with
Mpr1 =  Max(Mu1+ , Mu1-) = 3.0967E+008
  Mu1+ = 1.8333E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
  Mu1- = 3.0967E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 =  Max(Mu2+ , Mu2-) = 3.0967E+008
  Mu2+ = 1.8333E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
  Mu2- = 3.0967E+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 = 1.7539345E-005
Mu = 1.8333E+008
----------------------------------------------------------------------
with full section properties:
  b = 600.00
  d = 357.00
  d' = 43.00
  v = 0.0008621

N = 6093.866

fc = 33.00

co (5A.5, TBDY) = 0.002

Final value of cu: cu* = shear_factor * Max( cu, cc) = 0.01306815

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

   From (5.4b), TBDY: cu = 0.01306815

      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.05721847

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

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

   fx = 0.0528506

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

   af = 0.22333333

   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333

      bmax = 600.00

      hmax = 400.00

      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016

         bw = 200.00

      effective stress from (A.35), ff,e = 768.6287

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

   fy = 0.0528506

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

   af = 0.22333333

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

      bmax = 600.00

      hmax = 400.00

      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016

         bw = 200.00

      effective stress from (A.35), ff,e = 768.6287

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

   R = 40.00

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

   fu,f = 1055.00

   Ef = 64828.00

    u,f = 0.015

   ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846

      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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).

   psh,min = Min(psh,x , psh,y) = 0.00471239

   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) = 0.00471239

      Lstir (Length of stirrups along Y) = 1360.00

      Astir (stirrups area) = 78.53982

      Asec (section area) = 160000.00

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

   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588

      Lstir (Length of stirrups along X) = 960.00

      Astir (stirrups area) = 78.53982

      Asec (section area) = 160000.00

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

      s = 100.00

     fywe = 694.45

     fce = 33.00

   From ((5.A5), TBDY), TBDY: cc = 0.00260287

      c = confinement factor = 1.06029

  y1 = 0.00140044

  sh1 = 0.0044814

ft1 = 466.8167
fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs1 = fs = 389.0139
      with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs2 = fs = 389.0139
      with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fsv = fs = 389.0139
      with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
  v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
  b = 540.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
    cc (5A.5, TBDY) = 0.00260287
      c  = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
    v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008

u = ɛsu (4.1) = 1.7539345E-005
----------------------------------------------------------------

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

----------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
 φu = 2.4056447E-005
Mu = 3.0967E+008
----------------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 357.00
  d' = 43.00
  v = 0.00258631
    N = 6093.866
  fc = 33.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max( εcu, εcc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01306815
      ωwe ((5.4c), TBDY) = αse* ρsh,min*fywe/fce+Min( φfx, φfy) = 0.05721847
    where φf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
      φfx = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ----------------------------------------------------------------
      φfy = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00471239
  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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
    -------------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
        Lstir (Length of stirrups along X) = 960.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
    -------------------------------------------------------------------
        s = 100.00
      fywe = 694.45
      fce  = 33.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00260287
        c  = confinement factor = 1.06029
  y1 = 0.00140044
  sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs1 = fs = 389.0139
      with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs2 = fs = 389.0139
      with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.

with fsv = fs = 389.0139
         with Esv = Es = 200000.00
    ρ1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
    ρ2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
    ρv = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
   b = 140.00
   d = 327.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.98946
    εcc (5A.5, TBDY) = 0.00260287
       c  = confinement factor = 1.06029
    ρ1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
    ρ2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
    ρv = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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
--->
 εsu (4.8) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
 φu =   φsu (4.1) = 2.4056447E-005
------------------------------------------------------------

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

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


--------------------------------------------------------------------
Calculation of ultimate curvature  φu according to 4.1, Biskinis/Fardis 2013:
 φu = 1.7539345E-005
Mu = 1.8333E+008
--------------------------------------------------------------------
with full section properties:
   b = 600.00
   d = 357.00
   d' = 43.00
   ν = 0.0008621
     N = 6093.866
   fc = 33.00
    εco (5A.5, TBDY) = 0.002
   Final value of  εcu:  εcu* = shear_factor * Max( εcu, εcc) = 0.01306815
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY:  εcu = 0.01306815
        ωwe ((5.4c), TBDY) = αse* ρsh,min*fywe/fce+Min( ωfx, ωfy) = 0.05721847
      where  ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ----------------------------------------------------------------
        ωfx = 0.0528506
      Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
      αf = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
         bmax = 600.00
         hmax = 400.00
         From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
            bw = 200.00
         effective stress from (A.35), ff,e = 768.6287
      ----------------------------------------------------------------
        ωfy = 0.0528506
      Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)

af = 0.22333333
with Unconfined area = $((bmax-2R)^2+(hmax-2R)^2)/3$ = 0.00
    bmax = 600.00
    hmax = 400.00
    From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
      bw = 200.00
    effective stress from (A.35), ff,e = 768.6287
----------------------------------------------------------------
  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
  u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----------------------------------------------------------------
  psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----------------------------------------------------------------
    s = 100.00
    fywe = 694.45
    fce = 33.00
  From ((5.A5), TBDY), TBDY:  cc = 0.00260287
    c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with

```
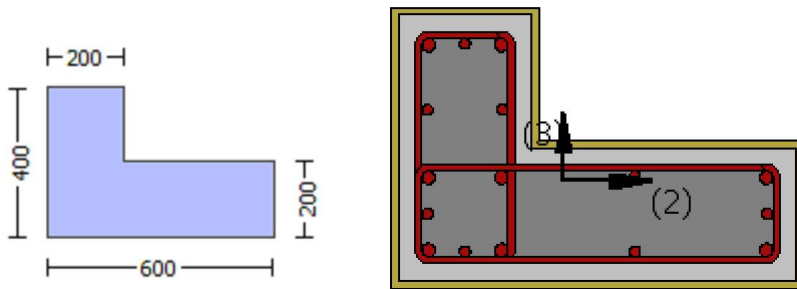      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.30
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
        with fs2 = fs =  389.0139
        with Es2 = Es =  200000.00
    yv = 0.00140044
    shv = 0.0044814
   ftv = 466.8167
   fyv = 389.0139
    suv = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and   yv,  shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
        with fsv = fs =  389.0139
        with Esv = Es =  200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
    v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
  b = 540.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
      c  = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
    v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
  u =    su (4.1) = 1.7539345E-005
------------------------------------------------------------

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

-------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.4056447E-005
Mu = 3.0967E+008
-------------------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 357.00
  d' = 43.00
```

v = 0.00258631
 N = 6093.866
fc = 33.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.01306815
    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
  where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
  ----
    fx = 0.0528506
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.22333333
  with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
    bmax = 600.00
    hmax = 400.00
    From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
      bw = 200.00
    effective stress from (A.35), ff,e = 768.6287
  ----
    fy = 0.0528506
  Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
  af = 0.22333333
  with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
    bmax = 600.00
    hmax = 400.00
    From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
      bw = 200.00
    effective stress from (A.35), ff,e = 768.6287

    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    fu,f = 1055.00
    Ef = 64828.00
     u,f = 0.015
    ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
      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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00471239
  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) = 0.00471239
      Lstir (Length of stirrups along Y) = 1360.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00
  ----
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
      Lstir (Length of stirrups along X) = 960.00
      Astir (stirrups area) = 78.53982
      Asec (section area) = 160000.00
  ----
      s = 100.00
    fywe = 694.45
    fce = 33.00
  From ((5.A5), TBDY), TBDY: cc = 0.00260287
      c = confinement factor = 1.06029
 y1 = 0.00140044

```
    sh1 = 0.0044814
  ft1 = 466.8167
  fy1 = 389.0139
   su1 = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.30
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
       with fs1 = fs = 389.0139
       with Es1 = Es = 200000.00
  y2 = 0.00140044
   sh2 = 0.0044814
  ft2 = 466.8167
  fy2 = 389.0139
   su2 = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 0.30
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
       with fs2 = fs = 389.0139
       with Es2 = Es = 200000.00
  yv = 0.00140044
   shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
   suv = 0.00512
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 0.30
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
       with fsv = fs = 389.0139
       with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
   2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
   v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
  b = 140.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
      c  = confinement factor = 1.06029
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
   2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
   v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
 u =   su (4.1) = 2.4056447E-005
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 290631.642
--------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 290631.642
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 290631.642
  knl = 1 (zero step-static loading)
-----------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-----------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 11.70883
     Vu = 0.00026803
  d = 0.8*h = 320.00
  Nu = 6093.866
  Ag = 80000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
  where:
  Vs1 = 279254.914 is calculated for section web, with:
    d = 320.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by  Col1 = 1.00
    s/d = 0.3125
  Vs2 = 139627.457 is calculated for section flange, with:
    d = 160.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by  Col2 = 1.00
    s/d = 0.625
  Vf ((11-3)-(11.4), ACI 440) = 188111.148
    f = 0.95, for fully-wrapped sections
   wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
  where   is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
  orientation 1:  1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 357.00
  ffe ((11-5), ACI 440) = 259.312
     Ef = 64828.00
      fe = 0.004, from (11.6a), ACI 440
        with  fu = 0.01
   From (11-11), ACI 440: Vs + Vf <= 244232.638
     bw = 200.00
-----------------------------------------------------------
--------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 290631.642
```

Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 290631.642
  knl = 1 (zero step-static loading)

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

   λ = 1 (normal-weight concrete)
  fc' = 33.00, but $fc^{0.5}$ <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 11.914
    Vu = 0.00026803
  d = 0.8*h = 320.00
  Nu = 6093.866
  Ag = 80000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
  where:
  Vs1 = 279254.914 is calculated for section web, with:
    d = 320.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by Col1 = 1.00
    s/d = 0.3125
  Vs2 = 139627.457 is calculated for section flange, with:
    d = 160.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by Col2 = 1.00
    s/d = 0.625
  Vf ((11-3)-(11.4), ACI 440) = 188111.148
    φf = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin α + cos α 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 = 1.016
  dfv = d (figure 11.2, ACI 440) = 357.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    εfe = 0.004, from (11.6a), ACI 440
      with εfu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 244232.638
    bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rclcs

Constant Properties

Knowledge Factor, γ = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00

New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00069415
EDGE -B-
Shear Force, Vb = -0.00069415
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
    -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2890.265
    -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 1.00732
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 438835.425
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.5825E+008
    Mu1+ = 6.5825E+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- = 2.1740E+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-) = 6.5825E+008
    Mu2+ = 6.5825E+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- = 2.1740E+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 = 1.4829616E-005
Mu = 6.5825E+008
----
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  v = 0.00165765
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.01306815
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05721847
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----
       fx = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
       bmax = 600.00
       hmax = 400.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
         bw = 200.00
       effective stress from (A.35), ff,e = 768.6287
     ----
       fy = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
       bmax = 600.00
       hmax = 400.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
         bw = 200.00
       effective stress from (A.35), ff,e = 768.6287

       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
       fu,f = 1055.00
       Ef = 64828.00
        u,f = 0.015
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
          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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00471239
     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) = 0.00471239

Lstir (Length of stirrups along Y) = 1360.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 160000.00
    ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
          Lstir (Length of stirrups along X) = 960.00
          Astir (stirrups area) = 78.53982
          Asec (section area) = 160000.00
    ----
          s = 100.00
        fywe = 694.45
        fce = 33.00
      From ((5.A5), TBDY), TBDY: cc = 0.00260287
          c = confinement factor = 1.06029
  y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
 fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
 fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
  2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:

```
   b = 140.00
   d = 527.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.98946
    cc (5A.5, TBDY) = 0.00260287
       c = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
  u =    su (4.1) = 1.4829616E-005
----------------------------------------------------------

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

---------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.0664224E-005
Mu = 2.1740E+008
---------------------------------------------------------------
with full section properties:
   b = 400.00
   d = 557.00
   d' = 43.00
   v = 0.00082883
     N = 6093.866
   fc = 33.00
    co (5A.5, TBDY) = 0.002
   Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01306815
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY:  cu = 0.01306815
        we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05721847
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ----------------------------------------------------------------
        fx = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
         bmax = 600.00
         hmax = 400.00
         From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
         effective stress from (A.35), ff,e = 768.6287
      ----------------------------------------------------------------
        fy = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
         bmax = 600.00
         hmax = 400.00
         From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
           bw = 200.00
```

effective stress from (A.35), ff,e = 768.6287

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
   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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239

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) = 0.00471239
   Lstir (Length of stirrups along Y) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00

----

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
   Lstir (Length of stirrups along X) = 960.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00

----

s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
  c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
        with fs2 = fs = 389.0139
        with Es2 = Es = 200000.00
    yv = 0.00140044
    shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
    suv = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
        with fsv = fs = 389.0139
        with Esv = Es = 200000.00
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
      2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
      v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
  b = 340.00
  d = 527.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
    cc (5A.5, TBDY) = 0.00260287
      c = confinement factor = 1.06029
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
      2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
      v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
  u =   su (4.1) = 1.0664224E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.4829616E-005
Mu = 6.5825E+008
----
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  v = 0.00165765
    N = 6093.866
  fc = 33.00
    co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)

From (5.4b), TBDY: cu = 0.01306815

we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847

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

----

fx = 0.0528506

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

af = 0.22333333

with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333

bmax = 600.00

hmax = 400.00

From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016

bw = 200.00

effective stress from (A.35), ff,e = 768.6287

----

fy = 0.0528506

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

af = 0.22333333

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

bmax = 600.00

hmax = 400.00

From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016

bw = 200.00

effective stress from (A.35), ff,e = 768.6287

R = 40.00

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

fu,f = 1055.00

Ef = 64828.00

u,f = 0.015

ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846

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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).

psh,min = Min(psh,x , psh,y) = 0.00471239

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) = 0.00471239

Lstir (Length of stirrups along Y) = 1360.00

Astir (stirrups area) = 78.53982

Asec (section area) = 160000.00

----

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588

Lstir (Length of stirrups along X) = 960.00

Astir (stirrups area) = 78.53982

Asec (section area) = 160000.00

----

s = 100.00

fywe = 694.45

fce = 33.00

From ((5.A5), TBDY), TBDY: cc = 0.00260287

c = confinement factor = 1.06029

y1 = 0.00140044

sh1 = 0.0044814

ft1 = 466.8167

fy1 = 389.0139

su1 = 0.00512

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
b = 140.00
d = 527.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
cc (5A.5, TBDY) = 0.00260287
c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
u =   su (4.1) = 1.4829616E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 1.0664224E-005
Mu = 2.1740E+008
----
with full section properties:
  b = 400.00
  d = 557.00
  d' = 43.00
  v = 0.00082883
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01306815
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05721847
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ----
      fy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00471239
    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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
--------------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
        Lstir (Length of stirrups along X) = 960.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
--------------------------------------------------------------------
        s = 100.00
      fywe = 694.45
      fce = 33.00
   From ((5.A5), TBDY), TBDY:  cc = 0.00260287
        c = confinement factor = 1.06029
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
```
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs1 = fs = 389.0139
     with Es1 = Es = 200000.00
```
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
```
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
```
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
```
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
```

```
      2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
      v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
   b = 340.00
   d = 527.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.98946
     cc (5A.5, TBDY) = 0.00260287
       c  = confinement factor = 1.06029
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
      2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
      v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
   ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
  u =    su (4.1) = 1.0664224E-005
-----------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 435646.093
---------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 435646.093
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 435646.093
   knl = 1 (zero step-static loading)
-------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------------
     = 1 (normal-weight concrete)
   fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 4.00
      Mu = 44.9328
      Vu = 0.00069415
   d = 0.8*h = 480.00
   Nu = 6093.866
   Ag = 120000.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
   where:
   Vs1 = 139627.457 is calculated for section web, with:
      d = 160.00
      Av = 157079.633
      fy = 555.56
      s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
      s/d = 0.625
   Vs2 = 418882.372 is calculated for section flange, with:
      d = 480.00
      Av = 157079.633
      fy = 555.56
      s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
      s/d = 0.20833333
   Vf ((11-3)-(11.4), ACI 440) = 293495.545
      f = 0.95, for fully-wrapped sections
   wf/sf = 1 (FRP strips adjacent to one another).
   In (11.3) sin   + cos   is replaced with (cot  +cota)sina which is more a generalised expression,
```

where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, = 45° and = -45° to take into consideration the cyclic seismic loading.
orientation 1:   1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 557.00
ffe ((11-5), ACI 440) = 259.312
   Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
      with fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 366348.956
    bw = 200.00

Calculation of Shear Strength at edge 2, Vr2 = 435646.093
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 435646.093
  knl = 1 (zero step-static loading)

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

    = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 44.60048
     Vu = 0.00069415
  d = 0.8*h = 480.00
  Nu = 6093.866
  Ag = 120000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 139627.457 is calculated for section web, with:
    d = 160.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.625
  Vs2 = 418882.372 is calculated for section flange, with:
    d = 480.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.20833333
  Vf ((11-3)-(11.4), ACI 440) = 293495.545
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
  where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, = 45° and = -45° to take into consideration the cyclic seismic loading.
orientation 1:   1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 557.00
ffe ((11-5), ACI 440) = 259.312
   Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
      with fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 366348.956
    bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1

At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

Bending Moment, M = -194281.256
Shear Force, V2 = -5181.087
Shear Force, V3 = 93.61987
Axial Force, F = -6416.475
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 829.3805
     -Compression: Asl,com = 1746.726
         -Middle: Asl,mid = 1545.664
Mean Diameter of Tension Reinforcement, DbL = 18.66667

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R = 1.0* u = 0.0485561
  u =   y +   p = 0.0485561

```
 - Calculation of  y -
--------------------------------------------------------
 y = (My*Ls/3)/EIeff = 0.0065561 ((4.29),Biskinis Phd))
  My = 1.3306E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 2075.214
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 1.4040E+013
     factor = 0.30
        Ag = 160000.00
        fc' = 33.00
        N = 6416.475
      Ec*Ig = 4.6799E+013
--------------------------------------------------------
--------------------------------------------------------

Calculation of Yielding Moment My
--------------------------------------------------------
Calculation of  y and My according to Annex 7  -
--------------------------------------------------------
Assuming neutral axis within flange ( y < t/d, compression zone rectangular) with:
flange width, b = 600.00
web width, bw = 200.00
flange thickness, t = 200.00
--------------------------------------------------------
  y = Min( y_ten,  y_com)
  y_ten = 5.8027904E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
    d = 357.00
     y = 0.24886144
    A = 0.01933888
    B = 0.00899303
     with pt = 0.00387199
        pc = 0.00815465
        pv = 0.00721598
        N = 6416.475
        b = 600.00
        " = 0.12044818
  y_comp = 2.5091513E-005
 with fc* (12.3, (ACI 440)) = 33.29607
    fc = 33.00
    fl = 0.73070932
    b = bmax = 600.00
    h = hmax = 400.00
    Ag = 160000.00
       g = pt + pc + pv = 0.01924262
       rc = 40.00
       Ae/Ac = 0.29079753
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
     effective strain from (12.5) and (12.12), efe = 0.004
      fu = 0.01
     Ef = 64828.00
    Ec = 26999.444
     y = 0.24780813
    A = 0.01917515
    B = 0.00889677
    with Es = 200000.00
CONFIRMATION:  y = 0.24825976 < t/d
--------------------------------------------------------
--------------------------------------------------------

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

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

with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VColOE = 0.71033407
   d = 357.00
   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 = 960.00, 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 = 6416.475
   Ag = 160000.00
   f'cE = 33.00
   fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.01924262
   b = 600.00
   d = 357.00
   f'cE = 33.00

End Of Calculation of Chord Rotation Capacity for element: column LC1 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 LC1 of floor 1
At local axis: 3

Integration Section: (a)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -194281.256
Shear Force, Va = 93.61987
EDGE -B-
Bending Moment, Mb = -85504.326
Shear Force, Vb = -93.61987
BOTH EDGES
Axial Force, F = -6416.475
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 829.3805
     -Compression: Asl,com = 1746.726
         -Middle: Asl,mid = 1545.664
Mean Diameter of Tension Reinforcement, DbL,ten = 18.66667

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 253072.019
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 253072.019
  VCol = 253072.019
  knl = 1.00
      displacement_ductility_demand = 0.00765501

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

    = 1 (normal-weight concrete)
  fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 194281.256
    Vu = 93.61987
  d = 0.8*h = 320.00
  Nu = 6416.475
  Ag = 80000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 376991.118
  where:
  Vs1 = 251327.412 is calculated for section web, with:
    d = 320.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.3125
  Vs2 = 125663.706 is calculated for section flange, with:
    d = 160.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.625
  Vf ((11-3)-(11.4), ACI 440) = 188111.148
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
  where   is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
  orientation 1:   1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 357.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
      with   fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 212577.225
    bw = 200.00

----
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   = 5.0186994E-005
 y = (My*Ls/3)/Eleff = 0.0065561 ((4.29),Biskinis Phd))
  My = 1.3306E+008
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 2075.214
  From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 1.4040E+013
    factor = 0.30
      Ag = 160000.00
      fc' = 33.00
      N = 6416.475

```
      Ec*Ig = 4.6799E+013
---------------------------------------------------------------
---------------------------------------------------------------

Calculation of Yielding Moment My
---------------------------------------------------------------
Calculation of  y and My according to Annex 7  -
---------------------------------------------------------------
Assuming neutral axis within flange ( y < t/d, compression zone rectangular) with:
flange width, b = 600.00
web width, bw = 200.00
flange thickness, t = 200.00
---------------------------------------------------------------
  y = Min( y_ten,  y_com)
  y_ten = 5.8027904E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
     d = 357.00
      y = 0.24886144
     A = 0.01933888
     B = 0.00899303
      with pt = 0.00387199
         pc = 0.00815465
         pv = 0.00721598
         N = 6416.475
         b = 600.00
          " = 0.12044818
   y_comp = 2.5091513E-005
  with fc* (12.3, (ACI 440)) = 33.29607
     fc = 33.00
     fl = 0.73070932
     b = bmax = 600.00
     h = hmax = 400.00
     Ag = 160000.00
        g = pt + pc + pv = 0.01924262
     rc = 40.00
     Ae/Ac = 0.29079753
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
   effective strain from (12.5) and (12.12), efe = 0.004
     fu = 0.01
   Ef = 64828.00
   Ec = 26999.444
     y = 0.24780813
   A = 0.01917515
   B = 0.00889677
     with Es = 200000.00
CONFIRMATION:  y = 0.24825976 < t/d
---------------------------------------------------------------
---------------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
---------------------------------------------------------------
End Of Calculation of Shear Capacity for element: column LC1 of floor 1
At local axis: 3
Integration Section: (a)

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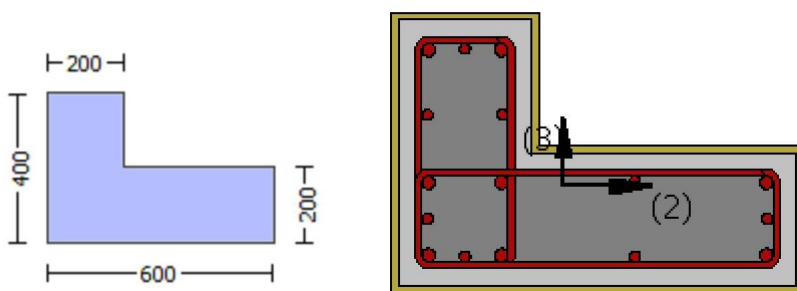```

## 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 (θu)

Edge: Start

Local Axis: (3)



Start Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rclcs

Constant Properties
-------------------------------------------------------------
Knowledge Factor, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
############################################################
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30

FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
At local axis: 3
EDGE -A-
Shear Force, Va = -0.00026803
EDGE -B-
Shear Force, Vb = 0.00026803
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 829.3805
     -Compression: Asl,com = 1746.726
         -Middle: Asl,mid = 1545.664
-------------------------------------------------------------
-------------------------------------------------------------


Calculation of Shear Capacity ratio , Ve/Vr  =  0.71033407
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 206445.557
with
Mpr1 =  Max(Mu1+ , Mu1-) = 3.0967E+008
   Mu1+ = 1.8333E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
   Mu1- = 3.0967E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 =  Max(Mu2+ , Mu2-) = 3.0967E+008
   Mu2+ = 1.8333E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
   Mu2- = 3.0967E+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 = 1.7539345E-005
Mu = 1.8333E+008
---------------------------------------------------------------------------
with full section properties:
   b = 600.00
   d = 357.00
   d' = 43.00
   v = 0.0008621
      N = 6093.866
   fc = 33.00
    co (5A.5, TBDY) = 0.002
   Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01306815
      The Shear_factor is considered equal to 1 (pure moment strength)

From (5.4b), TBDY:  cu = 0.01306815
  we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.05721847
where  f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

-------------------------------------------------------------------
  fx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333
  bmax = 600.00
  hmax = 400.00
  From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
  effective stress from (A.35), ff,e = 768.6287
-------------------------------------------------------------------
  fy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
  bmax = 600.00
  hmax = 400.00
  From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
  effective stress from (A.35), ff,e = 768.6287
-------------------------------------------------------------------
  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
  u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
-------------------------------------------------------------------
  psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
-------------------------------------------------------------------
  s = 100.00
  fywe = 694.45
  fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00260287
  c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
b = 540.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
cc (5A.5, TBDY) = 0.00260287
c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
u =   su (4.1) = 1.7539345E-005
------------------------------------------------------------

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

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

---------------------------------------------------------------------------
Calculation of ultimate curvature  φu according to 4.1, Biskinis/Fardis 2013:
  φu = 2.4056447E-005
Mu = 3.0967E+008
---------------------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 357.00
  d' = 43.00
  ν = 0.00258631
    N = 6093.866
  fc = 33.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu:  εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  εcu = 0.01306815
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
    where  ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ------------------------------------------------------------------
      ωfx = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ------------------------------------------------------------------
      ωfy = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ------------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
      εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to  bi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00471239
    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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
  ---------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
  ---------------------------------------------------------------
    s = 100.00
   fywe = 694.45
   fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
   c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fsv = fs = 389.0139
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255

and confined core properties:
   b = 140.00
   d = 327.00
   d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
    cc (5A.5, TBDY) = 0.00260287
       c = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
    v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
  u =   su (4.1) = 2.4056447E-005
------------------------------------------------------------

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

----------------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
   u = 1.7539345E-005
Mu = 1.8333E+008
----------------------------------------------------------------------
with full section properties:
   b = 600.00
   d = 357.00
   d' = 43.00
   v = 0.0008621
     N = 6093.866
   fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:  cu* = shear_factor * Max( cu, cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01306815
       we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05721847
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----------------------------------------------------------------------
       fx = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
          bw = 200.00
        effective stress from (A.35), ff,e = 768.6287
     ----------------------------------------------------------------------
       fy = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016

bw = 200.00
effective stress from (A.35), ff,e = 768.6287
----------------------------------------------------------------
R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
   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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
   Lstir (Length of stirrups along Y) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00
----------------------------------------------------------------
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
   Lstir (Length of stirrups along X) = 960.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00
----------------------------------------------------------------
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY:  cc = 0.00260287
   c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered

characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
 2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
 v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
 b = 540.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
  cc (5A.5, TBDY) = 0.00260287
   c = confinement factor = 1.06029
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
  2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
  v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
 u =  su (4.1) = 1.7539345E-005
------------------------------------------------------------

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

----------------------------------------------------------------------
Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 2.4056447E-005
Mu = 3.0967E+008
----------------------------------------------------------------------
with full section properties:
 b = 200.00
 d = 357.00
 d' = 43.00
 v = 0.00258631
  N = 6093.866
 fc = 33.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max( cu, cc) = 0.01306815

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: $\varepsilon$cu = 0.01306815
  $\omega$we ((5.4c), TBDY) = $\alpha$se* $\rho$sh,min*fywe/fce+Min($\omega$fx, $\omega$fy) = 0.05721847
where $\omega$f = $\alpha$f*$\rho$f*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
------------------------------------------------------------------
  $\omega$fx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
  bmax = 600.00
  hmax = 400.00
  From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
  effective stress from (A.35), ff,e = 768.6287
------------------------------------------------------------------
  $\omega$fy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
  bmax = 600.00
  hmax = 400.00
  From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
  effective stress from (A.35), ff,e = 768.6287
------------------------------------------------------------------
  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
  $\varepsilon$u,f = 0.015
  $\alpha$se = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to $\sum$bi2/6 as defined at (A.2).
  $\rho$sh,min = Min($\rho$sh,x , $\rho$sh,y) = 0.00471239
Expression ((5.4d), TBDY) for $\rho$sh,min has been miltiplied by 0.3 according to 15.7.1.3 for members without
earthquake detailing (90° closed stirrups)
------------------------------------------------------------------
  $\rho$sh,x ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
------------------------------------------------------------------
  $\rho$sh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
------------------------------------------------------------------
    s = 100.00
  fywe = 694.45
  fce = 33.00
  From ((5.A5), TBDY), TBDY: $\varepsilon$cc = 0.00260287
    $\lambda$c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
b = 140.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
cc (5A.5, TBDY) = 0.00260287
c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
u =   su (4.1) = 2.4056447E-005
-------------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------
Inadequate Lap Length with lb/ld = 0.30
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 290631.642
-----------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 290631.642
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 290631.642
  knl = 1 (zero step-static loading)
-----------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-----------------------------------------------------------------
    = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 11.70883
    Vu = 0.00026803
  d = 0.8*h = 320.00
  Nu = 6093.866
  Ag = 80000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
  where:
  Vs1 = 279254.914 is calculated for section web, with:
    d = 320.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.3125
  Vs2 = 139627.457 is calculated for section flange, with:
    d = 160.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.625
  Vf ((11-3)-(11.4), ACI 440) = 188111.148
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
  where   is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
  orientation 1:   1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 357.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
      with  fu = 0.01
  From (11-11), ACI 440: Vs + Vf <= 244232.638
    bw = 200.00
-----------------------------------------------------------------
-----------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 290631.642
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 290631.642
  knl = 1 (zero step-static loading)
-----------------------------------------------------------------
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ f*Vf'

where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
   = 1 (normal-weight concrete)
 fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
   Mu = 11.914
   Vu = 0.00026803
 d = 0.8*h = 320.00
 Nu = 6093.866
 Ag = 80000.00
 From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
 where:
 Vs1 = 279254.914 is calculated for section web, with:
   d = 320.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
 Vs1 is multiplied by   Col1 = 1.00
   s/d = 0.3125
 Vs2 = 139627.457 is calculated for section flange, with:
   d = 160.00
   Av = 157079.633
   fy = 555.56
   s = 100.00
 Vs2 is multiplied by   Col2 = 1.00
   s/d = 0.625
 Vf ((11-3)-(11.4), ACI 440) = 188111.148
   f = 0.95, for fully-wrapped sections
 wf/sf = 1 (FRP strips adjacent to one another).
 In (11.3) sin  + cos  is replaced with (cot  +cota)sina which is more a generalised expression,
 where    is the angle of the crack direction (see KANEPE).
 This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
 as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
 orientation 1:   1 = b1 + 90° = 90.00
 Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
 total thickness per orientation, tf1 = NL*t/NoDir = 1.016
 dfv = d (figure 11.2, ACI 440) = 357.00
 ffe ((11-5), ACI 440) = 259.312
   Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
     with  fu = 0.01
 From (11-11), ACI 440: Vs + Vf <= 244232.638
   bw = 200.00
------------------------------------------------------------
------------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 3


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


Start Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rclcs

Constant Properties
------------------------------------------------------------
Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
############################################################
Note: Especially for the calculation of moment strengths,

the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
############################################################
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00
------------------------------------------------------------

Stepwise Properties
------------------------------------------------------------
At local axis: 2
EDGE -A-
Shear Force, Va = 0.00069415
EDGE -B-
Shear Force, Vb = -0.00069415
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
    -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 2890.265
    -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 402.1239
------------------------------------------------------------
------------------------------------------------------------


Calculation of Shear Capacity ratio , Ve/Vr = 1.00732
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 438835.425
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.5825E+008
   Mu1+ = 6.5825E+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- = 2.1740E+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-) = 6.5825E+008
   Mu2+ = 6.5825E+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- = 2.1740E+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 = 1.4829616E-005
Mu = 6.5825E+008
---------------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  ν = 0.00165765
    N = 6093.866
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01306815
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
    where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ---------------------------------------------------------------
      ωfx = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
      ---------------------------------------------------------------
      ωfy = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
      ---------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00471239
    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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
      ---------------------------------------------------------------
      ρsh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588

```
            Lstir (Length of stirrups along X) = 960.00
            Astir (stirrups area) = 78.53982
            Asec (section area) = 160000.00

      ----------------------------------------------------------------
            s = 100.00
          fywe = 694.45
          fce = 33.00
      From ((5.A5), TBDY):  cc = 0.00260287
            c  = confinement factor = 1.06029
    y1 = 0.00140044
   sh1 = 0.0044814
  ft1 = 466.8167
  fy1 = 389.0139
   su1 = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
        su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
        with fs1 = fs = 389.0139
        with Es1 = Es = 200000.00
    y2 = 0.00140044
   sh2 = 0.0044814
  ft2 = 466.8167
  fy2 = 389.0139
   su2 = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.30
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
        with fs2 = fs = 389.0139
        with Es2 = Es = 200000.00
    yv = 0.00140044
   shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
   suv = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
        with fsv = fs = 389.0139
        with Esv = Es = 200000.00
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
      2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
      v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
  b = 140.00
  d = 527.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
```

```
     c  = confinement factor = 1.06029
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
   2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
  u =    su (4.1) = 1.4829616E-005
-------------------------------------------------------------

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

-----------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.0664224E-005
Mu = 2.1740E+008
-----------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 557.00
  d' = 43.00
  v = 0.00082883
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:  cu* = shear_factor * Max( cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01306815
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min( fx, fy) = 0.05721847
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----------------------------------------------------------------
      fx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
       bmax = 600.00
       hmax = 400.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
         bw = 200.00
       effective stress from (A.35), ff,e = 768.6287
    ----------------------------------------------------------------
      fy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
       bmax = 600.00
       hmax = 400.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
         bw = 200.00
       effective stress from (A.35), ff,e = 768.6287
    ----------------------------------------------------------------
      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
```

Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
Lstir (Length of stirrups along Y) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
Lstir (Length of stirrups along X) = 960.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814

ftv = 466.8167
fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fsv = fs = 389.0139
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
    v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
  b = 340.00
  d = 527.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
     c = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
    2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
    v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
  u =   su (4.1) = 1.0664224E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.4829616E-005
Mu = 6.5825E+008
----
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  v = 0.00165765
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01306815
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
    where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.0528506

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

af = 0.22333333

with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333

   bmax = 600.00

   hmax = 400.00

   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016

     bw = 200.00

   effective stress from (A.35), ff,e = 768.6287

----

  fy = 0.0528506

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

af = 0.22333333

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

   bmax = 600.00

   hmax = 400.00

   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016

     bw = 200.00

   effective stress from (A.35), ff,e = 768.6287

  R = 40.00

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

  fu,f = 1055.00

  Ef = 64828.00

  u,f = 0.015

  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846

    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).

  psh,min = Min(psh,x , psh,y) = 0.00471239

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) = 0.00471239

    Lstir (Length of stirrups along Y) = 1360.00

    Astir (stirrups area) = 78.53982

    Asec (section area) = 160000.00

----

  psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588

    Lstir (Length of stirrups along X) = 960.00

    Astir (stirrups area) = 78.53982

    Asec (section area) = 160000.00

----

    s = 100.00

   fywe = 694.45

   fce = 33.00

  From ((5A5), TBDY), TBDY: cc = 0.00260287

    c = confinement factor = 1.06029

 y1 = 0.00140044

 sh1 = 0.0044814

ft1 = 466.8167

fy1 = 389.0139

 su1 = 0.00512

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

  and also multiplied by the shear_factor according to 15.7.1.4, with

  Shear_factor = 1.00

  lo/lou,min = lb/ld = 0.30

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

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

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

characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
 2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
 v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
 b = 140.00
 d = 527.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
  cc (5A.5, TBDY) = 0.00260287
    c = confinement factor = 1.06029
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
   2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
 u =   su (4.1) = 1.4829616E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30


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


-------------------------------------------------------------------------
Calculation of ultimate curvature  u according to 4.1, Biskinis/Fardis 2013:
  u = 1.0664224E-005
Mu = 2.1740E+008
-------------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 557.00
  d' = 43.00
  v = 0.00082883
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu,  cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01306815
       we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min( fx,   fy) = 0.05721847
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     -----------------------------------------------------------------
       fx = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2 + (hmax-2R)^2)/3 = 35733.333
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
          bw = 200.00
        effective stress from (A.35), ff,e = 768.6287
     -----------------------------------------------------------------
       fy = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2 + (hmax-2R)^2)/3 = 0.00
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
          bw = 200.00
        effective stress from (A.35), ff,e = 768.6287
     -----------------------------------------------------------------
        R = 40.00
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
        fu,f = 1055.00
        Ef = 64828.00
         u,f = 0.015
        ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
           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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
        psh,min = Min(psh,x , psh,y) = 0.00471239
     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) = 0.00471239
           Lstir (Length of stirrups along Y) = 1360.00
           Astir (stirrups area) = 78.53982
```

Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
Lstir (Length of stirrups along X) = 960.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
b = 340.00
d = 527.00

d' = 13.00
fcc (5A.2, TBDY) = 34.98946
cc (5A.5, TBDY) = 0.00260287
c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
u = su (4.1) = 1.0664224E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 435646.093

Calculation of Shear Strength at edge 1, Vr1 = 435646.093
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
VCol0 = 435646.093
knl = 1 (zero step-static loading)

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

= 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 4.00
Mu = 44.9328
Vu = 0.00069415
d = 0.8*h = 480.00
Nu = 6093.866
Ag = 120000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
where:
Vs1 = 139627.457 is calculated for section web, with:
d = 160.00
Av = 157079.633
fy = 555.56
s = 100.00
Vs1 is multiplied by Col1 = 1.00
s/d = 0.625
Vs2 = 418882.372 is calculated for section flange, with:
d = 480.00
Av = 157079.633
fy = 555.56
s = 100.00
Vs2 is multiplied by Col2 = 1.00
s/d = 0.20833333
Vf ((11-3)-(11.4), ACI 440) = 293495.545
f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:

total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 557.00
ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
       with fu = 0.01
  From (11-11), ACI 440: Vs + Vf < = 366348.956
    bw = 200.00

Calculation of Shear Strength at edge 2, Vr2 = 435646.093
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 435646.093
  knl = 1 (zero step-static loading)

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

    = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
    Mu = 44.60048
    Vu = 0.00069415
  d = 0.8*h = 480.00
  Nu = 6093.866
  Ag = 120000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 139627.457 is calculated for section web, with:
    d = 160.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00
    s/d = 0.625
  Vs2 = 418882.372 is calculated for section flange, with:
    d = 480.00
    Av = 157079.633
    fy = 555.56
    s = 100.00
  Vs2 is multiplied by   Col2 = 1.00
    s/d = 0.20833333
  Vf ((11-3)-(11.4), ACI 440) = 293495.545
    f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
  where   is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
  orientation 1:   1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 557.00
  ffe ((11-5), ACI 440) = 259.312
    Ef = 64828.00
    fe = 0.004, from (11.6a), ACI 440
       with fu = 0.01
  From (11-11), ACI 440: Vs + Vf < = 366348.956
    bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

Bending Moment, M = -1.5643E+007
Shear Force, V2 = -5181.087
Shear Force, V3 = 93.61987
Axial Force, F = -6416.475
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2890.265
     -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL = 18.18182

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R = 1.0* u = 0.05333777
  u =   y +   p = 0.05333777

 - Calculation of   y -
----
  y = (My*Ls/3)/Eleff = 0.01133777 ((4.29),Biskinis Phd))
   My = 4.5016E+008
   Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 3019.223

From table 10.5, ASCE 41_17: Eleff = factor*Ec*Ig = 3.9959E+013
   factor = 0.30
      Ag = 160000.00
      fc' = 33.00
      N = 6416.475
   Ec*Ig = 1.3320E+014

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
 y = Min(y_ten, y_com)
 y_ten = 4.9173110E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
    d = 557.00
     y = 0.43187711
    A = 0.03718481
    B = 0.02864896
    with pt = 0.02594493
        pc = 0.00744507
        pv = 0.00360973
        N = 6416.475
        b = 200.00
        " = 0.07719928
 y_comp = 9.2350821E-006
 with fc* (12.3, (ACI 440)) = 33.28275
    fc = 33.00
    fl = 0.73070932
    b = bmax = 600.00
    h = hmax = 400.00
    Ag = 160000.00
       g = pt + pc + pv = 0.03699973
       rc = 40.00
       Ae/Ac = 0.27772029
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    effective strain from (12.5) and (12.12), efe = 0.004
     fu = 0.01
    Ef = 64828.00
   Ec = 26999.444
    y = 0.43136109
    A = 0.03686994
    B = 0.02846388
    with Es = 200000.00

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

 - Calculation of p -

From table 10-8: p = 0.042
with:
- Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
  shear control ratio VyE/VCol0E = 1.00732
  d = 557.00
  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
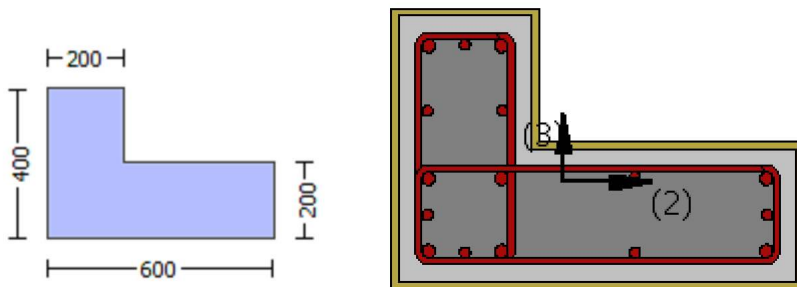 where   f = 2*tf/bw is FRP ratio (EC8 - 3, A.4.4.3(6)) and ffe/fs normalises f to steel strength
  All these variables have already been given in Shear control ratio calculation.

```
   NUD = 6416.475
   Ag = 160000.00
   f'cE = 33.00
   fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.03699973
  b = 200.00
  d = 557.00
   f'cE = 33.00
-----------------------------------------------------------
```
End Of Calculation of Chord Rotation Capacity for element: column LC1 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 LC1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rclcs

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

Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
###
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min =lb/ld = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.5643E+007
Shear Force, Va = -5181.087
EDGE -B-
Bending Moment, Mb = 96939.725
Shear Force, Vb = 5181.087
BOTH EDGES
Axial Force, F = -6416.475
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 0.00
   -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 2890.265
   -Compression: Asl,com = 829.3805
       -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 18.18182

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 439717.009
Vn ((10.3), ASCE 41-17) = knl*VColO = 439717.009
   VCol = 439717.009
   knl = 1.00
      displacement_ductility_demand = 0.05305065

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

   = 1 (normal-weight concrete)
 fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

M/Vd = 2.00
  Mu = 96939.725
  Vu = 5181.087
d = 0.8*h = 480.00
Nu = 6416.475
Ag = 120000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 502654.825
where:
Vs1 = 125663.706 is calculated for section web, with:
  d = 160.00
  Av = 157079.633
  fy = 500.00
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.625
Vs2 = 376991.118 is calculated for section flange, with:
  d = 480.00
  Av = 157079.633
  fy = 500.00
  s = 100.00
Vs2 is multiplied by   Col2 = 1.00
  s/d = 0.20833333
Vf ((11-3)-(11.4), ACI 440) = 293495.545
  f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where   is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1:   1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 557.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 318865.838
  bw = 200.00

----
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   = 5.9764675E-005
 y = (My*Ls/3)/Eleff = 0.00112656 ((4.29),Biskinis Phd))
 My = 4.5016E+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 = 3.9959E+013
  factor = 0.30
    Ag = 160000.00
    fc' = 33.00
    N = 6416.475
  Ec*Ig = 1.3320E+014

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7   -
----
 y = Min(y_ten, y_com)
 y_ten = 4.9173110E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^ 2/3) = 311.2112

```
      d = 557.00
      y = 0.43187711
      A = 0.03718481
      B = 0.02864896
     with pt = 0.02594493
         pc = 0.00744507
         pv = 0.00360973
         N = 6416.475
         b = 200.00
         " = 0.07719928
   y_comp = 9.2350821E-006
 with fc* (12.3, (ACI 440)) = 33.28275
     fc = 33.00
     fl = 0.73070932
     b = bmax = 600.00
     h = hmax = 400.00
     Ag = 160000.00
        g = pt + pc + pv = 0.03699973
        rc = 40.00
        Ae/Ac = 0.27772029
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
     effective strain from (12.5) and (12.12), efe = 0.004
       fu = 0.01
     Ef = 64828.00
    Ec = 26999.444
     y = 0.43136109
     A = 0.03686994
     B = 0.02846388
     with Es = 200000.00
```


Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

End Of Calculation of Shear Capacity for element: column LC1 of floor 1
At local axis: 2
Integration Section: (b)

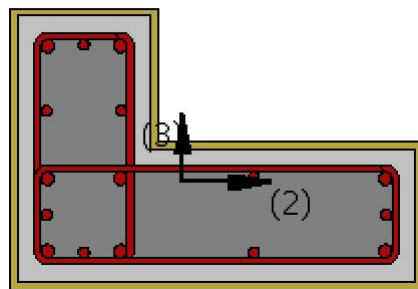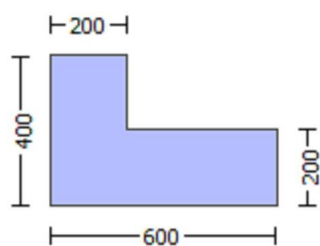
Calculation No. 14

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 LC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -0.00026803
EDGE -B-
Shear Force, Vb = 0.00026803

BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 0.00
    -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 829.3805
    -Compression: Asl,com = 1746.726
       -Middle: Asl,mid = 1545.664

Calculation of Shear Capacity ratio , Ve/Vr = 0.71033407
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 206445.557
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0967E+008
   Mu1+ = 1.8333E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
   Mu1- = 3.0967E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.0967E+008
   Mu2+ = 1.8333E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
   Mu2- = 3.0967E+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 = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
   b = 600.00
   d = 357.00
   d' = 43.00
   v = 0.0008621
      N = 6093.866
   fc = 33.00
    co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.01306815
         we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ----
         fx = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
         bmax = 600.00
         hmax = 400.00
         From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
            bw = 200.00
         effective stress from (A.35), ff,e = 768.6287
      ----
         fy = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
         bmax = 600.00
         hmax = 400.00

From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
   bw = 200.00
effective stress from (A.35), ff,e = 768.6287

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
   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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
   Lstir (Length of stirrups along Y) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
   Lstir (Length of stirrups along X) = 960.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY, TBDY: cc = 0.00260287
   c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and ɛy2, ɛsh2,ɛft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
ɛy1, ɛsh1,ɛft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
ɛyv = 0.00140044
ɛshv = 0.0044814
ftv = 466.8167
fyv = 389.0139
ɛsuv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
ɛsuv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and ɛyv, ɛshv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
ɛy1, ɛsh1,ɛft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
b = 540.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
ɛcc (5A.5, TBDY) = 0.00260287
c = confinement factor = 1.06029
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
ɛsu (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
ϕu = ϕsu (4.1) = 1.7539345E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu1-

Calculation of ultimate curvature ϕu according to 4.1, Biskinis/Fardis 2013:
ϕu = 2.4056447E-005
Mu = 3.0967E+008
----
with full section properties:
b = 200.00
d = 357.00
d' = 43.00
v = 0.00258631
N = 6093.866
fc = 33.00
ɛco (5A.5, TBDY) = 0.002

Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.01306815
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
   where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
   ----
      fx = 0.0528506
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.22333333
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
         bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
   ----
      fy = 0.0528506
   Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
   af = 0.22333333
   with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
         bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       u,f = 0.015
      ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
         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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
      psh,min = Min(psh,x , psh,y) = 0.00471239
   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) = 0.00471239
         Lstir (Length of stirrups along Y) = 1360.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 160000.00
   ----
      psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
         Lstir (Length of stirrups along X) = 960.00
         Astir (stirrups area) = 78.53982
         Asec (section area) = 160000.00
   ----
         s = 100.00
      fywe = 694.45
      fce = 33.00
   From ((5.A5), TBDY), TBDY: cc = 0.00260287
         c = confinement factor = 1.06029
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
 su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fs1 = fs = 389.0139
 with Es1 = Es = 200000.00
 y2 = 0.00140044
 sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
 su2 = 0.00512
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/lb,min = 0.30
 su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
 From table 5A.1, TBDY: esu2_nominal = 0.08,
 For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
 characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fs2 = fs = 389.0139
 with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/ld = 0.30
 suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
 From table 5A.1, TBDY: esuv_nominal = 0.08,
 considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
 For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
 characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fsv = fs = 389.0139
 with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
 2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
 v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
 b = 140.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
 cc (5A.5, TBDY) = 0.00260287
 c = confinement factor = 1.06029
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
 2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
 v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
 u = su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2+

Calculation of ultimate curvature   φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
  b = 600.00
  d = 357.00
  d' = 43.00
  v = 0.0008621
    N = 6093.866
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.01306815
       ωwe ((5.4c), TBDY) = ase* ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
     where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

       ωfx = 0.0528506
     Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
     αf = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
          bw = 200.00
        effective stress from (A.35), ff,e = 768.6287

       ωfy = 0.0528506
     Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
     αf = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
          bw = 200.00
        effective stress from (A.35), ff,e = 768.6287

       R = 40.00
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
       fu,f = 1055.00
       Ef = 64828.00
        εu,f = 0.015
       ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
          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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).

psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
Lstir (Length of stirrups along Y) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00

----

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
Lstir (Length of stirrups along X) = 960.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00

----

s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 389.0139

```
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
    v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
  b = 540.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
      c = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
    v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
 v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
  u =   su (4.1) = 1.7539345E-005
------------------------------------------------------------

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

-----------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 2.4056447E-005
Mu = 3.0967E+008
-----------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 357.00
  d' = 43.00
  v = 0.00258631
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:  cu* = shear_factor * Max( cu,  cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.01306815
      we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min( fx,  fy) = 0.05721847
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    -------------------------------------------------------------------
      fx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
       bmax = 600.00
       hmax = 400.00
       From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
          bw = 200.00
       effective stress from (A.35), ff,e = 768.6287
    -------------------------------------------------------------------
      fy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
       bmax = 600.00
```

hmax = 400.00
From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
effective stress from (A.35), ff,e = 768.6287

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fs2 = fs = 389.0139
     with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
 ftv = 466.8167
 fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
     with fsv = fs = 389.0139
     with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
  v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
  b = 140.00
  d = 327.00
  d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
  cc (5A.5, TBDY) = 0.00260287
    c = confinement factor = 1.06029
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
  2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
  v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
 u =   su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 290631.642

Calculation of Shear Strength at edge 1, Vr1 = 290631.642
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 290631.642
  knl = 1 (zero step-static loading)

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

    = 1 (normal-weight concrete)
 fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

M/Vd = 4.00
   Mu = 11.70883
   Vu = 0.00026803
d = 0.8*h = 320.00
Nu = 6093.866
Ag = 80000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
where:
Vs1 = 279254.914 is calculated for section web, with:
  d = 320.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.3125
Vs2 = 139627.457 is calculated for section flange, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by   Col2 = 1.00
  s/d = 0.625
Vf ((11-3)-(11.4), ACI 440) = 188111.148
  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(θ, α), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, θ =45° and θ =-45° to take into consideration the cyclic seismic loading.
orientation 1: α_1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, α_1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
  ϵfe = 0.004, from (11.6a), ACI 440
   with ϵfu = 0.01
From (11-11), ACI 440: Vs + Vf <= 244232.638
  bw = 200.00

Calculation of Shear Strength at edge 2, Vr2 = 290631.642
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
 VCol0 = 290631.642
 knl = 1 (zero step-static loading)

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

 λ = 1 (normal-weight concrete)
 fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
 M/Vd = 4.00
   Mu = 11.914
   Vu = 0.00026803
d = 0.8*h = 320.00
Nu = 6093.866
Ag = 80000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
where:
Vs1 = 279254.914 is calculated for section web, with:
  d = 320.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.3125
Vs2 = 139627.457 is calculated for section flange, with:

d = 160.00
Av = 157079.633
fy = 555.56
s = 100.00
Vs2 is multiplied by   Col2 = 1.00
s/d = 0.625
Vf ((11-3)-(11.4), ACI 440) = 188111.148
f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where   is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
fe = 0.004, from (11.6a), ACI 440
with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 244232.638
bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016

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

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00069415
EDGE -B-
Shear Force, Vb = -0.00069415
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 2890.265
     -Compression: Asl,com = 829.3805
         -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 1.00732
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 438835.425
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.5825E+008
   Mu1+ = 6.5825E+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- = 2.1740E+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-) = 6.5825E+008
   Mu2+ = 6.5825E+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- = 2.1740E+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 = 1.4829616E-005
Mu = 6.5825E+008
----
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  v = 0.00165765
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.01306815
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05721847
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----

fx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333
   bmax = 600.00
   hmax = 400.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
     bw = 200.00
   effective stress from (A.35), ff,e = 768.6287

----

  fy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
   bmax = 600.00
   hmax = 400.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
     bw = 200.00
   effective stress from (A.35), ff,e = 768.6287

  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00

   ----
   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00

   ----
    s = 100.00
   fywe = 694.45
   fce = 33.00
  From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
 y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs2 = fs = 389.0139
    with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
b = 140.00
d = 527.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
cc (5A.5, TBDY) = 0.00260287
    c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
u =   su (4.1) = 1.4829616E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.0664224E-005
Mu = 2.1740E+008
----
with full section properties:
  b = 400.00
  d = 557.00
  d' = 43.00
  v = 0.00082883
    N = 6093.866
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01306815
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
    where ωf = af*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      ωfx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      ωfy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00471239
    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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00

```
           Astir (stirrups area) = 78.53982
           Asec (section area) = 160000.00
      ---------------------------------------------------------------
        psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
           Lstir (Length of stirrups along X) = 960.00
           Astir (stirrups area) = 78.53982
           Asec (section area) = 160000.00
      ---------------------------------------------------------------
           s = 100.00
          fywe = 694.45
          fce  = 33.00
       From ((5.A5), TBDY), TBDY:  cc = 0.00260287
            c = confinement factor = 1.06029
     y1 = 0.00140044
    sh1 = 0.0044814
   ft1 = 466.8167
   fy1 = 389.0139
    su1 = 0.00512
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 0.30
        su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu1_nominal = 0.08,
       For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
       characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
        with fs1 = fs = 389.0139
        with Es1 = Es = 200000.00
     y2 = 0.00140044
    sh2 = 0.0044814
   ft2 = 466.8167
   fy2 = 389.0139
    su2 = 0.00512
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/lb,min = 0.30
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu2_nominal = 0.08,
       For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
       characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
        with fs2 = fs = 389.0139
        with Es2 = Es = 200000.00
     yv = 0.00140044
    shv = 0.0044814
   ftv = 466.8167
   fyv = 389.0139
    suv = 0.00512
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 0.30
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esuv_nominal = 0.08,
       considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
       For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
       characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
        with fsv = fs = 389.0139
        with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
     2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
     v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
 and confined core properties:
   b = 340.00
```

```
    d = 527.00
    d' = 13.00
   fcc (5A.2, TBDY) = 34.98946
     εcc (5A.5, TBDY) = 0.00260287
        c = confinement factor = 1.06029
     ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
     ω2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
     ωv = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
  ε' satisfies Eq. (4.3)
--->
εv < εvs,y2 - LHS eq.(4.5) is satisfied
--->
 εsu (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
  φu =    φsu (4.1) = 1.0664224E-005
------------------------------------------------------------

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


--------------------------------------------------------------------
Calculation of ultimate curvature  φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.4829616E-005
Mu = 6.5825E+008
--------------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  ν = 0.00165765
    N = 6093.866
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
   Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: εcu = 0.01306815
        ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
      where ωf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ----------------------------------------------------------------
        ωfx = 0.0528506
      Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
      αf = 0.22333333
      with Unconfined area = ((bmax-2R)^2 + (hmax-2R)^2)/3 = 35733.333
         bmax = 600.00
         hmax = 400.00
         From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
           bw = 200.00
         effective stress from (A.35), ff,e = 768.6287
      ----------------------------------------------------------------
        ωfy = 0.0528506
      Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
      αf = 0.22333333
      with Unconfined area = ((bmax-2R)^2 + (hmax-2R)^2)/3 = 0.00
         bmax = 600.00
         hmax = 400.00
         From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
           bw = 200.00
         effective stress from (A.35), ff,e = 768.6287
      ----------------------------------------------------------------
        R = 40.00
```

Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
Lstir (Length of stirrups along Y) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
Lstir (Length of stirrups along X) = 960.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
 su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fs1 = fs = 389.0139
 with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
 su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fs2 = fs = 389.0139
 with Es2 = Es = 200000.00

yv = 0.00140044
       shv = 0.0044814
     ftv = 466.8167
     fyv = 389.0139
      suv = 0.00512
         using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
         and also multiplied by the shear_factor according to 15.7.1.4, with
         Shear_factor = 1.00
         lo/lou,min = lb/ld = 0.30
          suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
         From table 5A.1, TBDY: esuv_nominal = 0.08,
         considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
         For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
         characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
          y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
          with fsv = fs = 389.0139
          with Esv = Es = 200000.00
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
      2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
      v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
   b = 140.00
   d = 527.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.98946
    cc (5A.5, TBDY) = 0.00260287
        c = confinement factor = 1.06029
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
      2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
      v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
  u =   su (4.1) = 1.4829616E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.0664224E-005
Mu = 2.1740E+008
----
with full section properties:
   b = 400.00
   d = 557.00
   d' = 43.00
   v = 0.00082883
     N = 6093.866
   fc = 33.00
    co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.01306815

we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
----
fx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333
bmax = 600.00
hmax = 400.00
From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
bw = 200.00
effective stress from (A.35), ff,e = 768.6287
----
fy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
bmax = 600.00
hmax = 400.00
From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
bw = 200.00
effective stress from (A.35), ff,e = 768.6287

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
Lstir (Length of stirrups along Y) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
Lstir (Length of stirrups along X) = 960.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

```
    lo/lou,min = lb/ld = 0.30
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs1 = fs = 389.0139
      with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fs2 = fs = 389.0139
      with Es2 = Es = 200000.00
  yv = 0.00140044
  shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
  suv = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
      with fsv = fs = 389.0139
      with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
  2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
  v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
  b = 340.00
  d = 527.00
  d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
    cc (5A.5, TBDY) = 0.00260287
      c  = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
    2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
    v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
 u =   su (4.1) = 1.0664224E-005
------------------------------------------------------------

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


Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 435646.093

Calculation of Shear Strength at edge 1, Vr1 = 435646.093
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 435646.093
  knl = 1 (zero step-static loading)

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

     = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 4.00
     Mu = 44.9328
     Vu = 0.00069415
   d = 0.8*h = 480.00
  Nu = 6093.866
  Ag = 120000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
  where:
  Vs1 = 139627.457 is calculated for section web, with:
     d = 160.00
     Av = 157079.633
     fy = 555.56
     s = 100.00
  Vs1 is multiplied by Col1 = 1.00
     s/d = 0.625
  Vs2 = 418882.372 is calculated for section flange, with:
     d = 480.00
     Av = 157079.633
     fy = 555.56
     s = 100.00
  Vs2 is multiplied by Col2 = 1.00
     s/d = 0.20833333
  Vf ((11-3)-(11.4), ACI 440) = 293495.545
     f = 0.95, for fully-wrapped sections
   wf/sf = 1 (FRP strips adjacent to one another).
  In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
  where is the angle of the crack direction (see KANEPE).
  This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
  as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
  orientation 1: 1 = b1 + 90° = 90.00
  Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
  total thickness per orientation, tf1 = NL*t/NoDir = 1.016
  dfv = d (figure 11.2, ACI 440) = 557.00
  ffe ((11-5), ACI 440) = 259.312
     Ef = 64828.00
      fe = 0.004, from (11.6a), ACI 440
       with fu = 0.01
   From (11-11), ACI 440: Vs + Vf <= 366348.956
     bw = 200.00

Calculation of Shear Strength at edge 2, Vr2 = 435646.093
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
  VCol0 = 435646.093
  knl = 1 (zero step-static loading)

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

     = 1 (normal-weight concrete)
  fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

M/Vd = 4.00
   Mu = 44.60048
   Vu = 0.00069415
d = 0.8*h = 480.00
Nu = 6093.866
Ag = 120000.00
From (11.5.4.8), ACI 318-14: $Vs = Vs_1 + Vs_2 = 558509.829$
where:
$Vs_1 = 139627.457$ is calculated for section web, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs_1 is multiplied by   Col1 = 1.00
  s/d = 0.625
$Vs_2 = 418882.372$ is calculated for section flange, with:
  d = 480.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs_2 is multiplied by   Col2 = 1.00
  s/d = 0.20833333
Vf ((11-3)-(11.4), ACI 440) = 293495.545
  f = 0.95, for fully-wrapped sections
  wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function $Vf(,)$, is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
$Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|)$, with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 557.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.01
From (11-11), ACI 440: $Vs + Vf <= 366348.956$
  bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rclcs

Constant Properties

Knowledge Factor, = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00

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

Stepwise Properties

Bending Moment, M = -85504.326
Shear Force, V2 = 5181.087
Shear Force, V3 = -93.61987
Axial Force, F = -6416.475
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 829.3805
      -Compression: Asl,com = 1746.726
         -Middle: Asl,mid = 1545.664
Mean Diameter of Tension Reinforcement, DbL = 18.66667

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity u,R = 1.0* u = 0.04488538
  u = y + p = 0.04488538

 - Calculation of y -
----
 y = (My*Ls/3)/EIeff = 0.00288538 ((4.29),Biskinis Phd))
  My = 1.3306E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 913.3139
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 1.4040E+013
     factor = 0.30
        Ag = 160000.00
        fc' = 33.00
        N = 6416.475
     Ec*Ig = 4.6799E+013

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -

Assuming neutral axis within flange (y < t/d, compression zone rectangular) with:
flange width, b = 600.00
web width, bw = 200.00
flange thickness, t = 200.00
----
  y = Min(y_ten, y_com)
  y_ten = 5.8027904E-006

with ((10.1), ASCE 41-17) $fy = Min(fy, 1.25*fy*(lb/ld)^{2/3}) = 311.2112$
   d = 357.00
    y = 0.24886144
   A = 0.01933888
   B = 0.00899303
    with pt = 0.00387199
      pc = 0.00815465
      pv = 0.00721598
      N = 6416.475
      b = 600.00
       " = 0.12044818
  y_comp = 2.5091513E-005
 with fc* (12.3, (ACI 440)) = 33.29607
    fc = 33.00
    fl = 0.73070932
    b = bmax = 600.00
    h = hmax = 400.00
    Ag = 160000.00
      g = pt + pc + pv = 0.01924262
     rc = 40.00
     Ae/Ac = 0.29079753
     Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    effective strain from (12.5) and (12.12), efe = 0.004
     fu = 0.01
   Ef = 64828.00
   Ec = 26999.444
    y = 0.24780813
   A = 0.01917515
   B = 0.00889677
    with Es = 200000.00
CONFIRMATION: y = 0.24825976 < t/d

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

 - Calculation of p -

From table 10-8: p = 0.042
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
  shear control ratio VyE/VColOE = 0.71033407
  d = 357.00
  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 = 960.00, 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 = 6416.475
  Ag = 160000.00
  f'cE = 33.00
  fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.01924262
  b = 600.00
  d = 357.00
  f'cE = 33.00

End Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 2
Integration Section: (b)

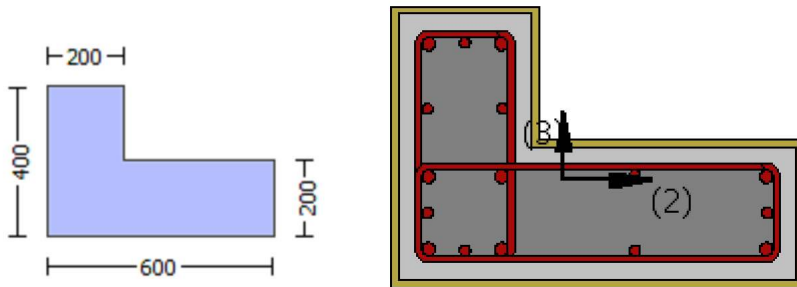
Calculation No. 15

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 LC1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fc_lower_bound = 25.00
New material of Secondary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of y for displacement ductility demand,
the expected (mean value) strengths are used (7.5.1.3, ASCE41-17) because bending is considered as
Deformation-Controlled Action (Table C7-1, ASCE41-17).
New material: Concrete Strength, fc = fcm = 33.00
New material: Steel Strength, fs = fsm = 555.56
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00

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

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -194281.256
Shear Force, Va = 93.61987
EDGE -B-
Bending Moment, Mb = -85504.326
Shear Force, Vb = -93.61987
BOTH EDGES
Axial Force, F = -6416.475
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 0.00
   -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 829.3805
    -Compression: Asl,com = 1746.726
      -Middle: Asl,mid = 1545.664
Mean Diameter of Tension Reinforcement, DbL,ten = 18.66667

New component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = 1.0*Vn = 269330.262
Vn ((10.3), ASCE 41-17) = knl*VCol0 = 269330.262
  VCol = 269330.262
  knl = 1.00
    displacement_ductility_demand = 1.5606114E-005

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

    = 1 (normal-weight concrete)
  fc' = 25.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  M/Vd = 2.85411
     Mu = 85504.326
     Vu = 93.61987
  d = 0.8*h = 320.00
  Nu = 6416.475
  Ag = 80000.00
  From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 376991.118
  where:
  Vs1 = 251327.412 is calculated for section web, with:
    d = 320.00
    Av = 157079.633
    fy = 500.00
    s = 100.00
  Vs1 is multiplied by   Col1 = 1.00

```
      s/d = 0.3125
    Vs2 = 125663.706 is calculated for section flange, with:
      d = 160.00
      Av = 157079.633
      fy = 500.00
      s = 100.00
    Vs2 is multiplied by  Col2 = 1.00
      s/d = 0.625
    Vf ((11-3)-(11.4), ACI 440) = 188111.148
      f = 0.95, for fully-wrapped sections
    wf/sf = 1 (FRP strips adjacent to one another).
    In (11.3) sin  + cos  is replaced with (cot +cota)sina which is more a generalised expression,
    where   is the angle of the crack direction (see KANEPE).
    This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
    as well as for 2 crack directions,  =45° and  =-45° to take into consideration the cyclic seismic loading.
    orientation 1:   1 = b1 + 90° = 90.00
    Vf = Min(|Vf(45,  1)|,|Vf(-45,a1)|), with:
    total thickness per orientation, tf1 = NL*t/NoDir = 1.016
    dfv = d (figure 11.2, ACI 440) = 357.00
    ffe ((11-5), ACI 440) = 259.312
      Ef = 64828.00
       fe = 0.004, from (11.6a), ACI 440
        with  fu = 0.01
    From (11-11), ACI 440: Vs + Vf <= 212577.225
      bw = 200.00
--------------------------------------------------------------


--------------------------------------------------------------
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    = 4.5029555E-008
  y = (My*Ls/3)/EIeff = 0.00288538 ((4.29),Biskinis Phd))
  My = 1.3306E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 913.3139
  From table 10.5, ASCE 41_17: EIeff = factor*Ec*Ig = 1.4040E+013
    factor = 0.30
      Ag = 160000.00
      fc' = 33.00
      N = 6416.475
    Ec*Ig = 4.6799E+013
--------------------------------------------------------------
--------------------------------------------------------------

Calculation of Yielding Moment My
--------------------------------------------------------------
Calculation of  y and My according to Annex 7  -
--------------------------------------------------------------
Assuming neutral axis within flange ( y < t/d, compression zone rectangular) with:
flange width, b = 600.00
web width, bw = 200.00
flange thickness, t = 200.00
--------------------------------------------------------------
  y = Min( y_ten,  y_com)
  y_ten = 5.8027904E-006
  with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
    d = 357.00
     y = 0.24886144
    A = 0.01933888
    B = 0.00899303
    with pt = 0.00387199
       pc = 0.00815465
       pv = 0.00721598
       N = 6416.475
       b = 600.00
```

```
      " = 0.12044818
   y_comp = 2.5091513E-005
 with fc* (12.3, (ACI 440)) = 33.29607
     fc = 33.00
     fl = 0.73070932
     b = bmax = 600.00
     h = hmax = 400.00
     Ag = 160000.00
        g = pt + pc + pv = 0.01924262
       rc = 40.00
       Ae/Ac = 0.29079753
       Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
     effective strain from (12.5) and (12.12), efe = 0.004
      fu = 0.01
     Ef = 64828.00
    Ec = 26999.444
     y = 0.24780813
     A = 0.01917515
     B = 0.00889677
     with Es = 200000.00
CONFIRMATION:  y = 0.24825976 < t/d
```


Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

End Of Calculation of Shear Capacity for element: column LC1 of floor 1
At local axis: 3
Integration Section: (b)

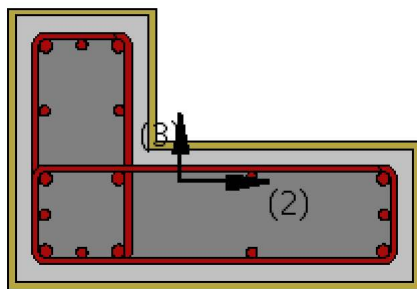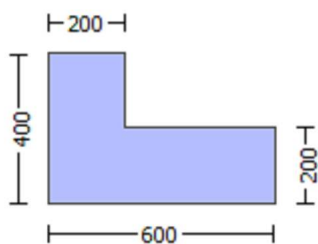# Calculation No. 16

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 LC1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rclcs

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016
Tensile Strength, ffu = 1055.00
Tensile Modulus, Ef = 64828.00
Elongation, efu = 0.01
Number of directions, NoDir = 1
Fiber orientations, bi: 0.00°
Number of layers, NL = 1
Radius of rounding corners, R = 40.00

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = -0.00026803
EDGE -B-
Shear Force, Vb = 0.00026803

BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 0.00
  -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 829.3805
  -Compression: Asl,com = 1746.726
    -Middle: Asl,mid = 1545.664

Calculation of Shear Capacity ratio , Ve/Vr = 0.71033407
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 206445.557
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.0967E+008
  Mu1+ = 1.8333E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction which is defined for the static loading combination
  Mu1- = 3.0967E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.0967E+008
  Mu2+ = 1.8333E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the the static loading combination
  Mu2- = 3.0967E+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 = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
  b = 600.00
  d = 357.00
  d' = 43.00
  v = 0.0008621
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.01306815
      we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
    where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
    ----
      fx = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287
    ----
      fy = 0.0528506
    Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
    af = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00

From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
    bw = 200.00
effective stress from (A.35), ff,e = 768.6287

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
 u,f = 0.015
ase = Max((((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
    Lstir (Length of stirrups along Y) = 1360.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
    Lstir (Length of stirrups along X) = 960.00
    Astir (stirrups area) = 78.53982
    Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 0.30
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs1 = fs = 389.0139
   with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 0.30
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fsv = fs = 389.0139
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
   2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
   v = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
 b = 540.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
  cc (5A.5, TBDY) = 0.00260287
    c = confinement factor = 1.06029
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
  2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
  v = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
 u =   su (4.1) = 1.7539345E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 2.4056447E-005
Mu = 3.0967E+008
----
with full section properties:
 b = 200.00
 d = 357.00
 d' = 43.00
 v = 0.00258631
   N = 6093.866
 fc = 33.00
  co (5A.5, TBDY) = 0.002

Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815

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

   From (5.4b), TBDY: cu = 0.01306815

    we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847

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

----

   fx = 0.0528506

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

   af = 0.22333333

   with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333

    bmax = 600.00

    hmax = 400.00

    From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016

     bw = 200.00

    effective stress from (A.35), ff,e = 768.6287

----

   fy = 0.0528506

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

   af = 0.22333333

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

    bmax = 600.00

    hmax = 400.00

    From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016

     bw = 200.00

    effective stress from (A.35), ff,e = 768.6287

   R = 40.00

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

   fu,f = 1055.00

   Ef = 64828.00

   u,f = 0.015

   ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846

    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to bi2/6 as defined at (A.2).

  psh,min = Min(psh,x , psh,y) = 0.00471239

 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) = 0.00471239

    Lstir (Length of stirrups along Y) = 1360.00

    Astir (stirrups area) = 78.53982

    Asec (section area) = 160000.00

----

   psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588

    Lstir (Length of stirrups along X) = 960.00

    Astir (stirrups area) = 78.53982

    Asec (section area) = 160000.00

----

    s = 100.00

    fywe = 694.45

    fce = 33.00

  From ((5.A5), TBDY), TBDY: cc = 0.00260287

    c = confinement factor = 1.06029

 y1 = 0.00140044

 sh1 = 0.0044814

ft1 = 466.8167

fy1 = 389.0139

 su1 = 0.00512

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
$su1 = 0.4 \cdot esu1\_nominal$ ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
$su2 = 0.4 \cdot esu2\_nominal$ ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
$suv = 0.4 \cdot esuv\_nominal$ ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fsv = fs = 389.0139
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
b = 140.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
cc (5A.5, TBDY) = 0.00260287
c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
u = su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 1.7539345E-005
Mu = 1.8333E+008
----
with full section properties:
   b = 600.00
   d = 357.00
   d' = 43.00
   v = 0.0008621
     N = 6093.866
   fc = 33.00
    co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.01306815
        we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx,   fy) = 0.05721847
      where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
      ----
        fx = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
         bmax = 600.00
         hmax = 400.00
         From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
            bw = 200.00
         effective stress from (A.35), ff,e = 768.6287
      ----
        fy = 0.0528506
      Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
      af = 0.22333333
      with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
         bmax = 600.00
         hmax = 400.00
         From EC8 A4.4.3(6), pf = 2tf/bw = 0.01016
            bw = 200.00
         effective stress from (A.35), ff,e = 768.6287

         R = 40.00
         Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
         fu,f = 1055.00
         Ef = 64828.00
          u,f = 0.015
         ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
            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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).

psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
   Lstir (Length of stirrups along Y) = 1360.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00

----

psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
   Lstir (Length of stirrups along X) = 960.00
   Astir (stirrups area) = 78.53982
   Asec (section area) = 160000.00

----

s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
  c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.00448141
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs1 = fs = 389.0139
  with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.00448141
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 0.30
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fs2 = fs = 389.0139
  with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.00448141
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
  with fsv = fs = 389.0139

with Esv = Es = 200000.00
    ρ1 = Asl,ten/(b*d)*(fs1/fc) = 0.0456442
    ρ2 = Asl,com/(b*d)*(fs2/fc) = 0.09612944
    ρv = Asl,mid/(b*d)*(fsv/fc) = 0.08506418
and confined core properties:
   b = 540.00
   d = 327.00
   d' = 13.00
   fcc (5A.2, TBDY) = 34.98946
    εcc (5A.5, TBDY) = 0.00260287
        ωc = confinement factor = 1.06029
    ρ1 = Asl,ten/(b*d)*(fs1/fc) = 0.0553686
    ρ2 = Asl,com/(b*d)*(fs2/fc) = 0.11660962
    ρv = Asl,mid/(b*d)*(fsv/fc) = 0.10318693
Case/Assumption: Unconfinesd full section - Steel rupture
   ε' satisfies Eq. (4.3)
--->
ν < νs,y2 - LHS eq.(4.5) is satisfied
--->
 εsu (4.9) = 0.18231057
Mu = MRc (4.14) = 1.8333E+008
  φu = φsu (4.1) = 1.7539345E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 2.4056447E-005
Mu = 3.0967E+008
----
with full section properties:
   b = 200.00
   d = 357.00
   d' = 43.00
   ν = 0.00258631
     N = 6093.866
   fc = 33.00
    εco (5A.5, TBDY) = 0.002
   Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.01306815
       ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(ρfx, ρfy) = 0.05721847
     where ρf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

       ρfx = 0.0528506
     Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
     αf = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
           bw = 200.00
        effective stress from (A.35), ff,e = 768.6287

       ρfy = 0.0528506
     Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
     αf = 0.22333333
     with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
        bmax = 600.00

```
    hmax = 400.00
    From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
        bw = 200.00
    effective stress from (A.35), ff,e = 768.6287
    ----------------------------------------------------------------
    R = 40.00
    Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    fu,f = 1055.00
    Ef = 64828.00
    u,f = 0.015
    ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
    psh,min = Min(psh,x , psh,y) = 0.00471239
    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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
    ----------------------------------------------------------------
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
        Lstir (Length of stirrups along X) = 960.00
        Astir (stirrups area) = 78.53982
        Asec (section area) = 160000.00
    ----------------------------------------------------------------
        s = 100.00
    fywe = 694.45
    fce = 33.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00260287
        c = confinement factor = 1.06029
  y1 = 0.00140044
  sh1 = 0.0044814
 ft1 = 466.8167
fy1 = 389.0139
  su1 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.30
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
    with fs1 = fs = 389.0139
    with Es1 = Es = 200000.00
  y2 = 0.00140044
  sh2 = 0.0044814
 ft2 = 466.8167
fy2 = 389.0139
  su2 = 0.00512
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.30
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
```

From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fs2 = fs = 389.0139
   with Es2 = Es = 200000.00
 yv = 0.00140044
 shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
 suv = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
   with fsv = fs = 389.0139
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.28838833
 2 = Asl,com/(b*d)*(fs2/fc) = 0.13693259
 v = Asl,mid/(b*d)*(fsv/fc) = 0.25519255
and confined core properties:
 b = 140.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 34.98946
  cc (5A.5, TBDY) = 0.00260287
   c = confinement factor = 1.06029
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.44977996
  2 = Asl,com/(b*d)*(fs2/fc) = 0.21356459
  v = Asl,mid/(b*d)*(fsv/fc) = 0.39800673
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) = 0.4038298
Mu = MRc (4.15) = 3.0967E+008
 u = su (4.1) = 2.4056447E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 290631.642

Calculation of Shear Strength at edge 1, Vr1 = 290631.642
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
 VCol0 = 290631.642
 knl = 1 (zero step-static loading)

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

  = 1 (normal-weight concrete)
 fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

M/Vd = 4.00
   Mu = 11.70883
   Vu = 0.00026803
d = 0.8*h = 320.00
Nu = 6093.866
Ag = 80000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
where:
Vs1 = 279254.914 is calculated for section web, with:
  d = 320.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.3125
Vs2 = 139627.457 is calculated for section flange, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by   Col2 = 1.00
  s/d = 0.625
Vf ((11-3)-(11.4), ACI 440) = 188111.148
  f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 244232.638
  bw = 200.00

Calculation of Shear Strength at edge 2, Vr2 = 290631.642
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
 VCol0 = 290631.642
 knl = 1 (zero step-static loading)

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

  = 1 (normal-weight concrete)
fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
M/Vd = 4.00
   Mu = 11.914
   Vu = 0.00026803
d = 0.8*h = 320.00
Nu = 6093.866
Ag = 80000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 418882.372
where:
Vs1 = 279254.914 is calculated for section web, with:
  d = 320.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by   Col1 = 1.00
  s/d = 0.3125
Vs2 = 139627.457 is calculated for section flange, with:

d = 160.00
Av = 157079.633
fy = 555.56
s = 100.00
Vs2 is multiplied by Col2 = 1.00
s/d = 0.625
Vf ((11-3)-(11.4), ACI 440) = 188111.148
f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf(,), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1: 1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 357.00
ffe ((11-5), ACI 440) = 259.312
Ef = 64828.00
fe = 0.004, from (11.6a), ACI 440
with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 244232.638
bw = 200.00

End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rclcs

Constant Properties

Knowledge Factor, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
##
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.06029
Element Length, L = 3000.00
Secondary Member
Ribbed Bars
Ductile Steel
Without Detailing for Earthquake Resistance (including stirrups not closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Inadequate Lap Length with lo/lou,min = 0.30
FRP Wrapping Data
Type: Carbon
Cured laminate properties (design values)
Thickness, t = 1.016

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

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = 0.00069415
EDGE -B-
Shear Force, Vb = -0.00069415
BOTH EDGES
Axial Force, F = -6093.866
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
     -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2890.265
      -Compression: Asl,com = 829.3805
         -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 1.00732
Member Controlled by Shear (Ve/Vr > 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 438835.425
with
Mpr1 = Max(Mu1+ , Mu1-) = 6.5825E+008
   Mu1+ = 6.5825E+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- = 2.1740E+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-) = 6.5825E+008
   Mu2+ = 6.5825E+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- = 2.1740E+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 = 1.4829616E-005
Mu = 6.5825E+008
----
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  v = 0.00165765
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.01306815
       we ((5.4c), TBDY) = ase* sh,min*fywe/fce+Min(fx, fy) = 0.05721847
     where f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     ----

fx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 35733.333
   bmax = 600.00
   hmax = 400.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
     bw = 200.00
   effective stress from (A.35), ff,e = 768.6287
----
  fy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+ (hmax-2R)^2)/3 = 0.00
   bmax = 600.00
   hmax = 400.00
   From EC8 A 4.4.3(6), pf = 2tf/bw = 0.01016
     bw = 200.00
   effective stress from (A.35), ff,e = 768.6287

  R = 40.00
  Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
  fu,f = 1055.00
  Ef = 64828.00
   u,f = 0.015
  ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
    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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
  psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
     Lstir (Length of stirrups along Y) = 1360.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 160000.00
    ----
    psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
     Lstir (Length of stirrups along X) = 960.00
     Astir (stirrups area) = 78.53982
     Asec (section area) = 160000.00
    ----
    s = 100.00
   fywe = 694.45
   fce = 33.00
  From ((5.A5), TBDY), TBDY: cc = 0.00260287
    c = confinement factor = 1.06029
 y1 = 0.00140044
 sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
 su1 = 0.00512
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fs1 = fs = 389.0139
 with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
 su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fs2 = fs = 389.0139
 with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
 suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fsv = fs = 389.0139
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
b = 140.00
d = 527.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
cc (5A.5, TBDY) = 0.00260287
 c = confinement factor = 1.06029
1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
u = su (4.1) = 1.4829616E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

Calculation of Mu1-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 1.0664224E-005
Mu = 2.1740E+008
----
with full section properties:
  b = 400.00
  d = 557.00
  d' = 43.00
  ν = 0.00082883
    N = 6093.866
  fc = 33.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.01306815
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.01306815
      ωwe ((5.4c), TBDY) = αse*ρsh,min*fywe/fce+Min(αfx, αfy) = 0.05721847
    where αf = αf*ρf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

      αfx = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      αfy = 0.0528506
    Expression ((15B.6), TBDY) is modified as αf = 1 - (Unconfined area)/(total area)
    αf = 0.22333333
    with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
      bmax = 600.00
      hmax = 400.00
      From EC8 A.4.4.3(6), ρf = 2tf/bw = 0.01016
        bw = 200.00
      effective stress from (A.35), ff,e = 768.6287

      R = 40.00
      Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
      fu,f = 1055.00
      Ef = 64828.00
       εu,f = 0.015
      αse = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
        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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σbi2/6 as defined at (A.2).
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00471239
    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) = 0.00471239
        Lstir (Length of stirrups along Y) = 1360.00

```
                Astir (stirrups area) = 78.53982
                Asec (section area) = 160000.00
        -----------------------------------------------------------------
            psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
                Lstir (Length of stirrups along X) = 960.00
                Astir (stirrups area) = 78.53982
                Asec (section area) = 160000.00
        -----------------------------------------------------------------
                s = 100.00
            fywe = 694.45
            fce  = 33.00
        From ((5.A5), TBDY), TBDY:  cc = 0.00260287
                c = confinement factor = 1.06029
    y1 = 0.00140044
   sh1 = 0.0044814
  ft1 = 466.8167
  fy1 = 389.0139
   su1 = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
       su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
       with fs1 = fs = 389.0139
       with Es1 = Es = 200000.00
    y2 = 0.00140044
   sh2 = 0.0044814
  ft2 = 466.8167
  fy2 = 389.0139
   su2 = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 0.30
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
       with fs2 = fs = 389.0139
       with Es2 = Es = 200000.00
    yv = 0.00140044
   shv = 0.0044814
  ftv = 466.8167
  fyv = 389.0139
   suv = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
       with fsv = fs = 389.0139
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
    v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
  b = 340.00
```

```
    d = 527.00
    d' = 13.00
   fcc (5A.2, TBDY) = 34.98946
     cc (5A.5, TBDY) = 0.00260287
        c = confinement factor = 1.06029
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
     2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
     v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
  u =    su (4.1) = 1.0664224E-005
-------------------------------------------------------------

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

----------------------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
  u = 1.4829616E-005
Mu = 6.5825E+008
----------------------------------------------------------------------------
with full section properties:
  b = 200.00
  d = 557.00
  d' = 43.00
  v = 0.00165765
    N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01306815
       we ((5.4c), TBDY) = ase*  sh,min*fywe/fce+Min(  fx,   fy) = 0.05721847
     where   f = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)
     -------------------------------------------------------------------
       fx = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2 + (hmax-2R)^2)/3 = 35733.333
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
          bw = 200.00
        effective stress from (A.35), ff,e = 768.6287
     -------------------------------------------------------------------
       fy = 0.0528506
     Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
     af = 0.22333333
     with Unconfined area = ((bmax-2R)^2 + (hmax-2R)^2)/3 = 0.00
        bmax = 600.00
        hmax = 400.00
        From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
          bw = 200.00
        effective stress from (A.35), ff,e = 768.6287
     -------------------------------------------------------------------
       R = 40.00
```

Effective FRP thickness, $t_f = NL*t*Cos(b1) = 1.016$
fu,f = 1055.00
Ef = 64828.00
u,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to   bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
Lstir (Length of stirrups along Y) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
Lstir (Length of stirrups along X) = 960.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.00260287
c = confinement factor = 1.06029
y1 = 0.00140044
sh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
su1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.30
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs1 = fs = 389.0139
with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.30
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
with fs2 = fs = 389.0139
with Es2 = Es = 200000.00

```
    yv = 0.00140044
   shv = 0.0044814
  ftv = 466.8167
  fyv =  389.0139
   suv = 0.00512
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 0.30
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
       with fsv = fs = 389.0139
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.30584665
    2 = Asl,com/(b*d)*(fs2/fc) = 0.08776469
    v = Asl,mid/(b*d)*(fsv/fc) = 0.04255258
and confined core properties:
   b = 140.00
   d = 527.00
   d' = 13.00
  fcc (5A.2, TBDY) = 34.98946
   cc (5A.5, TBDY) = 0.00260287
      c  = confinement factor = 1.06029
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.46179611
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13251541
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06424989
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) = 0.38015251
Mu = MRc (4.15) = 6.5825E+008
  u =   su (4.1) = 1.4829616E-005
----------------------------------------------------------

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

--------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 1.0664224E-005
Mu = 2.1740E+008
--------------------------------------------------------------------------
with full section properties:
   b = 400.00
   d = 557.00
   d' = 43.00
   v = 0.00082883
     N = 6093.866
  fc = 33.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.01306815
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.01306815
```

we ((5.4c), TBDY) = ase* ψsh,min*fywe/fce+Min(ωfx, ωfy) = 0.05721847
where ωf = af*pf*ffe/fce is accounting for FRP contribution like EC8-part3 A.4.4.3(6)

ωfx = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 35733.333
bmax = 600.00
hmax = 400.00
From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
bw = 200.00
effective stress from (A.35), ff,e = 768.6287

ωfy = 0.0528506
Expression ((15B.6), TBDY) is modified as af = 1 - (Unconfined area)/(total area)
af = 0.22333333
with Unconfined area = ((bmax-2R)^2+(hmax-2R)^2)/3 = 0.00
bmax = 600.00
hmax = 400.00
From EC8 A.4.4.3(6), pf = 2tf/bw = 0.01016
bw = 200.00
effective stress from (A.35), ff,e = 768.6287

R = 40.00
Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
fu,f = 1055.00
Ef = 64828.00
εu,f = 0.015
ase = Max(((Aconf,max-AnoConf)/Aconf,max)*(Aconf,min/Aconf,max),0) = 0.14681846
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 = 103600.00 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 = 66025.00 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 = 79733.333 is the unconfined core area which is equal to Σ bi2/6 as defined at (A.2).
psh,min = Min(psh,x , psh,y) = 0.00471239
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) = 0.00471239
Lstir (Length of stirrups along Y) = 1360.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00
----
psh,y ((5.4d), TBDY) = Lstir*Astir/(Asec*s) = 0.00667588
Lstir (Length of stirrups along X) = 960.00
Astir (stirrups area) = 78.53982
Asec (section area) = 160000.00
----
s = 100.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: εcc = 0.00260287
κc = confinement factor = 1.06029
εy1 = 0.00140044
psh1 = 0.0044814
ft1 = 466.8167
fy1 = 389.0139
εsu1 = 0.00512
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/ld = 0.30
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fs1 = fs = 389.0139
 with Es1 = Es = 200000.00
y2 = 0.00140044
sh2 = 0.0044814
ft2 = 466.8167
fy2 = 389.0139
su2 = 0.00512
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/lb,min = 0.30
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fs2 = fs = 389.0139
 with Es2 = Es = 200000.00
yv = 0.00140044
shv = 0.0044814
ftv = 466.8167
fyv = 389.0139
suv = 0.00512
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/ld = 0.30
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE41-17.
 with fsv = fs = 389.0139
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04388235
2 = Asl,com/(b*d)*(fs2/fc) = 0.15292333
v = Asl,mid/(b*d)*(fsv/fc) = 0.02127629
and confined core properties:
b = 340.00
d = 527.00
d' = 13.00
fcc (5A.2, TBDY) = 34.98946
 cc (5A.5, TBDY) = 0.00260287
  c = confinement factor = 1.06029
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.05456517
 2 = Asl,com/(b*d)*(fs2/fc) = 0.19015134
 v = Asl,mid/(b*d)*(fsv/fc) = 0.02645584
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.13804321
Mu = MRc (4.14) = 2.1740E+008
u =   su (4.1) = 1.0664224E-005

Calculation of ratio lb/ld

Inadequate Lap Length with lb/ld = 0.30

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

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 435646.093
```
------------------------------------------------------------------------
```
Calculation of Shear Strength at edge 1, Vr1 = 435646.093
Vr1 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 435646.093
   knl = 1 (zero step-static loading)
```
------------------------------------------------------------
```
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
```
------------------------------------------------------------
```
     λ = 1 (normal-weight concrete)
   fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   M/Vd = 4.00
      Mu = 44.9328
      Vu = 0.00069415
   d = 0.8*h = 480.00
   Nu = 6093.866
   Ag = 120000.00
   From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
   where:
   Vs1 = 139627.457 is calculated for section web, with:
      d = 160.00
      Av = 157079.633
      fy = 555.56
      s = 100.00
   Vs1 is multiplied by   Col1 = 1.00
      s/d = 0.625
   Vs2 = 418882.372 is calculated for section flange, with:
      d = 480.00
      Av = 157079.633
      fy = 555.56
      s = 100.00
   Vs2 is multiplied by   Col2 = 1.00
      s/d = 0.20833333
   Vf ((11-3)-(11.4), ACI 440) = 293495.545
      ψf = 0.95, for fully-wrapped sections
     wf/sf = 1 (FRP strips adjacent to one another).
   In (11.3) sin α + cos α is replaced with (cotθ +cota)sina which is more a generalised expression,
   where θ is the angle of the crack direction (see KANEPE).
   This later relation, considered as a function Vf(θ, α), is implemented for every different fiber orientation ai,
   as well as for 2 crack directions, θ=45° and θ=-45° to take into consideration the cyclic seismic loading.
   orientation 1: α1 = b1 + 90° = 90.00
   Vf = Min(|Vf(45, α1)|,|Vf(-45,a1)|), with:
   total thickness per orientation, tf1 = NL*t/NoDir = 1.016
   dfv = d (figure 11.2, ACI 440) = 557.00
   ffe ((11-5), ACI 440) = 259.312
      Ef = 64828.00
       εfe = 0.004, from (11.6a), ACI 440
        with εfu = 0.01
    From (11-11), ACI 440: Vs + Vf <= 366348.956
      bw = 200.00
```
------------------------------------------------------------
------------------------------------------------------------------
```
Calculation of Shear Strength at edge 2, Vr2 = 435646.093
Vr2 = VCol ((10.3), ASCE 41-17) = knl*VCol0
   VCol0 = 435646.093
   knl = 1 (zero step-static loading)
```
------------------------------------------------------------
```
NOTE: In expression (10-3) 'Vs' is replaced by 'Vs+ ψf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
```
------------------------------------------------------------
```
     λ = 1 (normal-weight concrete)
   fc' = 33.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
```

M/Vd = 4.00
   Mu = 44.60048
   Vu = 0.00069415
d = 0.8*h = 480.00
Nu = 6093.866
Ag = 120000.00
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 = 558509.829
where:
Vs1 = 139627.457 is calculated for section web, with:
  d = 160.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs1 is multiplied by  Col1 = 1.00
  s/d = 0.625
Vs2 = 418882.372 is calculated for section flange, with:
  d = 480.00
  Av = 157079.633
  fy = 555.56
  s = 100.00
Vs2 is multiplied by  Col2 = 1.00
  s/d = 0.20833333
Vf ((11-3)-(11.4), ACI 440) = 293495.545
  f = 0.95, for fully-wrapped sections
wf/sf = 1 (FRP strips adjacent to one another).
In (11.3) sin + cos is replaced with (cot +cota)sina which is more a generalised expression,
where is the angle of the crack direction (see KANEPE).
This later relation, considered as a function Vf( , ), is implemented for every different fiber orientation ai,
as well as for 2 crack directions, =45° and =-45° to take into consideration the cyclic seismic loading.
orientation 1:  1 = b1 + 90° = 90.00
Vf = Min(|Vf(45, 1)|,|Vf(-45,a1)|), with:
total thickness per orientation, tf1 = NL*t/NoDir = 1.016
dfv = d (figure 11.2, ACI 440) = 557.00
ffe ((11-5), ACI 440) = 259.312
  Ef = 64828.00
   fe = 0.004, from (11.6a), ACI 440
    with fu = 0.01
From (11-11), ACI 440: Vs + Vf <= 366348.956
  bw = 200.00
----------------------------------------------------------------
----------------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: column LC1 of floor 1
At local axis: 2


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


Start Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rclcs

Constant Properties
----------------------------------------------------------------
Knowledge Factor, = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
New material of Secondary Member: Concrete Strength, fc = fcm = 33.00
New material of Secondary Member: Steel Strength, fs = fsm = 555.56
Concrete Elasticity, Ec = 26999.444
Steel Elasticity, Es = 200000.00
Max Height, Hmax = 400.00
Min Height, Hmin = 200.00
Max Width, Wmax = 600.00
Min Width, Wmin = 200.00
Cover Thickness, c = 25.00

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

Stepwise Properties
------------------------------------------------------------
Bending Moment, M = 96939.725
Shear Force, V2 = 5181.087
Shear Force, V3 = -93.61987
Axial Force, F = -6416.475
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 0.00
      -Compression: Aslc = 4121.77
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 2890.265
      -Compression: Asl,com = 829.3805
        -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL = 18.18182
------------------------------------------------------------
------------------------------------------------------------


New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity  θu,R = 1.0* θu = 0.04312656
 θu = θy + θp = 0.04312656


------------------------------------------------------------
 - Calculation of θy -
------------------------------------------------------------
 θy = (My*Ls/3)/EIeff = 0.00112656 ((4.29),Biskinis Phd))
  My = 4.5016E+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 = 3.9959E+013
     factor = 0.30
        Ag = 160000.00
        fc' = 33.00
        N = 6416.475
     Ec*Ig = 1.3320E+014
------------------------------------------------------------
------------------------------------------------------------

Calculation of Yielding Moment My
------------------------------------------------------------
Calculation of θy and My according to Annex 7  -
------------------------------------------------------------
 θy = Min( θy_ten, θy_com)
 θy_ten = 4.9173110E-006
 with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 311.2112
     d = 557.00
     ξy = 0.43187711
     A = 0.03718481
     B = 0.02864896

with pt = 0.02594493
        pc = 0.00744507
        pv = 0.00360973
        N = 6416.475
        b = 200.00
        " = 0.07719928
  y_comp = 9.2350821E-006
 with fc* (12.3, (ACI 440)) = 33.28275
    fc = 33.00
    fl = 0.73070932
    b = bmax = 600.00
    h = hmax = 400.00
    Ag = 160000.00
        g = pt + pc + pv = 0.03699973
        rc = 40.00
        Ae/Ac = 0.27772029
        Effective FRP thickness, tf = NL*t*Cos(b1) = 1.016
    effective strain from (12.5) and (12.12), efe = 0.004
      fu = 0.01
    Ef = 64828.00
    Ec = 26999.444
      y = 0.43136109
    A = 0.03686994
    B = 0.02846388
    with Es = 200000.00
-----------------------------------------------------------
-----------------------------------------------------------

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


-----------------------------------------------------------
 - Calculation of  p -
-----------------------------------------------------------
From table 10-8:  p = 0.042
with:
 - Columns not controlled by inadequate development or splicing along the clear height because lb/ld >= 1
   shear control ratio VyE/VColOE = 1.00732
   d = 557.00
   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 = 6416.475
     Ag = 160000.00
     f'cE = 33.00
     fytE = fylE = 0.00
pl = Area_Tot_Long_Rein/(b*d) = 0.03699973
   b = 200.00
   d = 557.00
   f'cE = 33.00
-----------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: column LC1 of floor 1
At local axis: 3
Integration Section: (b)


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