Detailed Member Calculations

Units: N&mm

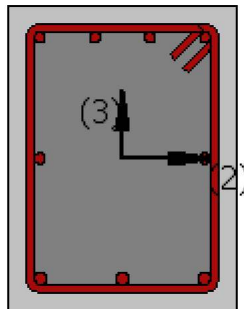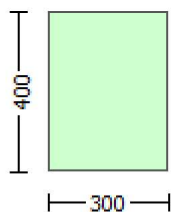**Regulation: ASCE 41-17**

Calculation No. 1

beam B1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)

Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 420.00
Concrete Elasticity, Ec = 23025.204

Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.1664849E-011
Shear Force, Va = 3.0430585E-014
EDGE -B-
Bending Moment, Mb = 6.7903689E-011
Shear Force, Vb = -3.0430585E-014
BOTH EDGES
Axial Force, F = -560.8745
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 603.1858
    -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 508.938
    -Compression: Asl,com = 508.938
        -Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.66667

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 140608.135
Vn ((22.5.1.1), ACI 318-14) = 140608.135

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 61440.00
       = 1 (normal-weight concrete)
    fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
       As (tension reinf.) = 603.1858
       bw = 400.00
       d = 240.00
    Vu*d/Mu < 1 = 0.00
       Mu = 1.1664849E-011
       Vu = 3.0430585E-014
  From (11.5.4.8), ACI 318-14: Vs = 79168.135
    Av = 157079.633
    fy = 420.00
    s = 150.00
  Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
    2(1-s/d) = 0.75
    Vf ((11-3)-(11.4), ACI 440) = 0.00
    From (11-11), ACI 440: Vs + Vf <= 255092.67

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)

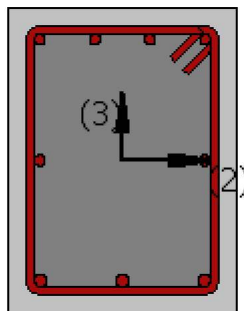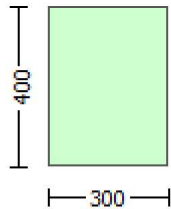
Calculation No. 2

beam B1, Floor 1

Limit State: Operational Level (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: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2740.265
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 603.1858
    -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 603.1858
    -Compression: Asl,com = 615.7522
       -Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.78793176
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 205990.317
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.8802E+008
  Mu1+ = 1.8495E+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- = 1.8802E+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-) = 1.8800E+008
  Mu2+ = 1.8498E+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- = 1.8800E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
  V1 = 2740.265, is the shear force acting at edge 1 for the the static loading combination
  V2 = 2740.264, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.0001071
Mu = 1.8495E+008
----
with full section properties:
  b = 300.00
  d = 357.00
  d' = 42.00
  v = 8.2121432E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00773686
       we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
            bi2 = 346400.00

```
        psh,min = Min(psh,x , psh,y) = 0.00261799
    ------------------------------------------------------------
        psh,x (5.4d) = 0.00349066
            Ash = Astir*ns = 78.53982
                No stirups, ns = 2.00
            bk = 300.00
    ------------------------------------------------------------
        psh,y (5.4d) = 0.00261799
            Ash = Astir*ns = 78.53982
                No stirups, ns = 2.00
            bk = 400.00
    ------------------------------------------------------------
          s = 150.00
        fywe = 656.25
        fce = 24.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00290026
          c = confinement factor = 1.09003
   y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
   y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
   yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15399964
```

```
      2 = Asl,com/(b*d)*(fs2/fc) = 0.15720797
      v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
   b = 240.00
   d = 327.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
      c  = confinement factor = 1.09003
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.21016006
      2 = Asl,com/(b*d)*(fs2/fc) = 0.21453839
      v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
 v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.1630814
Mu = MRc (4.14) = 1.8495E+008
   u =   su (4.1) = 0.0001071
------------------------------------------------------------

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

----------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 0.00010722
Mu = 1.8802E+008
----------------------------------------------------------------------
with full section properties:
   b = 300.00
   d = 358.00
   d' = 43.00
   v = 8.1892042E-005
      N = 211.0849
   fc = 24.00
    co (5A.5, TBDY) = 0.002
   Final value of   cu:   cu* = shear_factor * Max(  cu,  cc) = 0.00773686
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY:  cu = 0.00773686
         we (5.4c) = 0.01121936
          ase ((5.4d), TBDY) = 0.15672608
             bo = 240.00
             ho = 340.00
              bi2 = 346400.00
         psh,min = Min(psh,x , psh,y) = 0.00261799
      ----------------------------------------------------------------
         psh,x (5.4d) = 0.00349066
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 300.00
      ----------------------------------------------------------------
         psh,y (5.4d) = 0.00261799
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 400.00
      ----------------------------------------------------------------
            s = 150.00
          fywe = 656.25
          fce  = 24.00
```

From ((5.A5), TBDY), TBDY: cc = 0.00290026
     c = confinement factor = 1.09003
 y1 = 0.0025
 sh1 = 0.008
ft1 = 787.50
fy1 = 656.25
 su1 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs1 = fs = 656.25
   with Es1 = Es = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
 su2 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 1.00
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 656.25
   with Es2 = Es = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 787.50
fyv = 656.25
 suv = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 656.25
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.15676884
  2 = Asl,com/(b*d)*(fs2/fc) = 0.15356947
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
 b = 240.00
 d = 328.00
 d' = 13.00
 fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
    c = confinement factor = 1.09003
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.21388431
  2 = Asl,com/(b*d)*(fs2/fc) = 0.20951933
  v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->

v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16631328
Mu = MRc (4.14) = 1.8802E+008
 u =   su (4.1) = 0.00010722

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010701
Mu = 1.8498E+008
----
with full section properties:
  b = 300.00
  d = 358.00
  d' = 43.00
  v = 8.1892042E-005
     N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
      ase ((5.4d), TBDY) = 0.15672608
         bo = 240.00
         ho = 340.00
          bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
         Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
         bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
         Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
         bk = 400.00
      ----
          s = 150.00
        fywe = 656.25
        fce = 24.00
     From ((5.A5), TBDY), TBDY: cc = 0.00290026
         c = confinement factor = 1.09003
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs1 = fs = 656.25
  with Es1 = Es = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
 su2 = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 1.00
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 656.25
    with Es2 = Es = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 787.50
fyv = 656.25
 suv = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 656.25
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15356947
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15676884
   v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
  b = 240.00
  d = 328.00
  d' = 13.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
     c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.20951933
   2 = Asl,com/(b*d)*(fs2/fc) = 0.21388431
   v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16466458
Mu = MRc (4.14) = 1.8498E+008
 u =   su (4.1) = 0.00010701

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 0.00010732
Mu = 1.8800E+008
----
with full section properties:
  b = 300.00
  d = 357.00
  d' = 42.00
  v = 8.2121432E-005
    N = 211.0849
  fc = 24.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00773686
      αωe (5.4c) = 0.01121936
      αse ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
         bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      ----
        s = 150.00
        fywe = 656.25
        fce = 24.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00290026
        αc = confinement factor = 1.09003
  εy1 = 0.0025
  εsh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  εsu1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and εy1, εsh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     εy1, εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  εy2 = 0.0025
  εsh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  εsu2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
     εsu2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and εy2, εsh2,ft2,fy2, it is considered

characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^ 2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 656.25
     with Es2 = Es = 200000.00
   yv = 0.0025
   shv = 0.008
 ftv = 787.50
 fyv = 656.25
   suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^ 2/3), from 10.3.5, ASCE 41-17.
       with fsv = fs = 656.25
       with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.15720797
     2 = Asl,com/(b*d)*(fs2/fc) = 0.15399964
     v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
   b = 240.00
   d = 327.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
     cc (5A.5, TBDY) = 0.00290026
       c = confinement factor = 1.09003
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.21453839
     2 = Asl,com/(b*d)*(fs2/fc) = 0.21016006
     v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
   ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16474284
Mu = MRc (4.14) = 1.8800E+008
   u =   su (4.1) = 0.00010732

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 261431.672

Calculation of Shear Strength at edge 1, Vr1 = 261431.672
Vr1 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

   From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
       = 1 (normal-weight concrete)
     fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00628319
       As (tension reinf.) = 603.1858
       bw = 300.00
       d = 320.00
     Vu*d/Mu < 1 = 1.00

Mu = 30114.962
         Vu = 2740.265
   From (11.5.4.8), ACI 318-14: Vs = 175929.189
      Av = 157079.633
      fy = 525.00
      s = 150.00
   Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
    Vf ((11-3)-(11.4), ACI 440) = 0.00
    From (11-11), ACI 440: Vs + Vf <= 312423.44

Calculation of Shear Strength at edge 2, Vr2 = 261431.672
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

   From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
        = 1 (normal-weight concrete)
      fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00628319
         As (tension reinf.) = 603.1858
         bw = 300.00
         d = 320.00
      Vu*d/Mu < 1 = 1.00
         Mu = 30115.665
         Vu = 2740.264
   From (11.5.4.8), ACI 318-14: Vs = 175929.189
      Av = 157079.633
      fy = 525.00
      s = 150.00
   Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
    Vf ((11-3)-(11.4), ACI 440) = 0.00
    From (11-11), ACI 440: Vs + Vf <= 312423.44

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel

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

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -3.6870970E-015
EDGE -B-
Shear Force, Vb = 3.6870970E-015
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 603.1858
     -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 508.938
     -Compression: Asl,com = 508.938
         -Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.79211753
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 137993.601
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.2764E+008
   Mu1+ = 1.2764E+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- = 1.2764E+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-) = 1.2764E+008
   Mu2+ = 1.2764E+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- = 1.2764E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
   V1 = -3.6870970E-015, is the shear force acting at edge 1 for the the static loading combination
   V2 = 3.6870970E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
     N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00773686
       we (5.4c) = 0.01121936

ase ((5.4d), TBDY) = 0.15672608
               bo = 240.00
               ho = 340.00
                bi2 = 346400.00
          psh,min = Min(psh,x , psh,y) = 0.00261799
     ----
          psh,x (5.4d) = 0.00349066
             Ash = Astir*ns = 78.53982
                No stirups, ns = 2.00
             bk = 300.00
     ----
          psh,y (5.4d) = 0.00261799
             Ash = Astir*ns = 78.53982
                No stirups, ns = 2.00
             bk = 400.00
     ----
             s = 150.00
          fywe = 656.25
          fce = 24.00
       From ((5.A5), TBDY), TBDY: cc = 0.00290026
             c = confinement factor = 1.09003
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 1.00
         su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu1_nominal = 0.08,
       For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
       characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fs1 = fs = 656.25
         with Es1 = Es = 200000.00
   y2 = 0.0025
   sh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
   su2 = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/lb,min = 1.00
         su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu2_nominal = 0.08,
       For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
       characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fs2 = fs = 656.25
         with Es2 = Es = 200000.00
   yv = 0.0025
   shv = 0.008
  ftv = 787.50
  fyv = 656.25
   suv = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 1.00
         suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esuv_nominal = 0.08,
       considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
       For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
       characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 656.25
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
  v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
    c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
   2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
   v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
 u = su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
   N = 211.0849
  fc = 24.00
  co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00773686
    we (5.4c) = 0.01121936
    ase ((5.4d), TBDY) = 0.15672608
     bo = 240.00
     ho = 340.00
      bi2 = 346400.00
    psh,min = Min(psh,x , psh,y) = 0.00261799
   ----
    psh,x (5.4d) = 0.00349066
     Ash = Astir*ns = 78.53982
      No stirups, ns = 2.00
     bk = 300.00
   ----
    psh,y (5.4d) = 0.00261799
     Ash = Astir*ns = 78.53982
      No stirups, ns = 2.00
     bk = 400.00

```
                ------------------------------------------------------------------
            s = 150.00
         fywe = 656.25
          fce = 24.00
      From ((5.A5), TBDY), TBDY:   cc = 0.00290026
           c = confinement factor = 1.09003
     y1 = 0.0025
    sh1 = 0.008
   ft1 = 787.50
   fy1 = 656.25
    su1 = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 1.00
         su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu1_nominal = 0.08,
       For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
       characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fs1 = fs = 656.25
         with Es1 = Es = 200000.00
     y2 = 0.0025
    sh2 = 0.008
   ft2 = 787.50
   fy2 = 656.25
    su2 = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/lb,min = 1.00
         su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu2_nominal = 0.08,
       For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
       characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fs2 = fs = 656.25
         with Es2 = Es = 200000.00
     yv = 0.0025
    shv = 0.008
   ftv = 787.50
   fyv = 656.25
    suv = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 1.00
         suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esuv_nominal = 0.08,
       considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
       For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
       characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fsv = fs = 656.25
         with Esv = Es = 200000.00
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
      2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
      v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
 and confined core properties:
    b = 340.00
    d = 228.00
    d' = 12.00
    fcc (5A.2, TBDY) = 26.16063
     cc (5A.5, TBDY) = 0.00290026
         c = confinement factor = 1.09003
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
      2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
```

v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00773686
       we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
       psh,min = Min(psh,x , psh,y) = 0.00261799
       ----
       psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 300.00
       ----
       psh,y (5.4d) = 0.00261799
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 400.00
       ----
          s = 150.00
        fywe = 656.25
        fce = 24.00
      From ((5.A5), TBDY), TBDY: cc = 0.00290026
          c = confinement factor = 1.09003
    y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00

su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 656.25
    with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
fy2 = 656.25
 su2 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 1.00
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 656.25
   with Es2 = Es = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 787.50
fyv = 656.25
 suv = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 656.25
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
 2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
 v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
 b = 340.00
 d = 228.00
 d' = 12.00
 fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
   c = confinement factor = 1.09003
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
  2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
  v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
 u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00773686
      ωwe (5.4c) = 0.01121936
       αse ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00261799

      ρsh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
        bk = 300.00

      ρsh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
        bk = 400.00
      ----
         s = 150.00
        fywe = 656.25
        fce = 24.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00290026
        λc = confinement factor = 1.09003
  εy1 = 0.0025
  εsh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
  εsu1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and εy1, εsh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     εy1, εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  εy2 = 0.0025
  εsh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
  εsu2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00

```
      lo/lou,min = lb/lb,min = 1.00
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^ 2/3), from 10.3.5, ASCE 41-17.
        with fs2 = fs = 656.25
        with Es2 = Es = 200000.00
    yv = 0.0025
   shv = 0.008
  ftv = 787.50
  fyv = 656.25
    suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^ 2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
    v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
      c  = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =    su (4.1) = 0.00015613
-------------------------------------------------------------

Calculation of ratio lb/ld
-------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 174208.493
-----------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 174208.493
Vr1 = Vn ((22.5.1.1), ACI 318-14)
-------------------------------------------------------------
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------------
   From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
       = 1 (normal-weight concrete)
      fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00628319
```

As (tension reinf.) = 603.1858
　　　bw = 400.00
　　　d = 240.00
　　Vu*d/Mu < 1 = 0.00
　　　Mu = 7.6252677E-012
　　　Vu = 3.6870970E-015
　From (11.5.4.8), ACI 318-14: Vs = 98960.169
　　Av = 157079.633
　　fy = 525.00
　　s = 150.00
　Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
　2(1-s/d) = 0.75
　Vf ((11-3)-(11.4), ACI 440) = 0.00
　From (11-11), ACI 440: Vs + Vf <= 312423.44

Calculation of Shear Strength at edge 2, Vr2 = 174208.493
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+　f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

　From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
　　　= 1 (normal-weight concrete)
　　fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
　　pw = As/(bw*d) = 0.00628319
　　　As (tension reinf.) = 603.1858
　　　bw = 400.00
　　　d = 240.00
　　Vu*d/Mu < 1 = 0.00
　　　Mu = 8.0393416E-013
　　　Vu = 3.6870970E-015
　From (11.5.4.8), ACI 318-14: Vs = 98960.169
　　Av = 157079.633
　　fy = 525.00
　　s = 150.00
　Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
　2(1-s/d) = 0.75
　Vf ((11-3)-(11.4), ACI 440) = 0.00
　From (11-11), ACI 440: Vs + Vf <= 312423.44

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcars

Constant Properties

Knowledge Factor,　 = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars

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

Stepwise Properties

Bending Moment, M = 5.4177E+006
Shear Force, V2 = 3.0430585E-014
Shear Force, V3 = -3205.137
Axial Force, F = -560.8745
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 603.1858
     -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 603.1858
     -Compression: Asl,com = 615.7522
         -Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL = 16.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = * θu = 0.01103074
 θu = θy + θp = 0.01103074

 - Calculation of θy -

 θy = (My*Ls/3)/Eleff = 0.00603074 ((4.29),Biskinis Phd))
  My = 1.1830E+008
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 1690.313
  From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 1.1052E+013

Calculation of Yielding Moment My

Calculation of θy and My according to Annex 7 -

 θy = Min(θy_ten, θy_com)
  θy_ten = 1.0034997E-005
 with fy = 525.00
     d = 357.00
      ξy = 0.2672702
     A = 0.01426594
     B = 0.00792478
      with pt = 0.00563199
         pc = 0.00574932
         pv = 0.00287466
         N = 560.8745
         b = 300.00
          " = 0.11764706
  θy_comp = 1.9669384E-005
 with fc = 24.00
     Ec = 23025.204
      ξy = 0.26719068
     A = 0.01424201
     B = 0.00791481
      with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of p -

From table 10-7: p = 0.005
with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1
   shear control ratio Vp/Vo = 0.78793176
 - Transverse Reinforcement: NC
 - Stirrup Spacing > d/3
 - Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
       = 5.9520362E-005
 - Stirrup Spacing <= d/2
   d = 357.00
   s = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
   Vs = 175929.189,already given in calculation of shear control ratio
   design Shear = 3205.137
 - (- ')/ bal = -0.16985254
     = Aslt/(bw*d) = 0.00563199
    Tension Reinf Area: Aslt = 603.1858
    ' = Aslc/(bw*d) = 0.00862398
    Compression Reinf Area: Aslc = 923.6282
  From (B-1), ACI 318-11: bal = 0.01761524
    fc = 24.00
    fy = 525.00
    From 10.2.7.3, ACI 318-11: 1 = 0.85
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.53333333
       y = 0.002625
 - V/(bw*d*fc^0.5) = 0.0735656, NOTE: units in lb & in
    bw = 300.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)

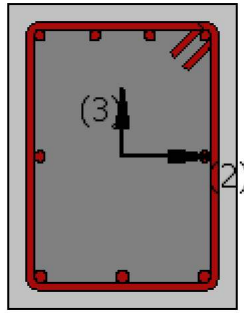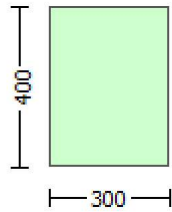
Calculation No. 3

beam B1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)

Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 420.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 5.4177E+006
Shear Force, Va = -3205.137
EDGE -B-
Bending Moment, Mb = 5.5813E+006
Shear Force, Vb = 8685.666
BOTH EDGES
Axial Force, F = -560.8745
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 603.1858
     -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 603.1858
      -Compression: Asl,com = 615.7522
        -Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL,ten = 16.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 204124.607
Vn ((22.5.1.1), ACI 318-14) = 204124.607

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ φf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 63381.256
       λ = 1 (normal-weight concrete)
     fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00628319
        As (tension reinf.) = 603.1858
        bw = 300.00
        d = 320.00
     Vu*d/Mu < 1 = 0.18931407
        Mu = 5.4177E+006
        Vu = 3205.137
  From (11.5.4.8), ACI 318-14: Vs = 140743.351
     Av = 157079.633
     fy = 420.00
     s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 255092.67

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)

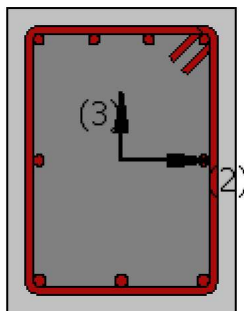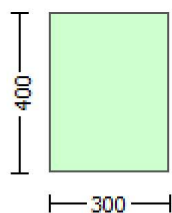## Calculation No. 4

beam B1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (3)

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)

Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2740.265
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 603.1858
    -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 603.1858
    -Compression: Asl,com = 615.7522
      -Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.78793176
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 205990.317
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.8802E+008
   Mu1+ = 1.8495E+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- = 1.8802E+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-) = 1.8800E+008
   Mu2+ = 1.8498E+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- = 1.8800E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with

V1 = 2740.265, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 0.0001071
Mu = 1.8495E+008
----
with full section properties:
  b = 300.00
  d = 357.00
  d' = 42.00
  ν = 8.2121432E-005
     N = 211.0849
  fc = 24.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.00773686
        ωwe (5.4c) = 0.01121936
        αase ((5.4d), TBDY) = 0.15672608
           bo = 240.00
           ho = 340.00
            bi2 = 346400.00
        ρsh,min = Min(ρsh,x , ρsh,y) = 0.00261799

        ρsh,x (5.4d) = 0.00349066
           Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
           bk = 300.00

        ρsh,y (5.4d) = 0.00261799
           Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
           bk = 400.00
        ----
           s = 150.00
        fywe = 656.25
        fce = 24.00
     From ((5.A5), TBDY), TBDY: εcc = 0.00290026
        αc = confinement factor = 1.09003
   εy1 = 0.0025
   εsh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   εsu1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and εy1, εsh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      εy1, εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs1 = fs = 656.25
        with Es1 = Es = 200000.00
   εy2 = 0.0025
   εsh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
   εsu2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 1.00
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 656.25
     with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 656.25
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15399964
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15720797
   v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
  b = 240.00
  d = 327.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.21016006
   2 = Asl,com/(b*d)*(fs2/fc) = 0.21453839
   v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.1630814
Mu = MRc (4.14) = 1.8495E+008
 u =   su (4.1) = 0.0001071

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010722
Mu = 1.8802E+008
----
with full section properties:
  b = 300.00
  d = 358.00

d' = 43.00
v = 8.1892042E-005
  N = 211.0849
fc = 24.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00773686
     we (5.4c) = 0.01121936
      ase ((5.4d), TBDY) = 0.15672608
         bo = 240.00
         ho = 340.00
          bi2 = 346400.00
     psh,min = Min(psh,x , psh,y) = 0.00261799
   ----
     psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
        bk = 300.00
   ----
     psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
        bk = 400.00
   ----
        s = 150.00
        fywe = 656.25
        fce = 24.00
    From ((5.A5), TBDY), TBDY: cc = 0.00290026
        c = confinement factor = 1.09003
 y1 = 0.0025
 sh1 = 0.008
ft1 = 787.50
fy1 = 656.25
 su1 = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 656.25
     with Es1 = Es = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
 su2 = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 1.00
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 656.25
     with Es2 = Es = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 787.50
fyv = 656.25
 suv = 0.032

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 656.25
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.15676884
2 = Asl,com/(b*d)*(fs2/fc) = 0.15356947
v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
 b = 240.00
 d = 328.00
 d' = 13.00
 fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
    c = confinement factor = 1.09003
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.21388431
  2 = Asl,com/(b*d)*(fs2/fc) = 0.20951933
  v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16631328
Mu = MRc (4.14) = 1.8802E+008
 u = su (4.1) = 0.00010722

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 0.00010701
Mu = 1.8498E+008
----
with full section properties:
 b = 300.00
 d = 358.00
 d' = 43.00
 v = 8.1892042E-005
   N = 211.0849
 fc = 24.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00773686
    we (5.4c) = 0.01121936
     ase ((5.4d), TBDY) = 0.15672608
       bo = 240.00
       ho = 340.00
        bi2 = 346400.00
    psh,min = Min(psh,x , psh,y) = 0.00261799

```
        psh,x (5.4d) = 0.00349066
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 300.00
        ----------------------------------------------------------------
          psh,y (5.4d) = 0.00261799
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 400.00
        ----------------------------------------------------------------
            s = 150.00
          fywe = 656.25
          fce  = 24.00
       From ((5.A5), TBDY), TBDY:   cc = 0.00290026
            c  = confinement factor = 1.09003
   y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
   y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
   yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15356947
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15676884
   v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
```

and confined core properties:
  b = 240.00
  d = 328.00
  d' = 13.00
  fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.20951933
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21388431
    v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.16466458
Mu = MRc (4.14) = 1.8498E+008
  u =   su (4.1) = 0.00010701

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010732
Mu = 1.8800E+008
----
with full section properties:
  b = 300.00
  d = 357.00
  d' = 42.00
  v = 8.2121432E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00773686
       we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
       psh,min = Min(psh,x , psh,y) = 0.00261799
       ----
       psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
          bk = 300.00
       ----
       psh,y (5.4d) = 0.00261799
          Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
          bk = 400.00
       ----
          s = 150.00
        fywe = 656.25
        fce = 24.00
      From ((5.A5), TBDY), TBDY: cc = 0.00290026
        c = confinement factor = 1.09003

y1 = 0.0025
sh1 = 0.008
ft1 = 787.50
fy1 = 656.25
su1 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  $l_o/l_{ou,min}$ = lb/ld = 1.00
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs1 = fs = 656.25
  with Es1 = Es = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
su2 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  $l_o/l_{ou,min}$ = lb/lb,min = 1.00
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 656.25
  with Es2 = Es = 200000.00
yv = 0.0025
shv = 0.008
ftv = 787.50
fyv = 656.25
suv = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  $l_o/l_{ou,min}$ = lb/ld = 1.00
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 656.25
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.15720797
2 = Asl,com/(b*d)*(fs2/fc) = 0.15399964
v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 26.16063
cc (5A.5, TBDY) = 0.00290026
  c = confinement factor = 1.09003
1 = Asl,ten/(b*d)*(fs1/fc) = 0.21453839
2 = Asl,com/(b*d)*(fs2/fc) = 0.21016006
v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->

```
  su (4.9) = 0.16474284
Mu = MRc (4.14) = 1.8800E+008
  u =   su (4.1) = 0.00010732
------------------------------------------------------------


Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 261431.672
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 261431.672
Vr1 = Vn ((22.5.1.1), ACI 318-14)
------------------------------------------------------------
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
------------------------------------------------------------
  From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
       = 1 (normal-weight concrete)
     fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00628319
        As (tension reinf.) = 603.1858
        bw = 300.00
        d = 320.00
     Vu*d/Mu < 1 = 1.00
        Mu = 30114.962
        Vu = 2740.265
  From (11.5.4.8), ACI 318-14: Vs = 175929.189
     Av = 157079.633
     fy = 525.00
     s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44
---------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 261431.672
Vr2 = Vn ((22.5.1.1), ACI 318-14)
-------------------------------------------------------------
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-------------------------------------------------------------
  From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
       = 1 (normal-weight concrete)
     fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00628319
        As (tension reinf.) = 603.1858
        bw = 300.00
        d = 320.00
     Vu*d/Mu < 1 = 1.00
        Mu = 30115.665
        Vu = 2740.264
  From (11.5.4.8), ACI 318-14: Vs = 175929.189
     Av = 157079.633
     fy = 525.00
     s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44
-------------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3


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

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -3.6870970E-015
EDGE -B-
Shear Force, Vb = 3.6870970E-015
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 603.1858
     -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 508.938
     -Compression: Asl,com = 508.938
         -Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.79211753
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 137993.601
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.2764E+008
   Mu1+ = 1.2764E+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- = 1.2764E+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-) = 1.2764E+008
   Mu2+ = 1.2764E+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- = 1.2764E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment

direction which is defined for the the static loading combination
and
$\pm w_u \cdot l_n = (|V_1| + |V_2|)/2$
with
  V_1 = -3.6870970E-015, is the shear force acting at edge 1 for the the static loading combination
  V_2 = 3.6870970E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature ϕ_u according to 4.1, Biskinis/Fardis 2013:
  ϕ_u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   ε_{co} (5A.5, TBDY) = 0.002
  Final value of ε_{cu}: ε_{cu}^* = shear_factor * Max(ε_{cu}, ε_{cc}) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: ε_{cu} = 0.00773686
      ω_{we} (5.4c) = 0.01121936
       a_{se} ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      ----
         s = 150.00
        fywe = 656.25
        fce = 24.00
    From ((5.A5), TBDY), TBDY: ε_{cc} = 0.00290026
        ε_c = confinement factor = 1.09003
  ε_{y1} = 0.0025
  ε_{sh1} = 0.008
  ft1 = 787.50
  fy1 = 656.25
  ε_{su1} = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     ε_{su1} = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and ε_{y1}, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     ε_{y1}, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  ε_{y2} = 0.0025
  ε_{sh2} = 0.008

ft2 = 787.50
    fy2 = 656.25
     su2 = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/lb,min = 1.00
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu2_nominal = 0.08,
       For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
       characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs2 = fs = 656.25
        with Es2 = Es = 200000.00
     yv = 0.0025
     shv = 0.008
    ftv = 787.50
    fyv = 656.25
     suv = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 1.00
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esuv_nominal = 0.08,
       considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
       For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
       characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fsv = fs = 656.25
        with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
     2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
     v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
   b = 340.00
   d = 228.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
     2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
     v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008

----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00773686
        we (5.4c) = 0.01121936
         ase ((5.4d), TBDY) = 0.15672608
            bo = 240.00
            ho = 340.00
             bi2 = 346400.00
         psh,min = Min(psh,x , psh,y) = 0.00261799
         ----
         psh,x (5.4d) = 0.00349066
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 300.00
         ----
         psh,y (5.4d) = 0.00261799
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 400.00
         ----
            s = 150.00
           fywe = 656.25
           fce = 24.00
     From ((5.A5), TBDY), TBDY: cc = 0.00290026
           c = confinement factor = 1.09003
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 656.25
       with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 656.25
       with Es2 = Es = 200000.00
  yv = 0.0025

shv = 0.008
ftv = 787.50
fyv = 656.25
 suv = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 656.25
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
  v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
     c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
   2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
   v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
       ase ((5.4d), TBDY) = 0.15672608
         bo = 240.00

```
                ho = 340.00
                  bi2 = 346400.00
            psh,min = Min(psh,x , psh,y) = 0.00261799
      ------------------------------------------------------------------
            psh,x (5.4d) = 0.00349066
                Ash = Astir*ns = 78.53982
                    No stirups, ns = 2.00
                bk = 300.00
      ------------------------------------------------------------------
            psh,y (5.4d) = 0.00261799
                Ash = Astir*ns = 78.53982
                    No stirups, ns = 2.00
                bk = 400.00
      ------------------------------------------------------------------
                s = 150.00
              fywe = 656.25
              fce  = 24.00
          From ((5.A5), TBDY), TBDY:  cc = 0.00290026
              c  = confinement factor = 1.09003
    y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
        su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs1 = fs = 656.25
        with Es1 = Es = 200000.00
    y2 = 0.0025
   sh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
   su2 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 1.00
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs2 = fs = 656.25
        with Es2 = Es = 200000.00
    yv = 0.0025
   shv = 0.008
  ftv = 787.50
  fyv = 656.25
   suv = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fsv = fs = 656.25
```

with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
 2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
 v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
 v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
       ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
     psh,min = Min(psh,x , psh,y) = 0.00261799
     ----
     psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
        bk = 300.00
     ----
     psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
        bk = 400.00
     ----
           s = 150.00

```
        fywe = 656.25
        fce  = 24.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00290026
        c  = confinement factor = 1.09003
  y1 = 0.0025
  sh1 = 0.008
ft1 = 787.50
fy1 = 656.25
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
ftv = 787.50
fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
  v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
      c  = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
```

' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
 u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 174208.493

Calculation of Shear Strength at edge 1, Vr1 = 174208.493
Vr1 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
       = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
       As (tension reinf.) = 603.1858
       bw = 400.00
       d = 240.00
    Vu*d/Mu < 1 = 0.00
       Mu = 7.6252677E-012
       Vu = 3.6870970E-015
  From (11.5.4.8), ACI 318-14: Vs = 98960.169
     Av = 157079.633
     fy = 525.00
     s = 150.00
  Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.75
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44

Calculation of Shear Strength at edge 2, Vr2 = 174208.493
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
       = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
       As (tension reinf.) = 603.1858
       bw = 400.00
       d = 240.00
    Vu*d/Mu < 1 = 0.00
       Mu = 8.0393416E-013
       Vu = 3.6870970E-015
  From (11.5.4.8), ACI 318-14: Vs = 98960.169
     Av = 157079.633
     fy = 525.00
     s = 150.00
  Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.75
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Bending Moment, M = -1.1664849E-011
Shear Force, V2 = 3.0430585E-014
Shear Force, V3 = -3205.137
Axial Force, F = -560.8745
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 603.1858
    -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 508.938
    -Compression: Asl,com = 508.938
       -Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.66667

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R =   * u = 0.00904335
  u =   y +   p = 0.00904335

 - Calculation of   y -
----
  y = (My*Ls/3)/Eleff = 0.00404335 ((4.29),Biskinis Phd))
  My = 8.1525E+007
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 925.00
  From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 6.2168E+012

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
  y = Min(y_ten, y_com)
  y_ten = 1.4111768E-005
 with fy = 525.00
    d = 258.00
     y = 0.27901178
    A = 0.01480506
    B = 0.00861193
    with pt = 0.00493157
        pc = 0.00493157
        pv = 0.00493157
        N = 560.8745
        b = 400.00
        " = 0.1627907
  y_comp = 2.6070636E-005
 with fc = 24.00
    Ec = 23025.204
     y = 0.2789388
    A = 0.01478023
    B = 0.00860158
    with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of p -

From table 10-7: p = 0.005
with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1
   shear control ratio Vp/Vo = 0.79211753
 - Transverse Reinforcement: NC
 - Stirrup Spacing > d/3
 - Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
       = -2.5453052E-021
 - Stirrup Spacing > d/2
  d = 258.00
  s = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
  Vs = 131946.891,already given in calculation of shear control ratio
  design Shear = 3.0430585E-014
 - (- ')/ bal = -0.17627139
     = Aslt/(bw*d) = 0.00584482
    Tension Reinf Area: Aslt = 603.1858
    ' = Aslc/(bw*d) = 0.00894989
    Compression Reinf Area: Aslc = 923.6282
  From (B-1), ACI 318-11: bal = 0.01761524
    fc = 24.00
    fy = 525.00
    From 10.2.7.3, ACI 318-11: 1 = 0.85
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.53333333
        y = 0.002625
 - V/(bw*d*fc^0.5) = 7.2485011E-019, NOTE: units in lb & in
    bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)

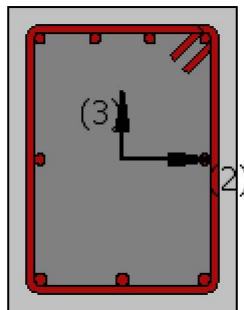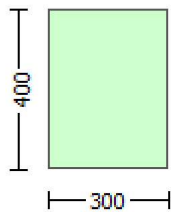
Calculation No. 5

beam B1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)

Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 420.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.1664849E-011
Shear Force, Va = 3.0430585E-014
EDGE -B-
Bending Moment, Mb = 6.7903689E-011
Shear Force, Vb = -3.0430585E-014
BOTH EDGES
Axial Force, F = -560.8745
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 615.7522
    -Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 508.938
    -Compression: Asl,com = 508.938
       -Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.66667

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 140608.135
Vn ((22.5.1.1), ACI 318-14) = 140608.135

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 61440.00
      = 1 (normal-weight concrete)
    fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00641409
       As (tension reinf.) = 615.7522
       bw = 400.00
       d = 240.00
    Vu*d/Mu < 1 = 0.00
       Mu = 6.7903689E-011
       Vu = 3.0430585E-014
  From (11.5.4.8), ACI 318-14: Vs = 79168.135
     Av = 157079.633
     fy = 420.00
     s = 150.00
  Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.75
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 255092.67

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 6
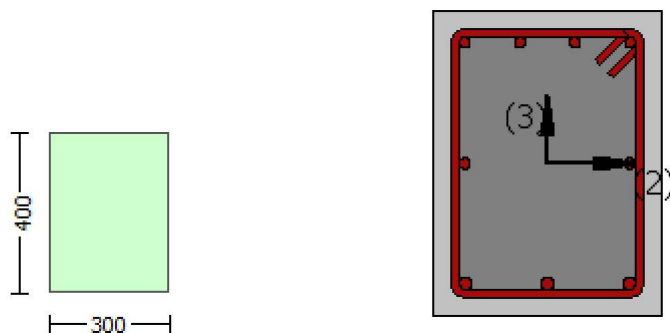
beam B1, Floor 1

Limit State: Operational Level (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: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2740.265
EDGE -B-

Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 603.1858
   -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 603.1858
   -Compression: Asl,com = 615.7522
      -Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.78793176
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 205990.317
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.8802E+008
  Mu1+ = 1.8495E+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- = 1.8802E+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-) = 1.8800E+008
  Mu2+ = 1.8498E+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- = 1.8800E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
  V1 = 2740.265, is the shear force acting at edge 1 for the the static loading combination
  V2 = 2740.264, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 0.0001071
Mu = 1.8495E+008
----
with full section properties:
  b = 300.00
  d = 357.00
  d' = 42.00
  v = 8.2121432E-005
     N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00773686
        we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
           bo = 240.00
           ho = 340.00
            bi2 = 346400.00
        psh,min = Min(psh,x , psh,y) = 0.00261799
        ----
        psh,x (5.4d) = 0.00349066
           Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
           bk = 300.00
        ----
        psh,y (5.4d) = 0.00261799

```
            Ash = Astir*ns = 78.53982
                No stirups, ns = 2.00
            bk = 400.00

        ----------------------------------------------------------------
            s = 150.00
          fywe = 656.25
          fce = 24.00
      From ((5.A5), TBDY):  cc = 0.00290026
          c  = confinement factor = 1.09003
    y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
        su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs1 = fs = 656.25
        with Es1 = Es = 200000.00
    y2 = 0.0025
   sh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
   su2 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 1.00
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs2 = fs = 656.25
        with Es2 = Es = 200000.00
    yv = 0.0025
   shv = 0.008
  ftv = 787.50
  fyv = 656.25
   suv = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fsv = fs = 656.25
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.15399964
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15720797
    v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
 and confined core properties:
   b = 240.00
   d = 327.00
   d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
```

```
      c  = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.21016006
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21453839
    v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.1630814
Mu = MRc (4.14) = 1.8495E+008
  u =    su (4.1) = 0.0001071
-----------------------------------------------------------

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

-----------------------------------------------------------------------
Calculation of ultimate curvature    u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010722
Mu = 1.8802E+008
-----------------------------------------------------------------------
with full section properties:
  b = 300.00
  d = 358.00
  d' = 43.00
  v = 8.1892042E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:  cu* = shear_factor * Max( cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.00773686
      we (5.4c) = 0.01121936
       ase ((5.4d), TBDY) = 0.15672608
         bo = 240.00
         ho = 340.00
          bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      -------------------------------------------------------------------
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      -------------------------------------------------------------------
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      -------------------------------------------------------------------
          s = 150.00
        fywe = 656.25
        fce  = 24.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00290026
          c = confinement factor = 1.09003
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
```

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 656.25
with Es1 = Es = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
su2 = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 656.25
with Es2 = Es = 200000.00
yv = 0.0025
shv = 0.008
ftv = 787.50
fyv = 656.25
suv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 656.25
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.15676884
2 = Asl,com/(b*d)*(fs2/fc) = 0.15356947
v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
b = 240.00
d = 328.00
d' = 13.00
fcc (5A.2, TBDY) = 26.16063
cc (5A.5, TBDY) = 0.00290026
c = confinement factor = 1.09003
1 = Asl,ten/(b*d)*(fs1/fc) = 0.21388431
2 = Asl,com/(b*d)*(fs2/fc) = 0.20951933
v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.16631328
Mu = MRc (4.14) = 1.8802E+008
u =   su (4.1) = 0.00010722

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 0.00010701
Mu = 1.8498E+008
----
with full section properties:
  b = 300.00
  d = 358.00
  d' = 43.00
  v = 8.1892042E-005
    N = 211.0849
  fc = 24.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00773686
      ωwe (5.4c) = 0.01121936
      αase ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
         bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      ----
        s = 150.00
      fywe = 656.25
      fce = 24.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00290026
        αc = confinement factor = 1.09003
  εy1 = 0.0025
  εsh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  εsu1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
    εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and εy1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    εy1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  εy2 = 0.0025
  εsh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  εsu2 = 0.032

53

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 656.25
    with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
ftv = 787.50
fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.15356947
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15676884
    v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
  b = 240.00
  d = 328.00
  d' = 13.00
  fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.20951933
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21388431
    v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16466458
Mu = MRc (4.14) = 1.8498E+008
  u =   su (4.1) = 0.00010701

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010732
Mu = 1.8800E+008
----
with full section properties:
  b = 300.00

d = 357.00
d' = 42.00
v = 8.2121432E-005
  N = 211.0849
fc = 24.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00773686
     we (5.4c) = 0.01121936
      ase ((5.4d), TBDY) = 0.15672608
         bo = 240.00
         ho = 340.00
          bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
   ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
   ----
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
   ----
        s = 150.00
      fywe = 656.25
      fce = 24.00
   From ((5.A5), TBDY), TBDY: cc = 0.00290026
        c = confinement factor = 1.09003
 y1 = 0.0025
 sh1 = 0.008
ft1 = 787.50
fy1 = 656.25
 su1 = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 656.25
     with Es1 = Es = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
 su2 = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 1.00
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 656.25
     with Es2 = Es = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 787.50
fyv = 656.25

suv = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 656.25
   with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.15720797
 2 = Asl,com/(b*d)*(fs2/fc) = 0.15399964
 v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
 b = 240.00
 d = 327.00
 d' = 12.00
 fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
   c = confinement factor = 1.09003
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.21453839
 2 = Asl,com/(b*d)*(fs2/fc) = 0.21016006
 v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16474284
Mu = MRc (4.14) = 1.8800E+008
 u = su (4.1) = 0.00010732

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 261431.672

Calculation of Shear Strength at edge 1, Vr1 = 261431.672
Vr1 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

 From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
    = 1 (normal-weight concrete)
  fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
  pw = As/(bw*d) = 0.00628319
   As (tension reinf.) = 603.1858
   bw = 300.00
   d = 320.00
  Vu*d/Mu < 1 = 1.00
   Mu = 30114.962
   Vu = 2740.265
 From (11.5.4.8), ACI 318-14: Vs = 175929.189
  Av = 157079.633
  fy = 525.00
  s = 150.00
 Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
 Vf ((11-3)-(11.4), ACI 440) = 0.00

From (11-11), ACI 440: Vs + Vf <= 312423.44

Calculation of Shear Strength at edge 2, Vr2 = 261431.672
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
      = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
      As (tension reinf.) = 603.1858
      bw = 300.00
      d = 320.00
    Vu*d/Mu < 1 = 1.00
      Mu = 30115.665
      Vu = 2740.264
  From (11.5.4.8), ACI 318-14: Vs = 175929.189
    Av = 157079.633
    fy = 525.00
    s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 312423.44

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -3.6870970E-015
EDGE -B-
Shear Force, Vb = 3.6870970E-015
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 603.1858
  -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 508.938
  -Compression: Asl,com = 508.938
    -Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.79211753
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 137993.601
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.2764E+008
  Mu1+ = 1.2764E+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- = 1.2764E+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-) = 1.2764E+008
  Mu2+ = 1.2764E+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- = 1.2764E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
  V1 = -3.6870970E-015, is the shear force acting at edge 1 for the the static loading combination
  V2 = 3.6870970E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
      ase ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
         bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982

```
          No stirups, ns = 2.00
        bk = 300.00
   ------------------------------------------------------------------
      psh,y (5.4d) = 0.00261799
         Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
         bk = 400.00
   ------------------------------------------------------------------
           s = 150.00
        fywe = 656.25
        fce = 24.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00290026
         c = confinement factor = 1.09003
   y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
   y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
   yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
     2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
     v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
```

```
    d = 228.00
    d' = 12.00
    fcc (5A.2, TBDY) = 26.16063
     cc (5A.5, TBDY) = 0.00290026
        c = confinement factor = 1.09003
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
      2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
      v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613
------------------------------------------------------------
```

Calculation of ratio lb/ld

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

Adequate Lap Length: lb/ld >= 1

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

Calculation of Mu1-

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

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

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
```
  u = 0.00015613
Mu = 1.2764E+008
------------------------------------------------------------------------
```

with full section properties:
```
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.00773686
        we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
           bo = 240.00
           ho = 340.00
            bi2 = 346400.00
       psh,min = Min(psh,x , psh,y) = 0.00261799
     ----------------------------------------------------------------
       psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
          bk = 300.00
     ----------------------------------------------------------------
       psh,y (5.4d) = 0.00261799
          Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
          bk = 400.00
     ----------------------------------------------------------------
          s = 150.00
        fywe = 656.25
        fce = 24.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00290026
         c = confinement factor = 1.09003
  y1 = 0.0025
  sh1 = 0.008
```

ft1 = 787.50
fy1 = 656.25
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 656.25
     with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 656.25
     with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 656.25
     with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
    v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008

u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
     N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00773686
        we (5.4c) = 0.01121936
         ase ((5.4d), TBDY) = 0.15672608
            bo = 240.00
            ho = 340.00
             bi2 = 346400.00
        psh,min = Min(psh,x , psh,y) = 0.00261799
        ----
        psh,x (5.4d) = 0.00349066
           Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
           bk = 300.00
        ----
        psh,y (5.4d) = 0.00261799
           Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
           bk = 400.00
        ----
           s = 150.00
          fywe = 656.25
          fce = 24.00
        From ((5.A5), TBDY), TBDY: cc = 0.00290026
           c = confinement factor = 1.09003
    y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 656.25
       with Es1 = Es = 200000.00
    y2 = 0.0025

```
    sh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
    su2 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 1.00
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs2 = fs = 656.25
        with Es2 = Es = 200000.00
    yv = 0.0025
    shv = 0.008
  ftv = 787.50
  fyv = 656.25
    suv = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fsv = fs = 656.25
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
    v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
      c  = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =    su (4.1) = 0.00015613
----------------------------------------------------------

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

------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
```

Mu = 1.2764E+008

----

with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
    co (5A.5, TBDY) = 0.002
  Final value of   cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
            bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      ----
        s = 150.00
        fywe = 656.25
        fce = 24.00
    From ((5.A5), TBDY), TBDY: cc = 0.00290026
        c = confinement factor = 1.09003
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00

```
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 656.25
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
   2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
   v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
 fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
     c  = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
   2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
   v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
 u =   su (4.1) = 0.00015613
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 174208.493
----------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 174208.493
Vr1 = Vn ((22.5.1.1), ACI 318-14)
-----------------------------------------------------------------
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-----------------------------------------------------------------
  From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
       = 1 (normal-weight concrete)
     fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00628319
       As (tension reinf.) = 603.1858
       bw = 400.00
       d = 240.00
     Vu*d/Mu < 1 = 0.00
       Mu = 7.6252677E-012
       Vu = 3.6870970E-015
  From (11.5.4.8), ACI 318-14: Vs = 98960.169
     Av = 157079.633
```

```
       fy = 525.00
        s = 150.00
      Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
        2(1-s/d) = 0.75
      Vf ((11-3)-(11.4), ACI 440) = 0.00
      From (11-11), ACI 440: Vs + Vf < = 312423.44
```

Calculation of Shear Strength at edge 2, Vr2 = 174208.493
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

```
   From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
         = 1 (normal-weight concrete)
      fc' = 24.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00628319
          As (tension reinf.) = 603.1858
          bw = 400.00
          d = 240.00
      Vu*d/Mu < 1 = 0.00
          Mu = 8.0393416E-013
          Vu = 3.6870970E-015
    From (11.5.4.8), ACI 318-14: Vs = 98960.169
        Av = 157079.633
        fy = 525.00
        s = 150.00
      Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
        2(1-s/d) = 0.75
      Vf ((11-3)-(11.4), ACI 440) = 0.00
      From (11-11), ACI 440: Vs + Vf < = 312423.44
```

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 5.5813E+006
Shear Force, V2 = -3.0430585E-014
Shear Force, V3 = 8685.666
Axial Force, F = -560.8745
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 615.7522
     -Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 615.7522
      -Compression: Asl,com = 603.1858
         -Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL = 14.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = * θu = 0.00733824
 θu = θy + θp = 0.00733824

 - Calculation of θy -

 θy = (My*Ls/3)/EIeff = 0.00233824 ((4.29),Biskinis Phd))
  My = 1.2065E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 642.5872
  From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.1052E+013

Calculation of Yielding Moment My

Calculation of θy and My according to Annex 7 -

 ϕy = Min(ϕy_ten, ϕy_com)
 ϕy_ten = 1.0040096E-005
with fy = 525.00
    d = 358.00
    ξy = 0.26968803
    A = 0.01422609
    B = 0.00802326
     with pt = 0.00573326
        pc = 0.00561626
        pv = 0.00286663
        N = 560.8745
        b = 300.00
        " = 0.12011173
  ϕy_comp = 1.9438402E-005
with fc = 24.00
    Ec = 23025.204
    ξy = 0.26961043
    A = 0.01420223
    B = 0.00801331
     with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of θp -

From table 10-7: θp = 0.005
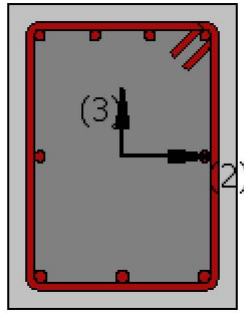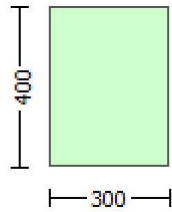with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1

shear control ratio Vp/Vo = 0.78793176
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
       = 2.2582492E-005
- Stirrup Spacing <= d/2
 d = 358.00
 s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
 Vs = 175929.189,already given in calculation of shear control ratio
 design Shear = 8685.666
- (- ')/ bal = -0.15609354
    = Aslt/(bw*d) = 0.00573326
   Tension Reinf Area: Aslt = 615.7522
   ' = Aslc/(bw*d) = 0.00848289
   Compression Reinf Area: Aslc = 911.0619
 From (B-1), ACI 318-11:   bal = 0.01761524
   fc = 24.00
   fy = 525.00
   From 10.2.7.3, ACI 318-11: 1 = 0.85
   From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.53333333
        y = 0.002625
- V/(bw*d*fc^0.5) = 0.19880004, NOTE: units in lb & in
   bw = 300.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 7

beam B1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)

Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 420.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 5.4177E+006
Shear Force, Va = -3205.137
EDGE -B-
Bending Moment, Mb = 5.5813E+006
Shear Force, Vb = 8685.666
BOTH EDGES
Axial Force, F = -560.8745
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 615.7522
    -Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 615.7522
    -Compression: Asl,com = 603.1858
     -Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL,ten = 14.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 207396.171
Vn ((22.5.1.1), ACI 318-14) = 207396.171

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ φf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 66652.82
      λ = 1 (normal-weight concrete)
    fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00641409
      As (tension reinf.) = 615.7522
      bw = 300.00
      d = 320.00
    Vu*d/Mu < 1 = 0.49798685
      Mu = 5.5813E+006
      Vu = 8685.666
  From (11.5.4.8), ACI 318-14: Vs = 140743.351
    Av = 157079.633
    fy = 420.00
    s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 255092.67

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)

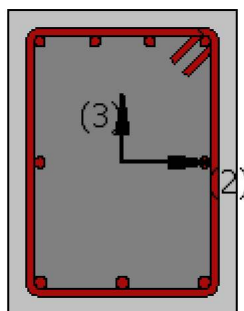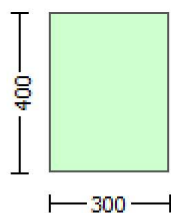
Calculation No. 8

beam B1, Floor 1

Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (3)

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)

Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2740.265
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 603.1858
   -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 603.1858
   -Compression: Asl,com = 615.7522
     -Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.78793176
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 205990.317
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.8802E+008
   Mu1+ = 1.8495E+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- = 1.8802E+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-) = 1.8800E+008
   Mu2+ = 1.8498E+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- = 1.8800E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with

V1 = 2740.265, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 0.0001071
Mu = 1.8495E+008
----
with full section properties:
  b = 300.00
  d = 357.00
  d' = 42.00
  v = 8.2121432E-005
    N = 211.0849
  fc = 24.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu^* = shear_factor * Max(εcu, εcc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00773686
      ωwe (5.4c) = 0.01121936
      αse ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
         bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      ----
        s = 150.00
        fywe = 656.25
        fce = 24.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00290026
        λc = confinement factor = 1.09003
  $\varepsilon y1$ = 0.0025
  $\varepsilon sh1$ = 0.008
  ft1 = 787.50
  fy1 = 656.25
  $\varepsilon su1$ = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
    $\varepsilon su1$ = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and $\varepsilon y1$, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    $\varepsilon y1$, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  $\varepsilon y2$ = 0.0025
  $\varepsilon sh2$ = 0.008
  ft2 = 787.50
  fy2 = 656.25
  $\varepsilon su2$ = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 1.00
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 656.25
    with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.15399964
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15720797
    v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
  b = 240.00
  d = 327.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
     c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.21016006
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21453839
    v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.1630814
Mu = MRc (4.14) = 1.8495E+008
  u =   su (4.1) = 0.0001071

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010722
Mu = 1.8802E+008
----
with full section properties:
  b = 300.00
  d = 358.00

d' = 43.00
v = 8.1892042E-005
  N = 211.0849
fc = 24.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.00773686
    we (5.4c) = 0.01121936
     ase ((5.4d), TBDY) = 0.15672608
       bo = 240.00
       ho = 340.00
        bi2 = 346400.00
    psh,min = Min(psh,x , psh,y) = 0.00261799
   ----
    psh,x (5.4d) = 0.00349066
     Ash = Astir*ns = 78.53982
      No stirups, ns = 2.00
     bk = 300.00
   ----
    psh,y (5.4d) = 0.00261799
     Ash = Astir*ns = 78.53982
      No stirups, ns = 2.00
     bk = 400.00
   ----
     s = 150.00
     fywe = 656.25
     fce = 24.00
  From ((5.A5), TBDY), TBDY: cc = 0.00290026
    c = confinement factor = 1.09003
 y1 = 0.0025
 sh1 = 0.008
ft1 = 787.50
fy1 = 656.25
 su1 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs1 = fs = 656.25
   with Es1 = Es = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
 su2 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 1.00
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 656.25
   with Es2 = Es = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 787.50
fyv = 656.25
 suv = 0.032

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 656.25
  with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.15676884
 2 = Asl,com/(b*d)*(fs2/fc) = 0.15356947
 v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
 b = 240.00
 d = 328.00
 d' = 13.00
 fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
    c = confinement factor = 1.09003
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.21388431
  2 = Asl,com/(b*d)*(fs2/fc) = 0.20951933
  v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16631328
Mu = MRc (4.14) = 1.8802E+008
 u =   su (4.1) = 0.00010722

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 0.00010701
Mu = 1.8498E+008
----
with full section properties:
 b = 300.00
 d = 358.00
 d' = 43.00
 v = 8.1892042E-005
   N = 211.0849
 fc = 24.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00773686
    we (5.4c) = 0.01121936
     ase ((5.4d), TBDY) = 0.15672608
       bo = 240.00
       ho = 340.00
        bi2 = 346400.00
    psh,min = Min(psh,x , psh,y) = 0.00261799

```
        psh,x (5.4d) = 0.00349066
            Ash = Astir*ns = 78.53982
                No stirups, ns = 2.00
            bk = 300.00
    ------------------------------------------------------------------
        psh,y (5.4d) = 0.00261799
            Ash = Astir*ns = 78.53982
                No stirups, ns = 2.00
            bk = 400.00
    ------------------------------------------------------------------
            s = 150.00
        fywe = 656.25
        fce = 24.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00290026
            c = confinement factor = 1.09003
   y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
   y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
   yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.15356947
  2 = Asl,com/(b*d)*(fs2/fc) = 0.15676884
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
```

and confined core properties:
   b = 240.00
   d = 328.00
   d' = 13.00
   fcc (5A.2, TBDY) = 26.16063
     cc (5A.5, TBDY) = 0.00290026
        c = confinement factor = 1.09003
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.20951933
     2 = Asl,com/(b*d)*(fs2/fc) = 0.21388431
     v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
   ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16466458
Mu = MRc (4.14) = 1.8498E+008
  u =   su (4.1) = 0.00010701

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010732
Mu = 1.8800E+008
----
with full section properties:
   b = 300.00
   d = 357.00
   d' = 42.00
   v = 8.2121432E-005
     N = 211.0849
   fc = 24.00
    co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.00773686
         we (5.4c) = 0.01121936
         ase ((5.4d), TBDY) = 0.15672608
            bo = 240.00
            ho = 340.00
             bi2 = 346400.00
         psh,min = Min(psh,x , psh,y) = 0.00261799
         ----
         psh,x (5.4d) = 0.00349066
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 300.00
         ----
         psh,y (5.4d) = 0.00261799
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 400.00
         ----
            s = 150.00
          fywe = 656.25
          fce = 24.00
        From ((5.A5), TBDY), TBDY: cc = 0.00290026
            c = confinement factor = 1.09003

```
   y1 = 0.0025
   sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
       su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 656.25
       with Es1 = Es = 200000.00
   y2 = 0.0025
   sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
   su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 656.25
       with Es2 = Es = 200000.00
   yv = 0.0025
   shv = 0.008
 ftv = 787.50
 fyv = 656.25
   suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fsv = fs = 656.25
       with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15720797
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15399964
   v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
   b = 240.00
   d = 327.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
     cc (5A.5, TBDY) = 0.00290026
       c  = confinement factor = 1.09003
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.21453839
     2 = Asl,com/(b*d)*(fs2/fc) = 0.21016006
     v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
   ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
```

```
su (4.9) = 0.16474284
Mu = MRc (4.14) = 1.8800E+008
 u =   su (4.1) = 0.00010732
-----------------------------------------------------------------

Calculation of ratio lb/ld
-----------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
-----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 261431.672
-----------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 261431.672
Vr1 = Vn ((22.5.1.1), ACI 318-14)
-----------------------------------------------------------------
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-----------------------------------------------------------------
   From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
        = 1 (normal-weight concrete)
     fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00628319
        As (tension reinf.) = 603.1858
        bw = 300.00
        d = 320.00
     Vu*d/Mu < 1 = 1.00
        Mu = 30114.962
        Vu = 2740.265
   From (11.5.4.8), ACI 318-14: Vs = 175929.189
     Av = 157079.633
     fy = 525.00
     s = 150.00
   Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44
-----------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 261431.672
Vr2 = Vn ((22.5.1.1), ACI 318-14)
-----------------------------------------------------------------
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-----------------------------------------------------------------
   From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
        = 1 (normal-weight concrete)
     fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00628319
        As (tension reinf.) = 603.1858
        bw = 300.00
        d = 320.00
     Vu*d/Mu < 1 = 1.00
        Mu = 30115.665
        Vu = 2740.264
   From (11.5.4.8), ACI 318-14: Vs = 175929.189
     Av = 157079.633
     fy = 525.00
     s = 150.00
   Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44
-----------------------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3


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

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -3.6870970E-015
EDGE -B-
Shear Force, Vb = 3.6870970E-015
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 603.1858
     -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 508.938
     -Compression: Asl,com = 508.938
        -Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.79211753
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 137993.601
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.2764E+008
   Mu1+ = 1.2764E+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- = 1.2764E+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-) = 1.2764E+008
   Mu2+ = 1.2764E+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- = 1.2764E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment

direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
 V1 = -3.6870970E-015, is the shear force acting at edge 1 for the the static loading combination
 V2 = 3.6870970E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
 b = 400.00
 d = 258.00
 d' = 42.00
 v = 8.5224858E-005
  N = 211.0849
 fc = 24.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00773686
    we (5.4c) = 0.01121936
    ase ((5.4d), TBDY) = 0.15672608
      bo = 240.00
      ho = 340.00
       bi2 = 346400.00
    psh,min = Min(psh,x , psh,y) = 0.00261799
   ----
    psh,x (5.4d) = 0.00349066
      Ash = Astir*ns = 78.53982
        No stirups, ns = 2.00
      bk = 300.00
   ----
    psh,y (5.4d) = 0.00261799
      Ash = Astir*ns = 78.53982
        No stirups, ns = 2.00
      bk = 400.00
   ----
       s = 150.00
      fywe = 656.25
      fce = 24.00
   From ((5.A5), TBDY), TBDY: cc = 0.00290026
       c = confinement factor = 1.09003
 y1 = 0.0025
 sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
 su1 = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 656.25
    with Es1 = Es = 200000.00
 y2 = 0.0025
 sh2 = 0.008

ft2 = 787.50
fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^ 2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
ftv = 787.50
fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^ 2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
    v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008

----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
       ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
       psh,min = Min(psh,x , psh,y) = 0.00261799
       ----
       psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 300.00
       ----
       psh,y (5.4d) = 0.00261799
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 400.00
       ----
          s = 150.00
         fywe = 656.25
         fce = 24.00
     From ((5.A5), TBDY), TBDY: cc = 0.00290026
          c = confinement factor = 1.09003
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
  yv = 0.0025

shv = 0.008
ftv = 787.50
fyv = 656.25
 suv = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 656.25
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
  v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
   2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
   v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
     N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
       ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00

```
            ho = 340.00
              bi2 = 346400.00
          psh,min = Min(psh,x , psh,y) = 0.00261799
       -----------------------------------------------------------------
          psh,x (5.4d) = 0.00349066
             Ash = Astir*ns = 78.53982
                No stirups, ns = 2.00
             bk = 300.00
       -----------------------------------------------------------------
          psh,y (5.4d) = 0.00261799
             Ash = Astir*ns = 78.53982
                No stirups, ns = 2.00
             bk = 400.00
       -----------------------------------------------------------------
             s = 150.00
          fywe = 656.25
          fce  = 24.00
       From ((5.A5), TBDY), TBDY:  cc = 0.00290026
             c  = confinement factor = 1.09003
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
   y2 = 0.0025
   sh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
   su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
   yv = 0.0025
   shv = 0.008
  ftv = 787.50
  fyv = 656.25
   suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
```

with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
     2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
     v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
     2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
     v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
 v < vs,c - RHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.20560388
 Mu = MRc (4.14) = 1.2764E+008
   u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
 Mu = 1.2764E+008
 ----
 with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00773686
       we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
        psh,min = Min(psh,x , psh,y) = 0.00261799
        ----
        psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
          bk = 300.00
        ----
        psh,y (5.4d) = 0.00261799
          Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
          bk = 400.00
        ----
            s = 150.00

```
        fywe = 656.25
         fce  = 24.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00290026
          c  = confinement factor = 1.09003
    y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
    su1 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
        su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs1 = fs = 656.25
        with Es1 = Es = 200000.00
    y2 = 0.0025
   sh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
    su2 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 1.00
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs2 = fs = 656.25
        with Es2 = Es = 200000.00
    yv = 0.0025
   shv = 0.008
  ftv = 787.50
  fyv = 656.25
    suv = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fsv = fs = 656.25
        with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
    v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
   b = 340.00
   d = 228.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
        c  = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
```

' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
 u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 174208.493

Calculation of Shear Strength at edge 1, Vr1 = 174208.493
Vr1 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
      = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
      As (tension reinf.) = 603.1858
      bw = 400.00
      d = 240.00
    Vu*d/Mu < 1 = 0.00
      Mu = 7.6252677E-012
      Vu = 3.6870970E-015
  From (11.5.4.8), ACI 318-14: Vs = 98960.169
    Av = 157079.633
    fy = 525.00
    s = 150.00
  Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
  2(1-s/d) = 0.75
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 312423.44

Calculation of Shear Strength at edge 2, Vr2 = 174208.493
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
      = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
      As (tension reinf.) = 603.1858
      bw = 400.00
      d = 240.00
    Vu*d/Mu < 1 = 0.00
      Mu = 8.0393416E-013
      Vu = 3.6870970E-015
  From (11.5.4.8), ACI 318-14: Vs = 98960.169
    Av = 157079.633
    fy = 525.00
    s = 150.00
  Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
  2(1-s/d) = 0.75
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 312423.44

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 6.7903689E-011
Shear Force, V2 = -3.0430585E-014
Shear Force, V3 = 8685.666
Axial Force, F = -560.8745
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 615.7522
     -Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 508.938
     -Compression: Asl,com = 508.938
         -Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.66667

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R =   * u = 0.00904335
 u = y + p = 0.00904335

 - Calculation of y -
----
 y = (My*Ls/3)/EIeff = 0.00404335 ((4.29),Biskinis Phd))
  My = 8.1525E+007
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 925.00
  From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 6.2168E+012

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7   -
----
  y = Min(y_ten, y_com)
  y_ten = 1.4111768E-005
 with fy = 525.00
    d = 258.00
     y = 0.27901178
    A = 0.01480506
    B = 0.00861193
     with pt = 0.00493157
        pc = 0.00493157
        pv = 0.00493157
        N = 560.8745
        b = 400.00
        " = 0.1627907
  y_comp = 2.6070636E-005
 with fc = 24.00
    Ec = 23025.204
     y = 0.2789388
    A = 0.01478023
    B = 0.00860158
     with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of p -

From table 10-7: p = 0.005
with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1
   shear control ratio Vp/Vo = 0.79211753
 - Transverse Reinforcement: NC
 - Stirrup Spacing > d/3
 - Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
       = 7.1684405E-022
 - Stirrup Spacing > d/2
  d = 258.00
  s = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
  Vs = 131946.891,already given in calculation of shear control ratio
  design Shear = 3.0430585E-014
 - (- ')/ bal = -0.16244618
    = Aslt/(bw*d) = 0.00596659
   Tension Reinf Area: Aslt = 615.7522
   ' = Aslc/(bw*d) = 0.00882812
   Compression Reinf Area: Aslc = 911.0619
  From (B-1), ACI 318-11: bal = 0.01761524
   fc = 24.00
   fy = 525.00
   From 10.2.7.3, ACI 318-11: 1 = 0.85
   From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.53333333
       y = 0.002625
 - V/(bw*d*fc^0.5) = 7.2485011E-019, NOTE: units in lb & in
   bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 9

beam B1, Floor 1
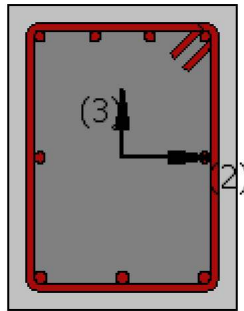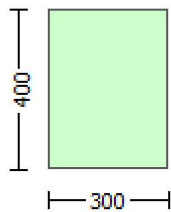
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (2)

Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 420.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.0854113E-011
Shear Force, Va = 2.3583230E-014
EDGE -B-
Bending Moment, Mb = 5.4436895E-011
Shear Force, Vb = -2.3583230E-014
BOTH EDGES
Axial Force, F = -490.6724
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 603.1858
     -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 508.938
      -Compression: Asl,com = 508.938
         -Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.66667

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 140608.135
Vn ((22.5.1.1), ACI 318-14) = 140608.135

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 61440.00
      = 1 (normal-weight concrete)
    fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
       As (tension reinf.) = 603.1858
       bw = 400.00
       d = 240.00
    Vu*d/Mu < 1 = 0.00
       Mu = 1.0854113E-011
       Vu = 2.3583230E-014
  From (11.5.4.8), ACI 318-14: Vs = 79168.135
     Av = 157079.633
     fy = 420.00
     s = 150.00
  Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.75
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 255092.67

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)

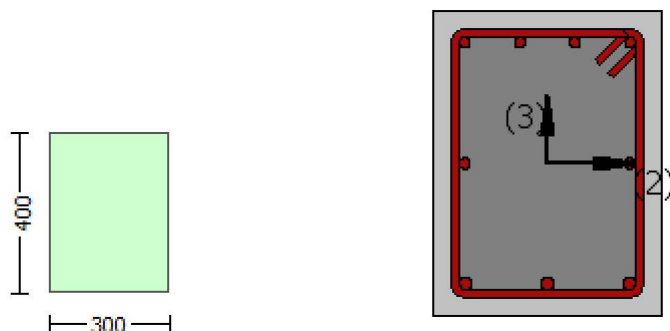

Calculation No. 10

beam B1, Floor 1

Limit State: Life Safety (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: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2740.265
EDGE -B-

Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 603.1858
    -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 603.1858
    -Compression: Asl,com = 615.7522
       -Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.78793176
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 205990.317
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.8802E+008
   Mu1+ = 1.8495E+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- = 1.8802E+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-) = 1.8800E+008
   Mu2+ = 1.8498E+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- = 1.8800E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
   V1 = 2740.265, is the shear force acting at edge 1 for the the static loading combination
   V2 = 2740.264, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 0.0001071
Mu = 1.8495E+008
----
with full section properties:
  b = 300.00
  d = 357.00
  d' = 42.00
  ν = 8.2121432E-005
      N = 211.0849
  fc = 24.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.00773686
       ωwe (5.4c) = 0.01121936
        αse ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00261799

       ρsh,x (5.4d) = 0.00349066
         Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
         bk = 300.00

       ρsh,y (5.4d) = 0.00261799

94

```
         Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
         bk = 400.00

   ------------------------------------------------------------------
           s = 150.00
        fywe = 656.25
        fce = 24.00
    From ((5.A5), TBDY):  cc = 0.00290026
         c  = confinement factor = 1.09003
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and   y1,  sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1,  sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and   y2,  sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1,  sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and   yv,  shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1,  sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.15399964
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15720797
    v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
  b = 240.00
  d = 327.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
```

```
        c  = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.21016006
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21453839
    v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.1630814
Mu = MRc (4.14) = 1.8495E+008
  u =    su (4.1) = 0.0001071
--------------------------------------------------------------

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

----------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010722
Mu = 1.8802E+008
----------------------------------------------------------------------------
with full section properties:
  b = 300.00
  d = 358.00
  d' = 43.00
  v = 8.1892042E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:  cu* = shear_factor * Max( cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
       ase ((5.4d), TBDY) = 0.15672608
         bo = 240.00
         ho = 340.00
          bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----------------------------------------------------------------
      psh,x (5.4d) = 0.00349066
         Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
         bk = 300.00
      ----------------------------------------------------------------
      psh,y (5.4d) = 0.00261799
         Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
         bk = 400.00
      ----------------------------------------------------------------
          s = 150.00
        fywe = 656.25
        fce = 24.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00290026
         c  = confinement factor = 1.09003
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
```

and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.15676884
  2 = Asl,com/(b*d)*(fs2/fc) = 0.15356947
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
  b = 240.00
  d = 328.00
  d' = 13.00
  fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
     c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.21388431
    2 = Asl,com/(b*d)*(fs2/fc) = 0.20951933
    v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16631328
Mu = MRc (4.14) = 1.8802E+008
  u =   su (4.1) = 0.00010722

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 0.00010701
Mu = 1.8498E+008
----
with full section properties:
  b = 300.00
  d = 358.00
  d' = 43.00
  v = 8.1892042E-005
    N = 211.0849
  fc = 24.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00773686
      ωwe (5.4c) = 0.01121936
      αase ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
          bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      ----
        s = 150.00
      fywe = 656.25
      fce = 24.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00290026
        εc = confinement factor = 1.09003
  εy1 = 0.0025
  εsh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  εsu1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and εy1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      εy1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  εy2 = 0.0025
  εsh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  εsu2 = 0.032

98

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 656.25
  with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 656.25
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15356947
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15676884
   v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
  b = 240.00
  d = 328.00
  d' = 13.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
     c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.20951933
   2 = Asl,com/(b*d)*(fs2/fc) = 0.21388431
   v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16466458
Mu = MRc (4.14) = 1.8498E+008
  u =   su (4.1) = 0.00010701

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010732
Mu = 1.8800E+008
----
with full section properties:
  b = 300.00

d = 357.00
d' = 42.00
v = 8.2121432E-005
  N = 211.0849
fc = 24.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00773686
     we (5.4c) = 0.01121936
      ase ((5.4d), TBDY) = 0.15672608
         bo = 240.00
         ho = 340.00
          bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
   ----
      psh,x (5.4d) = 0.00349066
         Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
         bk = 300.00
   ----
      psh,y (5.4d) = 0.00261799
         Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
         bk = 400.00
   ----
         s = 150.00
      fywe = 656.25
      fce = 24.00
   From ((5A5), TBDY), TBDY: cc = 0.00290026
        c = confinement factor = 1.09003
 y1 = 0.0025
 sh1 = 0.008
ft1 = 787.50
fy1 = 656.25
 su1 = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu1_nominal = 0.08,
   For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
   characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 656.25
    with Es1 = Es = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
 su2 = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 1.00
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 656.25
    with Es2 = Es = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 787.50
fyv = 656.25

suv = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 656.25
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15720797
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15399964
   v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
  b = 240.00
  d = 327.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
     c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.21453839
   2 = Asl,com/(b*d)*(fs2/fc) = 0.21016006
   v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16474284
Mu = MRc (4.14) = 1.8800E+008
  u =   su (4.1) = 0.00010732

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 261431.672

Calculation of Shear Strength at edge 1, Vr1 = 261431.672
Vr1 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
      = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
      As (tension reinf.) = 603.1858
      bw = 300.00
      d = 320.00
    Vu*d/Mu < 1 = 1.00
      Mu = 30114.962
      Vu = 2740.265
  From (11.5.4.8), ACI 318-14: Vs = 175929.189
    Av = 157079.633
    fy = 525.00
    s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00

From (11-11), ACI 440: Vs + Vf <= 312423.44

Calculation of Shear Strength at edge 2, Vr2 = 261431.672
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

   From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
        = 1 (normal-weight concrete)
     fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00628319
        As (tension reinf.) = 603.1858
        bw = 300.00
        d = 320.00
     Vu*d/Mu < 1 = 1.00
        Mu = 30115.665
        Vu = 2740.264
   From (11.5.4.8), ACI 318-14: Vs = 175929.189
        Av = 157079.633
        fy = 525.00
        s = 150.00
     Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
     Vf ((11-3)-(11.4), ACI 440) = 0.00
     From (11-11), ACI 440: Vs + Vf <= 312423.44

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -3.6870970E-015
EDGE -B-
Shear Force, Vb = 3.6870970E-015
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 603.1858
  -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 508.938
  -Compression: Asl,com = 508.938
    -Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.79211753
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 137993.601
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.2764E+008
  Mu1+ = 1.2764E+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- = 1.2764E+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-) = 1.2764E+008
  Mu2+ = 1.2764E+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- = 1.2764E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
  V1 = -3.6870970E-015, is the shear force acting at edge 1 for the the static loading combination
  V2 = 3.6870970E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
      ase ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
         bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
    ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982

```
                No stirups, ns = 2.00
            bk = 300.00
        ----------------------------------------------------------------
          psh,y (5.4d) = 0.00261799
             Ash = Astir*ns = 78.53982
                No stirups, ns = 2.00
            bk = 400.00
        ----------------------------------------------------------------
             s = 150.00
           fywe = 656.25
           fce = 24.00
        From ((5.A5), TBDY), TBDY:  cc = 0.00290026
             c  = confinement factor = 1.09003
     y1 = 0.0025
    sh1 = 0.008
   ft1 = 787.50
   fy1 = 656.25
    su1 = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 1.00
        su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu1_nominal = 0.08,
       For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
       characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs1 = fs = 656.25
        with Es1 = Es = 200000.00
     y2 = 0.0025
    sh2 = 0.008
   ft2 = 787.50
   fy2 = 656.25
    su2 = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/lb,min = 1.00
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu2_nominal = 0.08,
       For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
       characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs2 = fs = 656.25
        with Es2 = Es = 200000.00
     yv = 0.0025
    shv = 0.008
   ftv = 787.50
   fyv = 656.25
    suv = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 1.00
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esuv_nominal = 0.08,
       considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
       For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
       characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fsv = fs = 656.25
        with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
     2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
     v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
```

```
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
       c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =    su (4.1) = 0.00015613
-----------------------------------------------------------

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

------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
------------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.00773686
        we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
           bo = 240.00
           ho = 340.00
            bi2 = 346400.00
        psh,min = Min(psh,x , psh,y) = 0.00261799
     ----------------------------------------------------------------
        psh,x (5.4d) = 0.00349066
           Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
           bk = 300.00
     ----------------------------------------------------------------
        psh,y (5.4d) = 0.00261799
           Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
           bk = 400.00
     ----------------------------------------------------------------
           s = 150.00
        fywe = 656.25
        fce = 24.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00290026
          c = confinement factor = 1.09003
   y1 = 0.0025
   sh1 = 0.008
```

ft1 = 787.50
fy1 = 656.25
su1 = 0.032
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/ld = 1.00
 su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
 From table 5A.1, TBDY: esu1_nominal = 0.08,
 For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
 characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
 with fs1 = fs = 656.25
 with Es1 = Es = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
su2 = 0.032
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/lb,min = 1.00
 su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
 From table 5A.1, TBDY: esu2_nominal = 0.08,
 For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
 characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
 with fs2 = fs = 656.25
 with Es2 = Es = 200000.00
yv = 0.0025
shv = 0.008
ftv = 787.50
fyv = 656.25
suv = 0.032
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 lo/lou,min = lb/ld = 1.00
 suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
 From table 5A.1, TBDY: esuv_nominal = 0.08,
 considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
 For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
 characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
 with fsv = fs = 656.25
 with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
b = 340.00
d = 228.00
d' = 12.00
fcc (5A.2, TBDY) = 26.16063
cc (5A.5, TBDY) = 0.00290026
 c = confinement factor = 1.09003
1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008

u = su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00773686
       we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
       psh,min = Min(psh,x , psh,y) = 0.00261799
       ----
       psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
          bk = 300.00
       ----
       psh,y (5.4d) = 0.00261799
          Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
          bk = 400.00
       ----
          s = 150.00
         fywe = 656.25
         fce = 24.00
      From ((5.A5), TBDY), TBDY: cc = 0.00290026
          c = confinement factor = 1.09003
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
   y2 = 0.0025

sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
ftv = 787.50
fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
    v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
 u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613

Mu = 1.2764E+008

----

with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
      ase ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
        bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799

    ----

      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00

    ----

      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00

    ----

      s = 150.00
      fywe = 656.25
      fce = 24.00
    From ((5.A5), TBDY), TBDY: cc = 0.00290026
      c = confinement factor = 1.09003
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 656.25
    with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 656.25
    with Es2 = Es = 200000.00

yv = 0.0025
shv = 0.008
ftv = 787.50
fyv = 656.25
suv = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 656.25
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
    c = confinement factor = 1.09003
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
  2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
  v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
 u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 174208.493

Calculation of Shear Strength at edge 1, Vr1 = 174208.493
Vr1 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
    = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
     As (tension reinf.) = 603.1858
     bw = 400.00
     d = 240.00
    Vu*d/Mu < 1 = 0.00
     Mu = 7.6252677E-012
     Vu = 3.6870970E-015
  From (11.5.4.8), ACI 318-14: Vs = 98960.169
    Av = 157079.633

fy = 525.00
      s = 150.00
   Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.75
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44

Calculation of Shear Strength at edge 2, Vr2 = 174208.493
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

   From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
        = 1 (normal-weight concrete)
      fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00628319
         As (tension reinf.) = 603.1858
         bw = 400.00
         d = 240.00
      Vu*d/Mu < 1 = 0.00
         Mu = 8.0393416E-013
         Vu = 3.6870970E-015
   From (11.5.4.8), ACI 318-14: Vs = 98960.169
      Av = 157079.633
      fy = 525.00
      s = 150.00
   Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.75
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcars

Constant Properties

Knowledge Factor, = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 4.3364E+006
Shear Force, V2 = 2.3583230E-014
Shear Force, V3 = -2011.906
Axial Force, F = -490.6724
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 603.1858
     -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 603.1858
      -Compression: Asl,com = 615.7522
         -Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL = 16.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta u,R = \ast \theta u = 0.02768931$
 $\theta u = \theta y + \theta p = 0.02768931$

 - Calculation of θy -

 $\theta y = (My \ast Ls/3)/EIeff = 0.00768931$ ((4.29),Biskinis Phd))
  My = 1.1829E+008
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 2155.373
  From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.1052E+013

Calculation of Yielding Moment My

Calculation of ϕy and My according to Annex 7 -

 $\phi y = Min(\phi y\_ten, \phi y\_com)$
 $\phi y\_ten = 1.0034719E-005$
with fy = 525.00
    d = 357.00
     y = 0.26724988
    A = 0.01426469
    B = 0.00792353
     with pt = 0.00563199
        pc = 0.00574932
        pv = 0.00287466
        N = 490.6724
        b = 300.00
        " = 0.11764706
  $\phi y\_comp = 1.9670147E-005$
with fc = 24.00
    Ec = 23025.204
     y = 0.26718031
    A = 0.01424376
    B = 0.00791481
     with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of θp -

From table 10-7: $\theta p = 0.02$
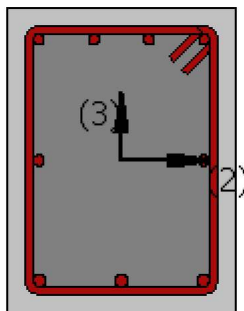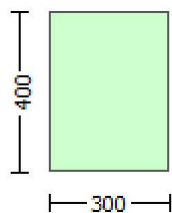with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1

shear control ratio Vp/Vo = 0.78793176
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
     = 5.1824485E-005
- Stirrup Spacing <= d/2
 d = 357.00
 s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
 Vs = 175929.189,already given in calculation of shear control ratio
 design Shear = 2011.906
- (- ')/ bal = -0.16985254
    = Aslt/(bw*d) = 0.00563199
   Tension Reinf Area: Aslt = 603.1858
   ' = Aslc/(bw*d) = 0.00862398
   Compression Reinf Area: Aslc = 923.6282
 From (B-1), ACI 318-11: bal = 0.01761524
   fc = 24.00
   fy = 525.00
   From 10.2.7.3, ACI 318-11: 1 = 0.85
   From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.53333333
      y = 0.002625
- V/(bw*d*fc^0.5) = 0.04617809, NOTE: units in lb & in
   bw = 300.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 11

beam B1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: Start

Local Axis: (3)

Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 420.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 4.3364E+006
Shear Force, Va = -2011.906
EDGE -B-
Bending Moment, Mb = 4.4551E+006
Shear Force, Vb = 7492.435
BOTH EDGES
Axial Force, F = -490.6724
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 603.1858
     -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 603.1858
     -Compression: Asl,com = 615.7522
       -Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL,ten = 16.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 203705.746
Vn ((22.5.1.1), ACI 318-14) = 203705.746

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ ϕ_f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 62962.395
      λ = 1 (normal-weight concrete)
    fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
      As (tension reinf.) = 603.1858
      bw = 300.00
      d = 320.00
    Vu*d/Mu < 1 = 0.14846615
      Mu = 4.3364E+006
      Vu = 2011.906
  From (11.5.4.8), ACI 318-14: Vs = 140743.351
    Av = 157079.633
    fy = 420.00
    s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 255092.67

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)

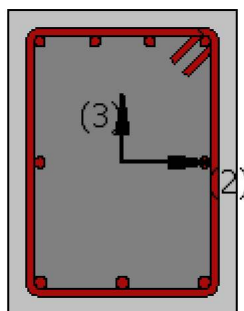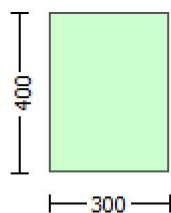# Calculation No. 12

beam B1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: Start

Local Axis: (3)

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)

Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2740.265
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 603.1858
    -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 603.1858
    -Compression: Asl,com = 615.7522
      -Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.78793176
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 205990.317
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.8802E+008
   Mu1+ = 1.8495E+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- = 1.8802E+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-) = 1.8800E+008
   Mu2+ = 1.8498E+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- = 1.8800E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with

V1 = 2740.265, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 0.0001071
Mu = 1.8495E+008
----
with full section properties:
  b = 300.00
  d = 357.00
  d' = 42.00
  ν = 8.2121432E-005
    N = 211.0849
  fc = 24.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00773686
      ωwe (5.4c) = 0.01121936
      αase ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
        bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      ----
        s = 150.00
        fywe = 656.25
        fce = 24.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00290026
        εc = confinement factor = 1.09003
  εy1 = 0.0025
  εsh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
  εsu1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and εy1, εsh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     εy1, εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  εy2 = 0.0025
  εsh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
  εsu2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 656.25
    with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 656.25
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.15399964
  2 = Asl,com/(b*d)*(fs2/fc) = 0.15720797
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
  b = 240.00
  d = 327.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
    c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.21016006
   2 = Asl,com/(b*d)*(fs2/fc) = 0.21453839
   v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.1630814
Mu = MRc (4.14) = 1.8495E+008
  u = su (4.1) = 0.0001071

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010722
Mu = 1.8802E+008
----
with full section properties:
  b = 300.00
  d = 358.00

d' = 43.00
v = 8.1892042E-005
  N = 211.0849
fc = 24.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.00773686
   we (5.4c) = 0.01121936
    ase ((5.4d), TBDY) = 0.15672608
     bo = 240.00
     ho = 340.00
      bi2 = 346400.00
    psh,min = Min(psh,x , psh,y) = 0.00261799
   ----
    psh,x (5.4d) = 0.00349066
     Ash = Astir*ns = 78.53982
      No stirups, ns = 2.00
     bk = 300.00
   ----
    psh,y (5.4d) = 0.00261799
     Ash = Astir*ns = 78.53982
      No stirups, ns = 2.00
     bk = 400.00
   ----
     s = 150.00
     fywe = 656.25
     fce = 24.00
  From ((5.A5), TBDY), TBDY: cc = 0.00290026
    c = confinement factor = 1.09003
 y1 = 0.0025
 sh1 = 0.008
ft1 = 787.50
fy1 = 656.25
 su1 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs1 = fs = 656.25
   with Es1 = Es = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
 su2 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 1.00
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fs2 = fs = 656.25
   with Es2 = Es = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 787.50
fyv = 656.25
 suv = 0.032

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 656.25
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.15676884
2 = Asl,com/(b*d)*(fs2/fc) = 0.15356947
v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
 b = 240.00
 d = 328.00
 d' = 13.00
 fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
     c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.21388431
   2 = Asl,com/(b*d)*(fs2/fc) = 0.20951933
   v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16631328
Mu = MRc (4.14) = 1.8802E+008
 u = su (4.1) = 0.00010722

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 0.00010701
Mu = 1.8498E+008
----
with full section properties:
 b = 300.00
 d = 358.00
 d' = 43.00
 v = 8.1892042E-005
   N = 211.0849
 fc = 24.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00773686
    we (5.4c) = 0.01121936
     ase ((5.4d), TBDY) = 0.15672608
       bo = 240.00
       ho = 340.00
        bi2 = 346400.00
    psh,min = Min(psh,x , psh,y) = 0.00261799
    ----

psh,x (5.4d) = 0.00349066
    Ash = Astir*ns = 78.53982
      No stirups, ns = 2.00
    bk = 300.00
----
psh,y (5.4d) = 0.00261799
    Ash = Astir*ns = 78.53982
      No stirups, ns = 2.00
    bk = 400.00
----
    s = 150.00
   fywe = 656.25
   fce = 24.00
From ((5.A5), TBDY), TBDY: cc = 0.00290026
   c = confinement factor = 1.09003
y1 = 0.0025
sh1 = 0.008
ft1 = 787.50
fy1 = 656.25
su1 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs1 = fs = 656.25
  with Es1 = Es = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
su2 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 1.00
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 656.25
  with Es2 = Es = 200000.00
yv = 0.0025
shv = 0.008
ftv = 787.50
fyv = 656.25
suv = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 656.25
  with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.15356947
2 = Asl,com/(b*d)*(fs2/fc) = 0.15676884
v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442

and confined core properties:
   b = 240.00
   d = 328.00
   d' = 13.00
   fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
        c = confinement factor = 1.09003
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.20951933
     2 = Asl,com/(b*d)*(fs2/fc) = 0.21388431
     v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16466458
Mu = MRc (4.14) = 1.8498E+008
  u =   su (4.1) = 0.00010701

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 0.00010732
Mu = 1.8800E+008
----
with full section properties:
   b = 300.00
   d = 357.00
   d' = 42.00
   v = 8.2121432E-005
     N = 211.0849
   fc = 24.00
    co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.00773686
         we (5.4c) = 0.01121936
          ase ((5.4d), TBDY) = 0.15672608
             bo = 240.00
             ho = 340.00
              bi2 = 346400.00
         psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
         psh,x (5.4d) = 0.00349066
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 300.00
      ----
         psh,y (5.4d) = 0.00261799
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 400.00
      ----
            s = 150.00
           fywe = 656.25
           fce = 24.00
       From ((5.A5), TBDY), TBDY: cc = 0.00290026
          c = confinement factor = 1.09003

y1 = 0.0025
    sh1 = 0.008
   ft1 = 787.50
   fy1 = 656.25
    su1 = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 1.00
        su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu1_nominal = 0.08,
       For calculation of esu1_nominal and   y1, sh1,ft1,fy1, it is considered
       characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fs1 = fs = 656.25
         with Es1 = Es = 200000.00
    y2 = 0.0025
    sh2 = 0.008
   ft2 = 787.50
   fy2 = 656.25
    su2 = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/lb,min = 1.00
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu2_nominal = 0.08,
       For calculation of esu2_nominal and   y2, sh2,ft2,fy2, it is considered
       characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fs2 = fs = 656.25
         with Es2 = Es = 200000.00
    yv = 0.0025
    shv = 0.008
   ftv = 787.50
   fyv = 656.25
    suv = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 1.00
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esuv_nominal = 0.08,
       considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
       For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
       characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fsv = fs = 656.25
         with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.15720797
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15399964
    v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
   b = 240.00
   d = 327.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
        c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.21453839
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21016006
    v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->

su (4.9) = 0.16474284
Mu = MRc (4.14) = 1.8800E+008
 u =   su (4.1) = 0.00010732

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 261431.672

Calculation of Shear Strength at edge 1, Vr1 = 261431.672
Vr1 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
      = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
      As (tension reinf.) = 603.1858
      bw = 300.00
      d = 320.00
    Vu*d/Mu < 1 = 1.00
      Mu = 30114.962
      Vu = 2740.265
  From (11.5.4.8), ACI 318-14: Vs = 175929.189
    Av = 157079.633
    fy = 525.00
    s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 312423.44

Calculation of Shear Strength at edge 2, Vr2 = 261431.672
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
      = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
      As (tension reinf.) = 603.1858
      bw = 300.00
      d = 320.00
    Vu*d/Mu < 1 = 1.00
      Mu = 30115.665
      Vu = 2740.264
  From (11.5.4.8), ACI 318-14: Vs = 175929.189
    Av = 157079.633
    fy = 525.00
    s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 312423.44

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -3.6870970E-015
EDGE -B-
Shear Force, Vb = 3.6870970E-015
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 603.1858
    -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 508.938
    -Compression: Asl,com = 508.938
      -Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.79211753
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 137993.601
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.2764E+008
  Mu1+ = 1.2764E+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- = 1.2764E+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-) = 1.2764E+008
  Mu2+ = 1.2764E+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- = 1.2764E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment

direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
  V1 = -3.6870970E-015, is the shear force acting at edge 1 for the the static loading combination
  V2 = 3.6870970E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
       ase ((5.4d), TBDY) = 0.15672608
         bo = 240.00
         ho = 340.00
          bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
         Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
         bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
         Ash = Astir*ns = 78.53982
           No stirups, ns = 2.00
         bk = 400.00
      ----
          s = 150.00
         fywe = 656.25
         fce = 24.00
     From ((5.A5), TBDY), TBDY: cc = 0.00290026
         c = confinement factor = 1.09003
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 656.25
       with Es1 = Es = 200000.00
   y2 = 0.0025
   sh2 = 0.008

```
   ft2 = 787.50
   fy2 = 656.25
    su2 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 1.00
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 656.25
       with Es2 = Es = 200000.00
    yv = 0.0025
    shv = 0.008
   ftv = 787.50
   fyv = 656.25
    suv = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fsv = fs = 656.25
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
    v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
   b = 340.00
   d = 228.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
       c  = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =    su (4.1) = 0.00015613
------------------------------------------------------------

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


-------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
 u = 0.00015613
Mu = 1.2764E+008
```

----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
      ase ((5.4d), TBDY) = 0.15672608
         bo = 240.00
         ho = 340.00
          bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
         Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
         bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
         Ash = Astir*ns = 78.53982
            No stirups, ns = 2.00
         bk = 400.00
      ----
         s = 150.00
        fywe = 656.25
        fce = 24.00
    From ((5.A5), TBDY), TBDY: cc = 0.00290026
         c = confinement factor = 1.09003
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 656.25
       with Es1 = Es = 200000.00
   y2 = 0.0025
   sh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
   su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 656.25
       with Es2 = Es = 200000.00
   yv = 0.0025

shv = 0.008
ftv = 787.50
fyv = 656.25
 suv = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 656.25
    with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
 2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
 v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
     c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
   2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
   v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
     N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
       ase ((5.4d), TBDY) = 0.15672608
         bo = 240.00

```
           ho = 340.00
             bi2 = 346400.00
        psh,min = Min(psh,x , psh,y) = 0.00261799
     ------------------------------------------------------------------
        psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 300.00
     ------------------------------------------------------------------
        psh,y (5.4d) = 0.00261799
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 400.00
     ------------------------------------------------------------------
           s = 150.00
         fywe = 656.25
         fce  = 24.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00290026
           c  = confinement factor = 1.09003
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
       su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 656.25
       with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 656.25
       with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fsv = fs = 656.25
```

with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
    v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00773686
       we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
       psh,min = Min(psh,x , psh,y) = 0.00261799
       ----
       psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 300.00
       ----
       psh,y (5.4d) = 0.00261799
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 400.00
       ----
          s = 150.00

```
          fywe = 656.25
          fce  = 24.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00290026
          c  = confinement factor = 1.09003
    y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
       su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 656.25
       with Es1 = Es = 200000.00
    y2 = 0.0025
   sh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
   su2 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 1.00
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 656.25
       with Es2 = Es = 200000.00
    yv = 0.0025
   shv = 0.008
  ftv = 787.50
  fyv = 656.25
   suv = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fsv = fs = 656.25
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
    v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
       c  = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
```

' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 174208.493

Calculation of Shear Strength at edge 1, Vr1 = 174208.493
Vr1 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
       = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
       As (tension reinf.) = 603.1858
       bw = 400.00
       d = 240.00
    Vu*d/Mu < 1 = 0.00
       Mu = 7.6252677E-012
       Vu = 3.6870970E-015
  From (11.5.4.8), ACI 318-14: Vs = 98960.169
     Av = 157079.633
     fy = 525.00
     s = 150.00
  Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
  2(1-s/d) = 0.75
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 312423.44

Calculation of Shear Strength at edge 2, Vr2 = 174208.493
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
       = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
       As (tension reinf.) = 603.1858
       bw = 400.00
       d = 240.00
    Vu*d/Mu < 1 = 0.00
       Mu = 8.0393416E-013
       Vu = 3.6870970E-015
  From (11.5.4.8), ACI 318-14: Vs = 98960.169
     Av = 157079.633
     fy = 525.00
     s = 150.00
  Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
  2(1-s/d) = 0.75
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 312423.44

```
-------------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2


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


Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcars

Constant Properties
-------------------------------------------------------------
Knowledge Factor,    = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping
-------------------------------------------------------------

Stepwise Properties
-------------------------------------------------------------
Bending Moment, M = -1.0854113E-011
Shear Force, V2 = 2.3583230E-014
Shear Force, V3 = -2011.906
Axial Force, F = -490.6724
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 603.1858
    -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 508.938
    -Compression: Asl,com = 508.938
       -Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.66667
-------------------------------------------------------------
-------------------------------------------------------------


Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R =   *  u = 0.02404297
  u =   y +   p = 0.02404297


-------------------------------------------------------------
 - Calculation of   y -
-------------------------------------------------------------
 y = (My*Ls/3)/Eleff = 0.00404297 ((4.29),Biskinis Phd))
  My = 8.1517E+007
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 925.00
  From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 6.2168E+012
-------------------------------------------------------------
-------------------------------------------------------------


Calculation of Yielding Moment My
```

Calculation of y and My according to Annex 7 -
----
  y = Min(y_ten, y_com)
  y_ten = 1.4111379E-005
 with fy = 525.00
    d = 258.00
     y = 0.27899188
    A = 0.01480377
    B = 0.00861063
    with pt = 0.00493157
        pc = 0.00493157
        pv = 0.00493157
        N = 490.6724
        b = 400.00
        " = 0.1627907
  y_comp = 2.6071644E-005
 with fc = 24.00
    Ec = 23025.204
     y = 0.27892802
    A = 0.01478204
    B = 0.00860158
    with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of p -

From table 10-7: p = 0.02
with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1
   shear control ratio Vp/Vo = 0.79211753
 - Transverse Reinforcement: NC
 - Stirrup Spacing > d/3
 - Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
       = -2.0351495E-021
 - Stirrup Spacing > d/2
  d = 258.00
  s = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
  Vs = 131946.891,already given in calculation of shear control ratio
  design Shear = 2.3583230E-014
 - (- ')/ bal = -0.17627139
     = Aslt/(bw*d) = 0.00584482
    Tension Reinf Area: Aslt = 603.1858
    ' = Aslc/(bw*d) = 0.00894989
    Compression Reinf Area: Aslc = 923.6282
  From (B-1), ACI 318-11: bal = 0.01761524
    fc = 24.00
    fy = 525.00
    From 10.2.7.3, ACI 318-11: 1 = 0.85
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.53333333
        y = 0.002625
 - V/(bw*d*fc^0.5) = 5.6174758E-019, NOTE: units in lb & in
    bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (a)

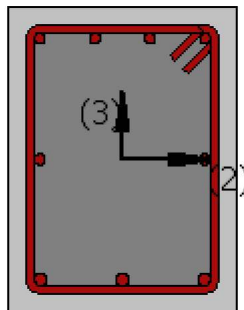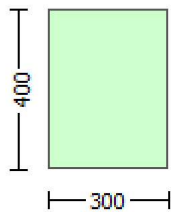
Calculation No. 13

beam B1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (2)

Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 420.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = -1.0854113E-011
Shear Force, Va = 2.3583230E-014
EDGE -B-
Bending Moment, Mb = 5.4436895E-011
Shear Force, Vb = -2.3583230E-014
BOTH EDGES
Axial Force, F = -490.6724
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 615.7522
     -Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 508.938
     -Compression: Asl,com = 508.938
        -Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL,ten = 14.66667

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 140608.135
Vn ((22.5.1.1), ACI 318-14) = 140608.135

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 61440.00
      = 1 (normal-weight concrete)
    fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00641409
       As (tension reinf.) = 615.7522
       bw = 400.00
       d = 240.00
    Vu*d/Mu < 1 = 0.00
       Mu = 5.4436895E-011
       Vu = 2.3583230E-014
  From (11.5.4.8), ACI 318-14: Vs = 79168.135
     Av = 157079.633
     fy = 420.00
     s = 150.00
  Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.75
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 255092.67

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 14
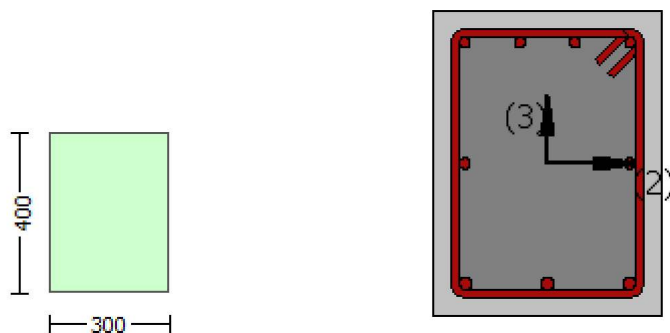
beam B1, Floor 1

Limit State: Life Safety (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: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2740.265
EDGE -B-

Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 603.1858
   -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 603.1858
   -Compression: Asl,com = 615.7522
     -Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.78793176
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 205990.317
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.8802E+008
  Mu1+ = 1.8495E+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- = 1.8802E+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-) = 1.8800E+008
  Mu2+ = 1.8498E+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- = 1.8800E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
  V1 = 2740.265, is the shear force acting at edge 1 for the the static loading combination
  V2 = 2740.264, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 0.0001071
Mu = 1.8495E+008
----
with full section properties:
 b = 300.00
 d = 357.00
 d' = 42.00
 v = 8.2121432E-005
    N = 211.0849
 fc = 24.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
      ase ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
         bi2 = 346400.00
    psh,min = Min(psh,x , psh,y) = 0.00261799
    ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
    ----
      psh,y (5.4d) = 0.00261799

```
              Ash = Astir*ns = 78.53982
                  No stirups, ns = 2.00
              bk = 400.00

      ----------------------------------------------------------------
              s = 150.00
            fywe = 656.25
             fce = 24.00
        From ((5.A5), TBDY):  cc = 0.00290026
              c = confinement factor = 1.09003
     y1 = 0.0025
    sh1 = 0.008
   ft1 = 787.50
   fy1 = 656.25
    su1 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
       su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs1 = fs = 656.25
        with Es1 = Es = 200000.00
     y2 = 0.0025
    sh2 = 0.008
   ft2 = 787.50
   fy2 = 656.25
    su2 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 1.00
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs2 = fs = 656.25
        with Es2 = Es = 200000.00
     yv = 0.0025
    shv = 0.008
   ftv = 787.50
   fyv = 656.25
    suv = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fsv = fs = 656.25
        with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.15399964
     2 = Asl,com/(b*d)*(fs2/fc) = 0.15720797
     v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
 and confined core properties:
   b = 240.00
   d = 327.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
```

```
        c  = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.21016006
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21453839
    v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.1630814
Mu = MRc (4.14) = 1.8495E+008
   u =    su (4.1) = 0.0001071
-----------------------------------------------------------

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

--------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010722
Mu = 1.8802E+008
--------------------------------------------------------------------
with full section properties:
   b = 300.00
   d = 358.00
   d' = 43.00
   v = 8.1892042E-005
     N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu:  cu* = shear_factor * Max( cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.00773686
       we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
       psh,min = Min(psh,x , psh,y) = 0.00261799
       -----------------------------------------------------------------
       psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 300.00
       -----------------------------------------------------------------
       psh,y (5.4d) = 0.00261799
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 400.00
       -----------------------------------------------------------------
          s = 150.00
        fywe = 656.25
        fce  = 24.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00290026
          c = confinement factor = 1.09003
    y1 = 0.0025
    sh1 = 0.008
   ft1 = 787.50
   fy1 = 656.25
    su1 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
```

and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 656.25
     with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/lb,min = 1.00
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esu2_nominal = 0.08,
   For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
   characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 656.25
    with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 656.25
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.15676884
  2 = Asl,com/(b*d)*(fs2/fc) = 0.15356947
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
  b = 240.00
  d = 328.00
  d' = 13.00
  fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
   c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.21388431
   2 = Asl,com/(b*d)*(fs2/fc) = 0.20951933
   v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16631328
Mu = MRc (4.14) = 1.8802E+008
 u =   su (4.1) = 0.00010722

Calculation of ratio lb/ld

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

-----------------------------------------------------------------------
Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 0.00010701
Mu = 1.8498E+008
-----------------------------------------------------------------------
with full section properties:
  b = 300.00
  d = 358.00
  d' = 43.00
  v = 8.1892042E-005
    N = 211.0849
  fc = 24.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu:  εcu* = shear_factor * Max(εcu, εcc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  εcu = 0.00773686
      ωwe (5.4c) = 0.01121936
      αse ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
        bi2 = 346400.00
      ρsh,min = Min(ρsh,x , ρsh,y) = 0.00261799
      -----------------------------------------------------------------
      ρsh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      -----------------------------------------------------------------
      ρsh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      -----------------------------------------------------------------
        s = 150.00
        fywe = 656.25
        fce = 24.00
      From ((5.A5), TBDY), TBDY:  εcc = 0.00290026
        εc = confinement factor = 1.09003
  εy1 = 0.0025
  εsh1 = 0.008
  εft1 = 787.50
  εfy1 = 656.25
  εsu1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
    εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and εy1, εsh1,εft1,εfy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    εy1, εsh1,εft1,εfy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  εy2 = 0.0025
  εsh2 = 0.008
  εft2 = 787.50
  εfy2 = 656.25
  εsu2 = 0.032
```

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 656.25
  with Es2 = Es = 200000.00
yv = 0.0025
shv = 0.008
ftv = 787.50
fyv = 656.25
  suv = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esuv_nominal = 0.08,
  considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
  For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
  characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 656.25
    with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.15356947
  2 = Asl,com/(b*d)*(fs2/fc) = 0.15676884
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
  b = 240.00
  d = 328.00
  d' = 13.00
  fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.20951933
    2 = Asl,com/(b*d)*(fs2/fc) = 0.21388431
    v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16466458
Mu = MRc (4.14) = 1.8498E+008
  u =   su (4.1) = 0.00010701

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010732
Mu = 1.8800E+008
----
with full section properties:
  b = 300.00

144.

d = 357.00
d' = 42.00
v = 8.2121432E-005
  N = 211.0849
fc = 24.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.00773686
   we (5.4c) = 0.01121936
   ase ((5.4d), TBDY) = 0.15672608
    bo = 240.00
    ho = 340.00
    bi2 = 346400.00
   psh,min = Min(psh,x , psh,y) = 0.00261799
  ----
   psh,x (5.4d) = 0.00349066
    Ash = Astir*ns = 78.53982
     No stirups, ns = 2.00
    bk = 300.00
  ----
   psh,y (5.4d) = 0.00261799
    Ash = Astir*ns = 78.53982
     No stirups, ns = 2.00
    bk = 400.00
  ----
    s = 150.00
   fywe = 656.25
   fce = 24.00
  From ((5A5), TBDY), TBDY: cc = 0.00290026
   c = confinement factor = 1.09003
 y1 = 0.0025
 sh1 = 0.008
ft1 = 787.50
fy1 = 656.25
 su1 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
  su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs1 = fs = 656.25
  with Es1 = Es = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
 su2 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 1.00
  su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
  y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fs2 = fs = 656.25
  with Es2 = Es = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 787.50
fyv = 656.25

suv = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 656.25
    with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15720797
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15399964
   v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
  b = 240.00
  d = 327.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
     c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.21453839
   2 = Asl,com/(b*d)*(fs2/fc) = 0.21016006
   v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16474284
Mu = MRc (4.14) = 1.8800E+008
 u =   su (4.1) = 0.00010732

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 261431.672

Calculation of Shear Strength at edge 1, Vr1 = 261431.672
Vr1 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
      = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
       As (tension reinf.) = 603.1858
       bw = 300.00
       d = 320.00
    Vu*d/Mu < 1 = 1.00
       Mu = 30114.962
       Vu = 2740.265
  From (11.5.4.8), ACI 318-14: Vs = 175929.189
    Av = 157079.633
    fy = 525.00
    s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00

From (11-11), ACI 440: Vs + Vf <= 312423.44

Calculation of Shear Strength at edge 2, Vr2 = 261431.672
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
     = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
      As (tension reinf.) = 603.1858
      bw = 300.00
      d = 320.00
    Vu*d/Mu < 1 = 1.00
      Mu = 30115.665
      Vu = 2740.264
  From (11.5.4.8), ACI 318-14: Vs = 175929.189
    Av = 157079.633
    fy = 525.00
    s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 312423.44

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -3.6870970E-015
EDGE -B-
Shear Force, Vb = 3.6870970E-015
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 603.1858
   -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 508.938
   -Compression: Asl,com = 508.938
     -Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.79211753
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 137993.601
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.2764E+008
   Mu1+ = 1.2764E+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- = 1.2764E+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-) = 1.2764E+008
   Mu2+ = 1.2764E+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- = 1.2764E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with
   V1 = -3.6870970E-015, is the shear force acting at edge 1 for the the static loading combination
   V2 = 3.6870970E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
   b = 400.00
   d = 258.00
   d' = 42.00
   v = 8.5224858E-005
     N = 211.0849
   fc = 24.00
    co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00773686
        we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
        psh,min = Min(psh,x , psh,y) = 0.00261799
     ----
        psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982

```
              No stirups, ns = 2.00
            bk = 300.00
      -----------------------------------------------------------------
        psh,y (5.4d) = 0.00261799
            Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
            bk = 400.00
      -----------------------------------------------------------------
            s = 150.00
          fywe = 656.25
          fce = 24.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00290026
          c  = confinement factor = 1.09003
    y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
       su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 656.25
       with Es1 = Es = 200000.00
    y2 = 0.0025
   sh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
   su2 = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/lb,min = 1.00
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu2_nominal = 0.08,
      For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
      characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 656.25
       with Es2 = Es = 200000.00
    yv = 0.0025
   shv = 0.008
  ftv = 787.50
  fyv = 656.25
   suv = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esuv_nominal = 0.08,
      considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
      For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
      characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fsv = fs = 656.25
       with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
    v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
```

```
   d = 228.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
     cc (5A.5, TBDY) = 0.00290026
        c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
 u =   su (4.1) = 0.00015613
------------------------------------------------------------

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

--------------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
--------------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.00773686
        we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
           bo = 240.00
           ho = 340.00
            bi2 = 346400.00
        psh,min = Min(psh,x , psh,y) = 0.00261799
        ----------------------------------------------------------------
        psh,x (5.4d) = 0.00349066
           Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
           bk = 300.00
        ----------------------------------------------------------------
        psh,y (5.4d) = 0.00261799
           Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
           bk = 400.00
        ----------------------------------------------------------------
           s = 150.00
         fywe = 656.25
         fce = 24.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00290026
          c = confinement factor = 1.09003
   y1 = 0.0025
   sh1 = 0.008
```

ft1 = 787.50
fy1 = 656.25
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
ftv = 787.50
fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
    2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
    v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
    2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
    v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008

u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
       we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
           bo = 240.00
           ho = 340.00
            bi2 = 346400.00
       psh,min = Min(psh,x , psh,y) = 0.00261799
       ----
       psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 300.00
       ----
       psh,y (5.4d) = 0.00261799
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 400.00
       ----
           s = 150.00
         fywe = 656.25
         fce = 24.00
     From ((5.A5), TBDY), TBDY: cc = 0.00290026
          c = confinement factor = 1.09003
    y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
   y2 = 0.0025

sh2 = 0.008
    ft2 = 787.50
    fy2 = 656.25
     su2 = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/lb,min = 1.00
        su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esu2_nominal = 0.08,
       For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
       characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fs2 = fs = 656.25
         with Es2 = Es = 200000.00
     yv = 0.0025
     shv = 0.008
    ftv = 787.50
    fyv = 656.25
     suv = 0.032
       using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
       and also multiplied by the shear_factor according to 15.7.1.4, with
       Shear_factor = 1.00
       lo/lou,min = lb/ld = 1.00
        suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
       From table 5A.1, TBDY: esuv_nominal = 0.08,
       considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
       For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
       characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
        y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
         with fsv = fs = 656.25
         with Esv = Es = 200000.00
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
      2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
      v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
   b = 340.00
   d = 228.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
    cc (5A.5, TBDY) = 0.00290026
      c = confinement factor = 1.09003
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
      2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
      v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613

Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
      we (5.4c) = 0.01121936
      ase ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
         bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      ----
        s = 150.00
      fywe = 656.25
      fce = 24.00
    From ((5.A5), TBDY), TBDY: cc = 0.00290026
      c = confinement factor = 1.09003
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 656.25
    with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 656.25
    with Es2 = Es = 200000.00

yv = 0.0025
shv = 0.008
ftv = 787.50
fyv = 656.25
suv = 0.032
   using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
   and also multiplied by the shear_factor according to 15.7.1.4, with
   Shear_factor = 1.00
   lo/lou,min = lb/ld = 1.00
   suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
   From table 5A.1, TBDY: esuv_nominal = 0.08,
   considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
   For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
   with fsv = fs = 656.25
   with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
  2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
  v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
  cc (5A.5, TBDY) = 0.00290026
    c = confinement factor = 1.09003
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
  2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
  v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
 u = su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 174208.493

Calculation of Shear Strength at edge 1, Vr1 = 174208.493
Vr1 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
    = 1 (normal-weight concrete)
    fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00628319
     As (tension reinf.) = 603.1858
     bw = 400.00
     d = 240.00
    Vu*d/Mu < 1 = 0.00
     Mu = 7.6252677E-012
     Vu = 3.6870970E-015
  From (11.5.4.8), ACI 318-14: Vs = 98960.169
    Av = 157079.633

```
    fy = 525.00
     s = 150.00
   Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
    2(1-s/d) = 0.75
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf < = 312423.44
-----------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 174208.493
Vr2 = Vn ((22.5.1.1), ACI 318-14)
-----------------------------------------------------------------
NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
-----------------------------------------------------------------
   From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
        = 1 (normal-weight concrete)
     fc' = 24.00, but fc^0.5 < = 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00628319
        As (tension reinf.) = 603.1858
        bw = 400.00
        d = 240.00
     Vu*d/Mu < 1 = 0.00
        Mu = 8.0393416E-013
        Vu = 3.6870970E-015
   From (11.5.4.8), ACI 318-14: Vs = 98960.169
     Av = 157079.633
     fy = 525.00
     s = 150.00
   Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
    2(1-s/d) = 0.75
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf < = 312423.44
---------------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2


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


Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcars

Constant Properties
---------------------------------------------------------------
Knowledge Factor,    = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping
---------------------------------------------------------------

Stepwise Properties
```

Bending Moment, M = 4.4551E+006
Shear Force, V2 = -2.3583230E-014
Shear Force, V3 = 7492.435
Axial Force, F = -490.6724
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 615.7522
  -Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 615.7522
   -Compression: Asl,com = 603.1858
     -Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL = 14.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = * θu = 0.02216348
 θu = θy + θp = 0.02216348

 - Calculation of θy -

 θy = (My*Ls/3)/EIeff = 0.00216348 ((4.29),Biskinis Phd))
  My = 1.2064E+008
  Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 594.6128
  From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 1.1052E+013

Calculation of Yielding Moment My

Calculation of ϕy and My according to Annex 7 -

 ϕy = Min(ϕy_ten, ϕy_com)
 ϕy_ten = 1.0039820E-005
with fy = 525.00
   d = 358.00
    y = 0.26966795
   A = 0.01422485
   B = 0.00802201
    with pt = 0.00573326
      pc = 0.00561626
      pv = 0.00286663
      N = 490.6724
      b = 300.00
       " = 0.12011173
 ϕy_comp = 1.9439150E-005
with fc = 24.00
   Ec = 23025.204
    y = 0.26960005
   A = 0.01420397
   B = 0.00801331
    with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of θp -

From table 10-7: θp = 0.02
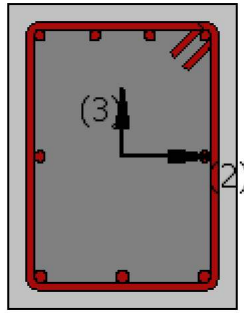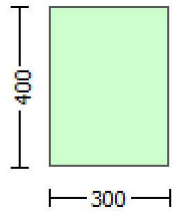with:
 - Condition i occured
  Beam controlled by flexure: Vp/Vo <= 1

shear control ratio Vp/Vo = 0.78793176
- Transverse Reinforcement: NC
- Stirrup Spacing > d/3
- Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
      = 1.3800479E-005
- Stirrup Spacing <= d/2
  d = 358.00
  s = 150.00
- Strength provided by hoops Vs < 3/4*design Shear
  Vs = 175929.189,already given in calculation of shear control ratio
  design Shear = 7492.435
- (- ')/ bal = -0.15609354
    = Aslt/(bw*d) = 0.00573326
  Tension Reinf Area: Aslt = 615.7522
  ' = Aslc/(bw*d) = 0.00848289
  Compression Reinf Area: Aslc = 911.0619
 From (B-1), ACI 318-11: bal = 0.01761524
  fc = 24.00
  fy = 525.00
  From 10.2.7.3, ACI 318-11: 1 = 0.85
  From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.53333333
      y = 0.002625
- V/(bw*d*fc^0.5) = 0.17148902, NOTE: units in lb & in
  bw = 300.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 2
Integration Section: (b)

Calculation No. 15

beam B1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Shear capacity VRd

Edge: End

Local Axis: (3)

Start Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Member Shear Force is generally considered as Force-Controlled Action according to Table C7-1, ASCE 41-17.
Lower-bound strengths are used for Force-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fc_lower_bound = 16.00
Existing material of Primary Member: Steel Strength, fs = fs_lower_bound = 420.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min = lb/ld >=1)
No FRP Wrapping

Stepwise Properties

EDGE -A-
Bending Moment, Ma = 4.3364E+006
Shear Force, Va = -2011.906
EDGE -B-
Bending Moment, Mb = 4.4551E+006
Shear Force, Vb = 7492.435
BOTH EDGES
Axial Force, F = -490.6724
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 615.7522
    -Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 615.7522
    -Compression: Asl,com = 603.1858
      -Middle: Asl,mid = 307.8761
Mean Diameter of Tension Reinforcement, DbL,ten = 14.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 207816.751
Vn ((22.5.1.1), ACI 318-14) = 207816.751

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+ ϕf*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

  From Table (22.5.5.1), ACI 318-14: Vc = 67073.40
      λ = 1 (normal-weight concrete)
    fc' = 16.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00641409
      As (tension reinf.) = 615.7522
      bw = 300.00
      d = 320.00
    Vu*d/Mu < 1 = 0.53816531
      Mu = 4.4551E+006
      Vu = 7492.435
  From (11.5.4.8), ACI 318-14: Vs = 140743.351
    Av = 157079.633
    fy = 420.00
    s = 150.00
  Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 255092.67

End Of Calculation of Shear Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)

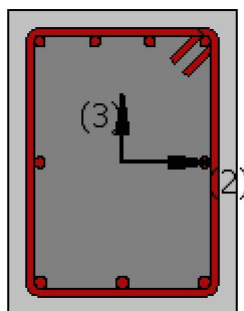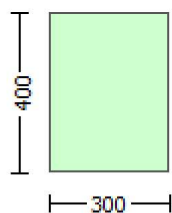# Calculation No. 16

beam B1, Floor 1

Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Chord rotation capacity (θu)

Edge: End

Local Axis: (3)

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)

Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
##
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 3
EDGE -A-
Shear Force, Va = 2740.265
EDGE -B-
Shear Force, Vb = 2740.264
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 603.1858
    -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 603.1858
    -Compression: Asl,com = 615.7522
      -Middle: Asl,mid = 307.8761

Calculation of Shear Capacity ratio , Ve/Vr = 0.78793176
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 205990.317
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.8802E+008
   Mu1+ = 1.8495E+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- = 1.8802E+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-) = 1.8800E+008
   Mu2+ = 1.8498E+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- = 1.8800E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
and
± wu*ln = (|V1| + |V2|)/2
with

V1 = 2740.265, is the shear force acting at edge 1 for the the static loading combination
V2 = 2740.264, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 0.0001071
Mu = 1.8495E+008
----
with full section properties:
  b = 300.00
  d = 357.00
  d' = 42.00
  ν = 8.2121432E-005
    N = 211.0849
  fc = 24.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00773686
      ωwe (5.4c) = 0.01121936
      αse ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
          bi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      ----
        s = 150.00
      fywe = 656.25
      fce = 24.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00290026
        εc = confinement factor = 1.09003
  εy1 = 0.0025
  εsh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
  εsu1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     εsu1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and εy1, εsh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    εy1, εsh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  εy2 = 0.0025
  εsh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
  εsu2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 1.00
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 656.25
with Es2 = Es = 200000.00
yv = 0.0025
shv = 0.008
ftv = 787.50
fyv = 656.25
suv = 0.032
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 656.25
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.15399964
2 = Asl,com/(b*d)*(fs2/fc) = 0.15720797
v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
b = 240.00
d = 327.00
d' = 12.00
fcc (5A.2, TBDY) = 26.16063
cc (5A.5, TBDY) = 0.00290026
c = confinement factor = 1.09003
1 = Asl,ten/(b*d)*(fs1/fc) = 0.21016006
2 = Asl,com/(b*d)*(fs2/fc) = 0.21453839
v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.1630814
Mu = MRc (4.14) = 1.8495E+008
u =   su (4.1) = 0.0001071

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
u = 0.00010722
Mu = 1.8802E+008
----
with full section properties:
b = 300.00
d = 358.00

d' = 43.00
v = 8.1892042E-005
  N = 211.0849
fc = 24.00
 co (5A.5, TBDY) = 0.002
Final value of cu: $cu^* = shear\_factor * Max(cu, cc) = 0.00773686$
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.00773686
   we (5.4c) = 0.01121936
    ase ((5.4d), TBDY) = 0.15672608
     bo = 240.00
     ho = 340.00
      bi2 = 346400.00
   psh,min = Min(psh,x , psh,y) = 0.00261799
  ----
   psh,x (5.4d) = 0.00349066
    Ash = Astir*ns = 78.53982
     No stirups, ns = 2.00
    bk = 300.00
  ----
   psh,y (5.4d) = 0.00261799
    Ash = Astir*ns = 78.53982
     No stirups, ns = 2.00
    bk = 400.00
  ----
    s = 150.00
    fywe = 656.25
    fce = 24.00
  From ((5.A5), TBDY), TBDY: cc = 0.00290026
    c = confinement factor = 1.09003
 y1 = 0.0025
 sh1 = 0.008
ft1 = 787.50
fy1 = 656.25
 su1 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/ld = 1.00
   su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu1_nominal = 0.08,
  For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
  characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by $Min(1,1.25*(lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
   with fs1 = fs = 656.25
   with Es1 = Es = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 787.50
fy2 = 656.25
 su2 = 0.032
  using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
  and also multiplied by the shear_factor according to 15.7.1.4, with
  Shear_factor = 1.00
  lo/lou,min = lb/lb,min = 1.00
   su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
  From table 5A.1, TBDY: esu2_nominal = 0.08,
  For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
  characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
   y1, sh1,ft1,fy1, are also multiplied by $Min(1,1.25*(lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
   with fs2 = fs = 656.25
   with Es2 = Es = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 787.50
fyv = 656.25
 suv = 0.032

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 1.00
  suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
 y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
  with fsv = fs = 656.25
  with Esv = Es = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.15676884
 2 = Asl,com/(b*d)*(fs2/fc) = 0.15356947
 v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
and confined core properties:
  b = 240.00
  d = 328.00
  d' = 13.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
     c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.21388431
   2 = Asl,com/(b*d)*(fs2/fc) = 0.20951933
   v = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.16631328
Mu = MRc (4.14) = 1.8802E+008
  u =   su (4.1) = 0.00010722

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2+

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00010701
Mu = 1.8498E+008
----
with full section properties:
  b = 300.00
  d = 358.00
  d' = 43.00
  v = 8.1892042E-005
   N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00773686
     we (5.4c) = 0.01121936
      ase ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
         bi2 = 346400.00
     psh,min = Min(psh,x , psh,y) = 0.00261799

```
        psh,x (5.4d) = 0.00349066
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 300.00
        -------------------------------------------------------------------
        psh,y (5.4d) = 0.00261799
            Ash = Astir*ns = 78.53982
               No stirups, ns = 2.00
            bk = 400.00
        -------------------------------------------------------------------
            s = 150.00
         fywe = 656.25
          fce = 24.00
       From ((5.A5), TBDY), TBDY:  cc = 0.00290026
            c = confinement factor = 1.09003
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs1 = fs = 656.25
      with Es1 = Es = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.15356947
  2 = Asl,com/(b*d)*(fs2/fc) = 0.15676884
  v = Asl,mid/(b*d)*(fsv/fc) = 0.07838442
```

and confined core properties:
  b = 240.00
  d = 328.00
  d' = 13.00
  fcc (5A.2, TBDY) = 26.16063
   εcc (5A.5, TBDY) = 0.00290026
      κc = confinement factor = 1.09003
    ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.20951933
    ω2 = Asl,com/(b*d)*(fs2/fc) = 0.21388431
    ωv = Asl,mid/(b*d)*(fsv/fc) = 0.10694216
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
ωv < ωvs,y2 - LHS eq.(4.5) is satisfied
--->
 εsu (4.9) = 0.16466458
Mu = MRc (4.14) = 1.8498E+008
  φu = φsu (4.1) = 0.00010701

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature φu according to 4.1, Biskinis/Fardis 2013:
  φu = 0.00010732
Mu = 1.8800E+008
----
with full section properties:
  b = 300.00
  d = 357.00
  d' = 42.00
  ν = 8.2121432E-005
    N = 211.0849
  fc = 24.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00773686
      ωwe (5.4c) = 0.01121936
      αse ((5.4d), TBDY) = 0.15672608
        bo = 240.00
        ho = 340.00
         Σbi2 = 346400.00
      psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
      psh,x (5.4d) = 0.00349066
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 300.00
      ----
      psh,y (5.4d) = 0.00261799
        Ash = Astir*ns = 78.53982
          No stirups, ns = 2.00
        bk = 400.00
      ----
        s = 150.00
       fywe = 656.25
       fce = 24.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00290026
        κc = confinement factor = 1.09003

```
   y1 = 0.0025
   sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
       su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 656.25
       with Es1 = Es = 200000.00
   y2 = 0.0025
   sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
   su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 656.25
       with Es2 = Es = 200000.00
   yv = 0.0025
   shv = 0.008
 ftv = 787.50
 fyv = 656.25
   suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
       y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fsv = fs = 656.25
       with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15720797
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15399964
   v = Asl,mid/(b*d)*(fsv/fc) = 0.07860398
and confined core properties:
   b = 240.00
   d = 327.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
     cc (5A.5, TBDY) = 0.00290026
        c  = confinement factor = 1.09003
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.21453839
     2 = Asl,com/(b*d)*(fs2/fc) = 0.21016006
     v = Asl,mid/(b*d)*(fsv/fc) = 0.1072692
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
```

su (4.9) = 0.16474284
Mu = MRc (4.14) = 1.8800E+008
 u =   su (4.1) = 0.00010732

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 261431.672

Calculation of Shear Strength at edge 1, Vr1 = 261431.672
Vr1 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

   From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
        = 1 (normal-weight concrete)
      fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00628319
         As (tension reinf.) = 603.1858
         bw = 300.00
         d = 320.00
      Vu*d/Mu < 1 = 1.00
         Mu = 30114.962
         Vu = 2740.265
   From (11.5.4.8), ACI 318-14: Vs = 175929.189
      Av = 157079.633
      fy = 525.00
      s = 150.00
   Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44

Calculation of Shear Strength at edge 2, Vr2 = 261431.672
Vr2 = Vn ((22.5.1.1), ACI 318-14)

NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+   f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

   From Table (22.5.5.1), ACI 318-14: Vc = 85502.483
        = 1 (normal-weight concrete)
      fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00628319
         As (tension reinf.) = 603.1858
         bw = 300.00
         d = 320.00
      Vu*d/Mu < 1 = 1.00
         Mu = 30115.665
         Vu = 2740.264
   From (11.5.4.8), ACI 318-14: Vs = 175929.189
      Av = 157079.633
      fy = 525.00
      s = 150.00
   Vs has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
###
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
###
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.09003
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lo/lou,min>=1)
No FRP Wrapping

Stepwise Properties

At local axis: 2
EDGE -A-
Shear Force, Va = -3.6870970E-015
EDGE -B-
Shear Force, Vb = 3.6870970E-015
BOTH EDGES
Axial Force, F = -211.0849
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 603.1858
    -Compression: Aslc = 923.6282
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 508.938
    -Compression: Asl,com = 508.938
      -Middle: Asl,mid = 508.938

Calculation of Shear Capacity ratio , Ve/Vr = 0.79211753
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln ± wu*ln/2 = 137993.601
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.2764E+008
   Mu1+ = 1.2764E+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- = 1.2764E+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-) = 1.2764E+008
   Mu2+ = 1.2764E+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- = 1.2764E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment

direction which is defined for the the static loading combination
and
$\pm w_u * l_n = (|V1| + |V2|)/2$
with
  V1 = -3.6870970E-015, is the shear force acting at edge 1 for the the static loading combination
  V2 = 3.6870970E-015, is the shear force acting at edge 2 for the the static loading combination

----
Calculation of Mu1+

Calculation of ultimate curvature ϕ_u according to 4.1, Biskinis/Fardis 2013:
  ϕ_u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   ϵ_{co} (5A.5, TBDY) = 0.002
  Final value of ϵ_{cu}: ϵ_{cu}* = shear_factor * Max(ϵ_{cu}, ϵ_{cc}) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: ϵ_{cu} = 0.00773686
        ω_{we} (5.4c) = 0.01121936
        α_{se} ((5.4d), TBDY) = 0.15672608
           bo = 240.00
           ho = 340.00
            bi2 = 346400.00
        psh,min = Min(psh,x , psh,y) = 0.00261799
        ----
        psh,x (5.4d) = 0.00349066
           Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
           bk = 300.00
        ----
        psh,y (5.4d) = 0.00261799
           Ash = Astir*ns = 78.53982
              No stirups, ns = 2.00
           bk = 400.00
        ----
           s = 150.00
          fywe = 656.25
          fce = 24.00
        From ((5A.5), TBDY), TBDY: ϵ_{cc} = 0.00290026
           α_c = confinement factor = 1.09003
   ϵ_{y1} = 0.0025
   ϵ_{sh1} = 0.008
   ft1 = 787.50
   fy1 = 656.25
   ϵ_{su1} = 0.032
      using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
      and also multiplied by the shear_factor according to 15.7.1.4, with
      Shear_factor = 1.00
      lo/lou,min = lb/ld = 1.00
       ϵ_{su1} = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
      From table 5A.1, TBDY: esu1_nominal = 0.08,
      For calculation of esu1_nominal and ϵ_{y1}, sh1,ft1,fy1, it is considered
      characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
       ϵ_{y1}, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
        with fs1 = fs = 656.25
        with Es1 = Es = 200000.00
   ϵ_{y2} = 0.0025
   ϵ_{sh2} = 0.008

ft2 = 787.50
fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fs2 = fs = 656.25
      with Es2 = Es = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
   2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
   v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
     c = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
   2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
   v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008

```
---------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
    N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00773686
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.00773686
      we (5.4c) = 0.01121936
       ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
          ho = 340.00
           bi2 = 346400.00
       psh,min = Min(psh,x , psh,y) = 0.00261799
      ---------------------------------------------------------------
       psh,x (5.4d) = 0.00349066
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 300.00
      ---------------------------------------------------------------
       psh,y (5.4d) = 0.00261799
          Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
          bk = 400.00
      ---------------------------------------------------------------
          s = 150.00
         fywe = 656.25
         fce  = 24.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00290026
         c  = confinement factor = 1.09003
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
  fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 656.25
       with Es1 = Es = 200000.00
   y2 = 0.0025
   sh2 = 0.008
  ft2 = 787.50
  fy2 = 656.25
   su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
      su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 656.25
       with Es2 = Es = 200000.00
   yv = 0.0025
```

```
   shv = 0.008
  ftv = 787.50
  fyv = 656.25
   suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
      suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and   yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
      with fsv = fs = 656.25
      with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
   2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
   v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
      c  = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
   2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
   v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =    su (4.1) = 0.00015613
-----------------------------------------------------------

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

-------------------------------------------------------------------
Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
  u = 0.00015613
Mu = 1.2764E+008
-------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 258.00
  d' = 42.00
  v = 8.5224858E-005
     N = 211.0849
  fc = 24.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00773686
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.00773686
       we (5.4c) = 0.01121936
        ase ((5.4d), TBDY) = 0.15672608
          bo = 240.00
```

```
                ho = 340.00
                  bi2 = 346400.00
             psh,min = Min(psh,x , psh,y) = 0.00261799
        ------------------------------------------------------------------
             psh,x (5.4d) = 0.00349066
                Ash = Astir*ns = 78.53982
                   No stirups, ns = 2.00
                bk = 300.00
        ------------------------------------------------------------------
             psh,y (5.4d) = 0.00261799
                Ash = Astir*ns = 78.53982
                   No stirups, ns = 2.00
                bk = 400.00
        ------------------------------------------------------------------
                s = 150.00
             fywe = 656.25
             fce  = 24.00
        From ((5.A5), TBDY), TBDY:  cc = 0.00290026
                c  = confinement factor = 1.09003
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 787.50
 fy1 = 656.25
   su1 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
       su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu1_nominal = 0.08,
     For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
     characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs1 = fs = 656.25
       with Es1 = Es = 200000.00
   y2 = 0.0025
   sh2 = 0.008
  ft2 = 787.50
 fy2 = 656.25
   su2 = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/lb,min = 1.00
       su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esu2_nominal = 0.08,
     For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
     characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fs2 = fs = 656.25
       with Es2 = Es = 200000.00
   yv = 0.0025
   shv = 0.008
  ftv = 787.50
 fyv = 656.25
   suv = 0.032
     using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
     and also multiplied by the shear_factor according to 15.7.1.4, with
     Shear_factor = 1.00
     lo/lou,min = lb/ld = 1.00
       suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
     From table 5A.1, TBDY: esuv_nominal = 0.08,
     considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
     For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
     characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
      y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
       with fsv = fs = 656.25
```

with Esv = Es = 200000.00
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
     2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
     v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
and confined core properties:
   b = 340.00
   d = 228.00
   d' = 12.00
   fcc (5A.2, TBDY) = 26.16063
     cc (5A.5, TBDY) = 0.00290026
        c = confinement factor = 1.09003
     1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
     2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
     v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
  su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
   u =   su (4.1) = 0.00015613

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu2-

Calculation of ultimate curvature   u according to 4.1, Biskinis/Fardis 2013:
   u = 0.00015613
Mu = 1.2764E+008
----
with full section properties:
   b = 400.00
   d = 258.00
   d' = 42.00
   v = 8.5224858E-005
     N = 211.0849
   fc = 24.00
    co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00773686
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.00773686
        we (5.4c) = 0.01121936
         ase ((5.4d), TBDY) = 0.15672608
            bo = 240.00
            ho = 340.00
             bi2 = 346400.00
        psh,min = Min(psh,x , psh,y) = 0.00261799
      ----
        psh,x (5.4d) = 0.00349066
           Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
           bk = 300.00
      ----
        psh,y (5.4d) = 0.00261799
           Ash = Astir*ns = 78.53982
             No stirups, ns = 2.00
           bk = 400.00
      ----
           s = 150.00

```
      fywe = 656.25
       fce  = 24.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00290026
        c  = confinement factor = 1.09003
   y1 = 0.0025
  sh1 = 0.008
 ft1 = 787.50
 fy1 = 656.25
  su1 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and  y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs1 = fs = 656.25
     with Es1 = Es = 200000.00
   y2 = 0.0025
  sh2 = 0.008
 ft2 = 787.50
 fy2 = 656.25
  su2 = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 1.00
     su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and  y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fs2 = fs = 656.25
     with Es2 = Es = 200000.00
   yv = 0.0025
  shv = 0.008
 ftv = 787.50
 fyv = 656.25
  suv = 0.032
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 1.00
     suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and  yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
     y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with fsv = fs = 656.25
     with Esv = Es = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.13484761
   2 = Asl,com/(b*d)*(fs2/fc) = 0.13484761
   v = Asl,mid/(b*d)*(fsv/fc) = 0.13484761
 and confined core properties:
  b = 340.00
  d = 228.00
  d' = 12.00
  fcc (5A.2, TBDY) = 26.16063
   cc (5A.5, TBDY) = 0.00290026
      c  = confinement factor = 1.09003
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.17951849
   2 = Asl,com/(b*d)*(fs2/fc) = 0.17951849
   v = Asl,mid/(b*d)*(fsv/fc) = 0.17951849
Case/Assumption: Unconfinesd full section - Steel rupture
```

```
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.20560388
Mu = MRc (4.14) = 1.2764E+008
  u =    su (4.1) = 0.00015613
---------------------------------------------------------

Calculation of ratio lb/ld
---------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
---------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 174208.493
---------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 174208.493
Vr1 = Vn ((22.5.1.1), ACI 318-14)
---------------------------------------------------------
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
---------------------------------------------------------
   From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
       = 1 (normal-weight concrete)
     fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00628319
        As (tension reinf.) = 603.1858
        bw = 400.00
        d = 240.00
     Vu*d/Mu < 1 = 0.00
        Mu = 7.6252677E-012
        Vu = 3.6870970E-015
   From (11.5.4.8), ACI 318-14: Vs = 98960.169
     Av = 157079.633
     fy = 525.00
     s = 150.00
   Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.75
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44
---------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 174208.493
Vr2 = Vn ((22.5.1.1), ACI 318-14)
---------------------------------------------------------
NOTE: In expression (22.5.1.1) 'Vw ' is replaced by 'Vw+  f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).
---------------------------------------------------------
   From Table (22.5.5.1), ACI 318-14: Vc = 75248.325
       = 1 (normal-weight concrete)
     fc' = 24.00, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00628319
        As (tension reinf.) = 603.1858
        bw = 400.00
        d = 240.00
     Vu*d/Mu < 1 = 0.00
        Mu = 8.0393416E-013
        Vu = 3.6870970E-015
   From (11.5.4.8), ACI 318-14: Vs = 98960.169
     Av = 157079.633
     fy = 525.00
     s = 150.00
   Vs has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.75
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 312423.44
```

End Of Calculation of Shear Capacity ratio for element: beam B1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcars

Constant Properties

Knowledge Factor,   = 1.00
Chord Rotation is generally considered as Deformation-Controlled Action according to Table C7-1, ASCE 41-17.
Mean strengths are used for Deformation-Controlled Actions according to 7.5.1.3, ASCE 41-17
Consequently:
Existing material of Primary Member: Concrete Strength, fc = fcm = 24.00
Existing material of Primary Member: Steel Strength, fs = fsm = 525.00
Concrete Elasticity, Ec = 23025.204
Steel Elasticity, Es = 200000.00
Section Height, H = 400.00
Section Width, W = 300.00
Cover Thickness, c = 25.00
Element Length, L = 1850.00
Primary Member
Smooth Bars
Ductile Steel
With Detailing for Earthquake Resistance (including stirrups closed at 135°)
Longitudinal Bars With Ends Lapped Starting at the End Sections
Adequate Lap Length (lb/ld>=1)
No FRP Wrapping

Stepwise Properties

Bending Moment, M = 5.4436895E-011
Shear Force, V2 = -2.3583230E-014
Shear Force, V3 = 7492.435
Axial Force, F = -490.6724
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 615.7522
    -Compression: Aslc = 911.0619
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 508.938
    -Compression: Asl,com = 508.938
       -Middle: Asl,mid = 508.938
Mean Diameter of Tension Reinforcement, DbL = 14.66667

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R =   * u = 0.02404297
  u =   y +   p = 0.02404297

 - Calculation of   y -
----
  y = (My*Ls/3)/Eleff = 0.00404297 ((4.29),Biskinis Phd))
  My = 8.1517E+007
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 925.00
  From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 6.2168E+012

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7   -
----
  y = Min(y_ten, y_com)
  y_ten = 1.4111379E-005
 with fy = 525.00
    d = 258.00
     y = 0.27899188
    A = 0.01480377
    B = 0.00861063
     with pt = 0.00493157
        pc = 0.00493157
        pv = 0.00493157
        N = 490.6724
        b = 400.00
        " = 0.1627907
  y_comp = 2.6071644E-005
 with fc = 24.00
    Ec = 23025.204
     y = 0.27892802
    A = 0.01478204
    B = 0.00860158
     with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of p -

From table 10-7: p = 0.02
with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1
   shear control ratio Vp/Vo = 0.79211753
 - Transverse Reinforcement: NC
 - Stirrup Spacing > d/3
 - Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
        = 5.4314820E-022
 - Stirrup Spacing > d/2
  d = 258.00
  s = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
  Vs = 131946.891,already given in calculation of shear control ratio
  design Shear = 2.3583230E-014
 - (- ')/ bal = -0.16244618
     = Aslt/(bw*d) = 0.00596659
    Tension Reinf Area: Aslt = 615.7522
    ' = Aslc/(bw*d) = 0.00882812
    Compression Reinf Area: Aslc = 911.0619
  From (B-1), ACI 318-11: bal = 0.01761524
    fc = 24.00
    fy = 525.00
    From 10.2.7.3, ACI 318-11: 1 = 0.85
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.53333333
        y = 0.002625
 - V/(bw*d*fc^0.5) = 5.6174758E-019, NOTE: units in lb & in
    bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam B1 of floor 1
At local axis: 3
Integration Section: (b)