Detailed Member Calculations

Units: N&mm

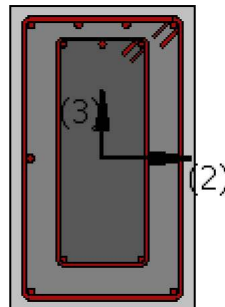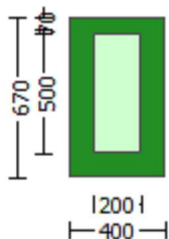**Regulation: ASCE 41-17**

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 JB1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00

Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -8.4907098E-011
Shear Force, Va = -5.4911670E-014
EDGE -B-
Bending Moment, Mb = -7.9998090E-011
Shear Force, Vb = 5.4911670E-014
BOTH EDGES
Axial Force, F = -7188.634
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 911.0619
    -Compression: Asl,com = 911.0619
      -Middle: Asl,mid = 556.0619
Mean Diameter of Tension Reinforcement, DbL,ten = 15.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 315128.448
Vn ((22.5.1.1), ACI 318-14) = 315128.448

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 = 147576.839
      = 1 (normal-weight concrete)
    Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 18.50746, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
      As (tension reinf.) = 709.9999
      bw = 670.00
      d = 320.00
    Vu*d/Mu < 1 = 0.00
      Mu = 8.4907098E-011
      Vu = 5.4911670E-014
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 167551.608
  Vs1 = 167551.608 is calculated for jacket, with:
    d = 320.00
    Av = 157079.633
    fy = 500.00
    s = 150.00

Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for core, with:
    d = 160.00
    Av = 100530.965
    fy = 420.00
    s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 612724.122

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)

Calculation No. 2
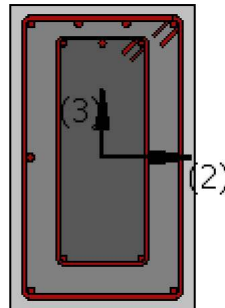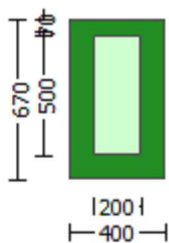
beam B1, Floor 1

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 JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96

Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 709.9999
    -Compression: Asl,com = 1266.062
      -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.92480584
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 = 535287.788
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.8817E+008
   Mu1+ = 4.6479E+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- = 7.8817E+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-) = 7.8817E+008
   Mu2+ = 4.6479E+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- = 7.8817E+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 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
V2 = 9840.634, 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 = 5.6369735E-005
Mu = 4.6479E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00680405
      ωwe (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
            bi2_1 = 975400.00
      ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
            bi2_2 = 557856.00
    ρsh,min*Fywe = Min(ρsh,x*Fywe , ρsh,y*Fywe) = 1.38519

    ρsh_x*Fywe = ρsh1*Fywe1+ρs2*Fywe2 = 2.45559
      ρs1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
        Ash1 = Astir_1*ns_1 = 157.0796
          No stirups, ns_1 = 2.00
        h1 = 670.00
      ρs2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
        Ash2 = Astir_2*ns_2 = 100.531
          No stirups, ns_2 = 2.00
        h2 = 500.00

    ρsh_y*Fywe = ρsh1*Fywe1+ρs2*Fywe2 = 1.38519
      ρs1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
        Ash1 = Astir_1*ns_1 = 157.0796
          No stirups, ns_1 = 2.00
        h1 = 400.00
      ρs2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
        Ash2 = Astir_2*ns_2 = 100.531
          No stirups, ns_2 = 2.00
        h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce = 30.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00242514
        εc = confinement factor = 1.04251
  εy1 = 0.0025
  εsh1 = 0.008
  ft1 = 872.4558
  fy1 = 727.0465

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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
   with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 882.7854
fy2 = 735.6545
 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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
   with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 937.50
fyv = 781.25
 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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
   with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
  2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
 b = 340.00
 d = 597.00
 d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
   c = confinement factor = 1.04251
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
  2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
 u =   su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
      ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ----
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 500.00
    ----
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 200.00

          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce = 30.00
      From ((5.A5), TBDY), TBDY: cc = 0.00242514
          c = confinement factor = 1.04251
    y1 = 0.0025

sh1 = 0.008
ft1 = 882.7854
fy1 = 735.6545
 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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
     with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
ft2 = 872.4558
fy2 = 727.0465
 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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
     with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
ftv = 937.50
fyv = 781.25
 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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
     with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
   2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
   v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
   2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
   v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied

```
--->
 su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
  u =   su (4.1) = 6.0907698E-005
------------------------------------------------------------

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 = 5.6369735E-005
Mu = 4.6479E+008
----------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.00680405
     we (5.4c) = 0.00682295
     ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
           bo_1 = 340.00
           ho_1 = 610.00
            bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
           bo_2 = 192.00
           ho_2 = 492.00
            bi2_2 = 557856.00
     psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ------------------------------------------------------------
     psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
           Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
           h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
           Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
           h2 = 500.00
    ------------------------------------------------------------
     psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
           Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
           h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
           Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
           h2 = 200.00
    ------------------------------------------------------------
           Asec = 268000.00
           s1 = 150.00
           s2 = 300.00
        fywe1 = 781.25
```

fywe2 = 656.25
fce = 30.00
From ((5.A5), TBDY), TBDY: cc = 0.00242514
c = confinement factor = 1.04251
y1 = 0.0025
sh1 = 0.008
ft1 = 872.4558
fy1 = 727.0465
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 882.7854
fy2 = 735.6545
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
cc (5A.5, TBDY) = 0.00242514
c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture

' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
 u =   su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
           bo_1 = 340.00
           ho_1 = 610.00
            bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
           bo_2 = 192.00
           ho_2 = 492.00
            bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ----
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
           Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
           h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
           Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
           h2 = 500.00
      ----
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
           Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
           h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
           Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
           h2 = 200.00

           Asec = 268000.00

s1 = 150.00
s2 = 300.00
fywe1 = 781.25
fywe2 = 656.25
fce = 30.00
From ((5.A5), TBDY), TBDY: cc = 0.00242514
c = confinement factor = 1.04251
y1 = 0.0025
sh1 = 0.008
ft1 = 882.7854
fy1 = 735.6545
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 872.4558
fy2 = 727.0465
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
cc (5A.5, TBDY) = 0.00242514
c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169

```
    2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
  u =   su (4.1) = 6.0907698E-005
-------------------------------------------------------------
```

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 578810.994

Calculation of Shear Strength at edge 1, Vr1 = 578810.994
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 = 192813.976
       = 1 (normal-weight concrete)
     Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 400.00
        d = 536.00
     Vu*d/Mu < 1 = 1.00
        Mu = 1.1510E+006
        Vu = 9840.632
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
   Vs1 = 350811.18 is calculated for jacket, with:
     d = 536.00
     Av = 157079.633
     fy = 625.00
     s = 150.00
    Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 35185.838 is calculated for jacket, with:
     d2 = 400.00
     Av = 100530.965
     fy = 525.00
     s = 300.00
   Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
    2(1-s/d) = 0.50
    Vf ((11-3)-(11.4), ACI 440) = 0.00
    From (11-11), ACI 440: Vs + Vf <= 750430.726

Calculation of Shear Strength at edge 2, Vr2 = 578810.994
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 = 192813.976
       = 1 (normal-weight concrete)
     Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)

```
   pw = As/(bw*d) = 0.00331157
      As (tension reinf.) = 709.9999
      bw = 400.00
      d = 536.00
   Vu*d/Mu < 1 = 1.00
      Mu = 1.1510E+006
      Vu = 9840.634
 From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
 Vs1 = 350811.18 is calculated for jacket, with:
    d = 536.00
    Av = 157079.633
    fy = 625.00
    s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
 Vs2 = 35185.838 is calculated for jacket, with:
    d = 400.00
    Av = 100530.965
    fy = 525.00
    s = 300.00
  Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
  2(1-s/d) = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726
-----------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3


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


Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties
-----------------------------------------------------------
Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
############################################################
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = -6.9728406E-015
EDGE -B-
Shear Force, Vb = 6.9728406E-015
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 709.9999
     -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 911.0619
     -Compression: Asl,com = 911.0619
         -Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.55914272
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 = 218168.257
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.2725E+008
  Mu1+ = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
  Mu1- = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.2725E+008
  Mu2+ = 3.2725E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
  Mu2- = 3.2725E+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 = -6.9728406E-015, is the shear force acting at edge 1 for the the static loading combination
  V2 = 6.9728406E-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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
     N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00680405

```
        we (5.4c) = 0.00682295
        ase ((5.4d), TBDY) = (ase1*Aext+ ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
              bo_1 = 340.00
              ho_1 = 610.00
               bi2_1 = 975400.00
          ase2 = Max(ase1,ase2) = 0.14776895
               bo_2 = 192.00
               ho_2 = 492.00
                bi2_2 = 557856.00
        psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
     ----------------------------------------------------------------
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 670.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 500.00
     ----------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 400.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 200.00
     ----------------------------------------------------------------
          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00242514
          c  = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
  with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 895.9746
fyv = 746.6455
 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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
     c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002

Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00680405
     we (5.4c) = 0.00682295
     ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
       ase1 = 0.14776895
         bo_1 = 340.00
         ho_1 = 610.00
          bi2_1 = 975400.00
       ase2 = Max(ase1,ase2) = 0.14776895
         bo_2 = 192.00
         ho_2 = 492.00
          bi2_2 = 557856.00
     psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
----
     psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
       ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
         Ash1 = Astir_1*ns_1 = 157.0796
          No stirups, ns_1 = 2.00
         h1 = 670.00
       ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
         Ash2 = Astir_2*ns_2 = 100.531
          No stirups, ns_2 = 2.00
         h2 = 500.00
----
     psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
       ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
         Ash1 = Astir_1*ns_1 = 157.0796
          No stirups, ns_1 = 2.00
          h1 = 400.00
       ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
         Ash2 = Astir_2*ns_2 = 100.531
          No stirups, ns_2 = 2.00
         h2 = 200.00

      Asec = 268000.00
      s1 = 150.00
      s2 = 300.00
    fywe1 = 781.25
    fywe2 = 656.25
    fce = 30.00
   From ((5.A5), TBDY), TBDY: cc = 0.00242514
     c = confinement factor = 1.04251
 y1 = 0.0025
 sh1 = 0.008
ft1 = 886.8103
fy1 = 739.0086
 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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
   with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 886.8103
fy2 = 739.0086
 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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
 with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 895.9746
fyv = 746.6455
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
 with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
 b = 610.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
 cc (5A.5, TBDY) = 0.00242514
 c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
 b = 670.00
 d = 357.00
 d' = 43.00
 v = 0.0003219

```
      N = 2309.834
fc = 30.00
 co (5A.5, TBDY) = 0.002
Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.00680405
       we (5.4c) = 0.00682295
        ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
           ase1 = 0.14776895
              bo_1 = 340.00
              ho_1 = 610.00
               bi2_1 = 975400.00
           ase2 = Max(ase1,ase2) = 0.14776895
              bo_2 = 192.00
              ho_2 = 492.00
               bi2_2 = 557856.00
        psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ----------------------------------------------------------------
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
              Ash1 = Astir_1*ns_1 = 157.0796
                 No stirups, ns_1 = 2.00
              h1 = 670.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
              Ash2 = Astir_2*ns_2 = 100.531
                 No stirups, ns_2 = 2.00
              h2 = 500.00
      ----------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
              Ash1 = Astir_1*ns_1 = 157.0796
                 No stirups, ns_1 = 2.00
              h1 = 400.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
              Ash2 = Astir_2*ns_2 = 100.531
                 No stirups, ns_2 = 2.00
              h2 = 200.00
      ----------------------------------------------------------------
           Asec = 268000.00
           s1 = 150.00
           s2 = 300.00
         fywe1 = 781.25
         fywe2 = 656.25
         fce = 30.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00242514
         c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 895.9746
fyv = 746.6455
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
cc (5A.5, TBDY) = 0.00242514
c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
u = su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
b = 670.00

d = 357.00
d' = 43.00
v = 0.0003219
  N = 2309.834
fc = 30.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.00680405
    we (5.4c) = 0.00682295
    ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
      ase1 = 0.14776895
        bo_1 = 340.00
        ho_1 = 610.00
         bi2_1 = 975400.00
      ase2 = Max(ase1,ase2) = 0.14776895
        bo_2 = 192.00
        ho_2 = 492.00
         bi2_2 = 557856.00
    psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ----
    psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
      ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
        Ash1 = Astir_1*ns_1 = 157.0796
          No stirups, ns_1 = 2.00
        h1 = 670.00
      ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
        Ash2 = Astir_2*ns_2 = 100.531
          No stirups, ns_2 = 2.00
        h2 = 500.00
    ----
    psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
      ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
        Ash1 = Astir_1*ns_1 = 157.0796
          No stirups, ns_1 = 2.00
        h1 = 400.00
      ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
        Ash2 = Astir_2*ns_2 = 100.531
          No stirups, ns_2 = 2.00
        h2 = 200.00

      Asec = 268000.00
      s1 = 150.00
      s2 = 300.00
    fywe1 = 781.25
    fywe2 = 656.25
    fce = 30.00
  From ((5.A5), TBDY), TBDY: cc = 0.00242514
      c = confinement factor = 1.04251
 y1 = 0.0025
 sh1 = 0.008
ft1 = 886.8103
fy1 = 739.0086
 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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
    with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
 y2 = 0.0025
 sh2 = 0.008

ft2 = 886.8103
fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
ftv = 895.9746
fyv = 746.6455
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
      with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
    cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  u =   su (4.1) = 0.00010507

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 390183.487

Calculation of Shear Strength at edge 1, Vr1 = 390183.487
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 = 180743.977
      = 1 (normal-weight concrete)
    Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
      As (tension reinf.) = 709.9999
      bw = 670.00
      d = 320.00
    Vu*d/Mu < 1 = 0.00
      Mu = 2.1102257E-011
      Vu = 6.9728406E-015
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
  Vs1 = 209439.51 is calculated for jacket, with:
    d = 320.00
    Av = 157079.633
    fy = 625.00
    s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 0.00 is calculated for jacket, with:
    d2 = 160.00
    Av = 100530.965
    fy = 525.00
    s = 300.00
  Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726

Calculation of Shear Strength at edge 2, Vr2 = 390183.487
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 = 180743.977
      = 1 (normal-weight concrete)
    Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
      As (tension reinf.) = 709.9999
      bw = 670.00
      d = 320.00
    Vu*d/Mu < 1 = 0.00
      Mu = 1.8034731E-013
      Vu = 6.9728406E-015
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
  Vs1 = 209439.51 is calculated for jacket, with:
    d = 320.00
    Av = 157079.633
    fy = 625.00
    s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 0.00 is calculated for jacket, with:
    d = 160.00
    Av = 100530.965
    fy = 525.00
    s = 300.00
  Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 5.6603E+006
Shear Force, V2 = -5.4911670E-014
Shear Force, V3 = 4044.434
Axial Force, F = -7188.634
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 709.9999
    -Compression: Asl,com = 1266.062
       -Middle: Asl,mid = 402.1239
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten,jacket = 402.1239
    -Compression: Asl,com,jacket = 804.2477
       -Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten,core = 307.8761
    -Compression: Asl,com,core = 461.8141
       -Middle: Asl,mid,core = 0.00
Mean Diameter of Tension Reinforcement, DbL = 15.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R =   * u = 0.01180116
  u = y + p = 0.01180116

- Calculation of y -
----
 y = (My*Ls/3)/Eleff = 0.00180116 ((4.29),Biskinis Phd))
 My = 2.9231E+008
 Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1399.522
 From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 7.5708E+013

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7   -
----
 y = Min(y_ten, y_com)
 y_ten = 5.8234912E-006
with fy = 625.00
   d = 627.00
    y = 0.18846616
   A = 0.00953076
   B = 0.00408217
   with pt = 0.00283094
       pc = 0.00504809
       pv = 0.00160336
       N = 7188.634
       b = 400.00
        " = 0.06858054
 y_comp = 1.7825663E-005
with fc = 27.76119
   Ec = 25742.96
    y = 0.18768175
   A = 0.00941408
   B = 0.0040338
    with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of p -

From table 10-7: p = 0.01
with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1
   shear control ratio Vp/Vo = 0.92480584
 - Transverse Reinforcement: C
 - Stirrup Spacing <= d/3
 - Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
      = 5.9873569E-005
 - Stirrup Spacing <= d/2
  d = d_external = 627.00
  s = s_external = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
  Vs = 421182.855,already given in calculation of shear control ratio
  design Shear = 4044.434
 - (- ')/ bal = -0.3178459
    = Aslt/(bw*d) = 0.00283094
   Tension Reinf Area: Aslt = 709.9999
   ' = Aslc/(bw*d) = 0.00665146
   Compression Reinf Area: Aslc = 1668.186
  From (B-1), ACI 318-11: bal = 0.01202003
   fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 27.76119
   fy = fy_jacket_bars = 625.00
   From 10.2.7.3, ACI 318-11: 1 = 0.65
   From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.48979592

```
    y = 0.003125
- V/(bw*d*fc^0.5) = 0.03685823, NOTE: units in lb & in
   bw = 400.00
------------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)


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

Calculation No. 3
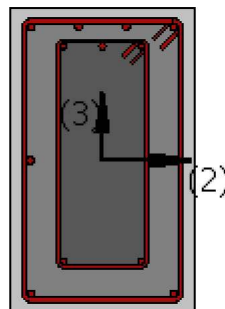
beam B1, Floor 1

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 JB1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 5.6603E+006
Shear Force, Va = 4044.434
EDGE -B-
Bending Moment, Mb = 1.1729E+007
Shear Force, Vb = 15636.832
BOTH EDGES
Axial Force, F = -7188.634
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 709.9999
     -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 709.9999
     -Compression: Asl,com = 1266.062
         -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 15.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR = *Vn = 460997.117
Vn ((22.5.1.1), ACI 318-14) = 460997.117

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 = 152199.503
      = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 18.50746, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 400.00
        d = 536.00
     Vu*d/Mu < 1 = 0.38298791
        Mu = 5.6603E+006
        Vu = 4044.434
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 308797.614
   Vs1 = 280648.944 is calculated for jacket, with:
     d = 536.00
     Av = 157079.633
     fy = 500.00
     s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 28148.67 is calculated for core, with:
     d = 400.00
     Av = 100530.965

```
      fy = 420.00
       s = 300.00
   Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 612724.122
--------------------------------------------------------------
End Of Calculation of Shear Capacity for element: beam JB1 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 (u)

Edge: Start

Local Axis: (3)


```
Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties
------------------------------------------------------------
Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 709.9999
     -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 709.9999
     -Compression: Asl,com = 1266.062
        -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.92480584
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 = 535287.788
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.8817E+008
   Mu1+ = 4.6479E+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- = 7.8817E+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-) = 7.8817E+008
   Mu2+ = 4.6479E+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- = 7.8817E+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 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
   V2 = 9840.634, 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 = 5.6369735E-005
Mu = 4.6479E+008
-----------------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.00680405
       we (5.4c) = 0.00682295
       ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
             bo_1 = 340.00
             ho_1 = 610.00
              bi2_1 = 975400.00
          ase2 = Max(ase1,ase2) = 0.14776895
             bo_2 = 192.00
             ho_2 = 492.00
              bi2_2 = 557856.00
       psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
       ----------------------------------------------------------------
       psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 670.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 500.00
       ----------------------------------------------------------------
       psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 400.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 200.00
       ----------------------------------------------------------------
          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
       fywe1 = 781.25
       fywe2 = 656.25
       fce  = 30.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00242514
         c = confinement factor = 1.04251
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 872.4558
  fy1 = 727.0465
   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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 882.7854
fy2 = 735.6545
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
cc (5A.5, TBDY) = 0.00242514
c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
u = su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
     N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
           bo_1 = 340.00
           ho_1 = 610.00
            bi2_1 = 975400.00
      ase2 = Max(ase1,ase2) = 0.14776895
           bo_2 = 192.00
           ho_2 = 492.00
            bi2_2 = 557856.00
    psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ----
    psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
      ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
        Ash1 = Astir_1*ns_1 = 157.0796
           No stirups, ns_1 = 2.00
        h1 = 670.00
      ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
        Ash2 = Astir_2*ns_2 = 100.531
           No stirups, ns_2 = 2.00
        h2 = 500.00
    ----
    psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
      ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
        Ash1 = Astir_1*ns_1 = 157.0796
           No stirups, ns_1 = 2.00
        h1 = 400.00
      ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
        Ash2 = Astir_2*ns_2 = 100.531
           No stirups, ns_2 = 2.00
        h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce = 30.00
    From ((5.A5), TBDY), TBDY: cc = 0.00242514
        c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 882.7854
 fy1 = 735.6545

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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
   with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 872.4558
fy2 = 727.0465
 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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
   with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 937.50
fyv = 781.25
 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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
   with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
  2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
 b = 340.00
 d = 597.00
 d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
   c = confinement factor = 1.04251
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
  2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008

u =   su (4.1) = 6.0907698E-005

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 = 5.6369735E-005
Mu = 4.6479E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of   cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
      ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           bi2_2 = 557856.00
    psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ----
    psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
      ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
        Ash1 = Astir_1*ns_1 = 157.0796
          No stirups, ns_1 = 2.00
        h1 = 670.00
      ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
        Ash2 = Astir_2*ns_2 = 100.531
          No stirups, ns_2 = 2.00
        h2 = 500.00
    ----
    psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
      ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
        Ash1 = Astir_1*ns_1 = 157.0796
          No stirups, ns_1 = 2.00
        h1 = 400.00
      ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
        Ash2 = Astir_2*ns_2 = 100.531
          No stirups, ns_2 = 2.00
        h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce = 30.00
    From ((5.A5), TBDY), TBDY: cc = 0.00242514

c = confinement factor = 1.04251

y1 = 0.0025

sh1 = 0.008

ft1 = 872.4558

fy1 = 727.0465

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 y_1, sh1,ft1,fy1, it is considered

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

y_1, 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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465

with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00

y2 = 0.0025

sh2 = 0.008

ft2 = 882.7854

fy2 = 735.6545

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 y_2, sh2,ft2,fy2, it is considered

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

y_1, 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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545

with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00

yv = 0.0025

shv = 0.008

ftv = 937.50

fyv = 781.25

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 y_v, shv,ftv,fyv, it is considered

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

y_1, 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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25

with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00

1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752

2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842

v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429

and confined core properties:

b = 340.00

d = 597.00

d' = 13.00

fcc (5A.2, TBDY) = 31.27541

cc (5A.5, TBDY) = 0.00242514

c = confinement factor = 1.04251

1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074

2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169

v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117

Case/Assumption: Unconfinesd full section - Steel rupture

' satisfies Eq. (4.3)

--->

v < vs,y2 - LHS eq.(4.5) is satisfied

```
--->
 su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
  u =   su (4.1) = 5.6369735E-005
---------------------------------------------------------------

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 = 6.0907698E-005
Mu = 7.8817E+008
----------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.00680405
       we (5.4c) = 0.00682295
       ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
             bo_1 = 340.00
             ho_1 = 610.00
              bi2_1 = 975400.00
          ase2 = Max(ase1,ase2) = 0.14776895
             bo_2 = 192.00
             ho_2 = 492.00
              bi2_2 = 557856.00
       psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
       ----------------------------------------------------------------
       psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
         ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
            Ash1 = Astir_1*ns_1 = 157.0796
               No stirups, ns_1 = 2.00
            h1 = 670.00
         ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
            Ash2 = Astir_2*ns_2 = 100.531
               No stirups, ns_2 = 2.00
            h2 = 500.00
       ----------------------------------------------------------------
       psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
         ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
            Ash1 = Astir_1*ns_1 = 157.0796
               No stirups, ns_1 = 2.00
            h1 = 400.00
         ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
            Ash2 = Astir_2*ns_2 = 100.531
               No stirups, ns_2 = 2.00
            h2 = 200.00
       ----------------------------------------------------------------
            Asec = 268000.00
            s1 = 150.00
            s2 = 300.00
         fywe1 = 781.25
```

```
      fywe2 = 656.25
       fce  = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c  = confinement factor = 1.04251
   y1 = 0.0025
  sh1 = 0.008
 ft1 = 882.7854
 fy1 = 735.6545
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
     with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 872.4558
 fy2 = 727.0465
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
     with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 937.50
 fyv = 781.25
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
     with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
   2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
   v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
     c  = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
   2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
   v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
```

' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
  u =   su (4.1) = 6.0907698E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 578810.994

Calculation of Shear Strength at edge 1, Vr1 = 578810.994
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 = 192813.976
        = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00331157
         As (tension reinf.) = 709.9999
         bw = 400.00
         d = 536.00
      Vu*d/Mu < 1 = 1.00
         Mu = 1.1510E+006
         Vu = 9840.632
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
   Vs1 = 350811.18 is calculated for jacket, with:
      d = 536.00
      Av = 157079.633
      fy = 625.00
      s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 35185.838 is calculated for jacket, with:
      d2 = 400.00
      Av = 100530.965
      fy = 525.00
      s = 300.00
   Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 750430.726

Calculation of Shear Strength at edge 2, Vr2 = 578810.994
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 = 192813.976
        = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00331157
         As (tension reinf.) = 709.9999
         bw = 400.00

d = 536.00
    Vu*d/Mu < 1 = 1.00
        Mu = 1.1510E+006
        Vu = 9840.634
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
   Vs1 = 350811.18 is calculated for jacket, with:
      d = 536.00
      Av = 157079.633
      fy = 625.00
      s = 150.00
    Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 35185.838 is calculated for jacket, with:
      d = 400.00
      Av = 100530.965
      fy = 525.00
      s = 300.00
    Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
    2(1-s/d) = 0.50
    Vf ((11-3)-(11.4), ACI 440) = 0.00
    From (11-11), ACI 440: Vs + Vf <= 750430.726

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = -6.9728406E-015
EDGE -B-
Shear Force, Vb = 6.9728406E-015
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 709.9999
  -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 911.0619
  -Compression: Asl,com = 911.0619
    -Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.55914272
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 = 218168.257
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.2725E+008
  Mu1+ = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
  Mu1- = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.2725E+008
  Mu2+ = 3.2725E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
  Mu2- = 3.2725E+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 = -6.9728406E-015, is the shear force acting at edge 1 for the the static loading combination
  V2 = 6.9728406E-015, 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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  ν = 0.0003219
    N = 2309.834
  fc = 30.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00680405
      ωwe (5.4c) = 0.00682295
      αse ((5.4d), TBDY) = (αse1*Aext+αse2*Aint)/Asec = 0.14776895
        αse1 = 0.14776895

```
                bo_1 = 340.00
                ho_1 = 610.00
                 bi2_1 = 975400.00
            ase2 = Max(ase1,ase2) = 0.14776895
                bo_2 = 192.00
                ho_2 = 492.00
                 bi2_2 = 557856.00
           psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
        ---------------------------------------------------------------
           psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
              ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
                 Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                 h1 = 670.00
              ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
                 Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                 h2 = 500.00
        ---------------------------------------------------------------
           psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
              ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                 Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                 h1 = 400.00
              ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                 Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                 h2 = 200.00
        ---------------------------------------------------------------
           Asec = 268000.00
           s1 = 150.00
           s2 = 300.00
         fywe1 = 781.25
         fywe2 = 656.25
         fce  = 30.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00242514
          c = confinement factor = 1.04251
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 886.8103
  fy1 = 739.0086
   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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
   y2 = 0.0025
   sh2 = 0.008
  ft2 = 886.8103
  fy2 = 739.0086
   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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
ε_{yv} = 0.0025
ε_{shv} = 0.008
ftv = 895.9746
fyv = 746.6455
ε_{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
ε_{suv} = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and ε_{yv}, ε_{shv},ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
ε_{y1}, ε_{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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω_1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
ω_2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
ω_v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
b = 610.00
d = 327.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
ε_{cc} (5A.5, TBDY) = 0.00242514
α_c = confinement factor = 1.04251
ω_1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
ω_2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
ω_v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
Case/Assumption: Unconfinesd full section - Steel rupture
' does not satisfy Eq. (4.3)
--->
ω_v < $\omega_{s,c}$ - RHS eq.(4.5) is satisfied
--->
ε_{su} (4.9) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
φ_u = φ_{su} (4.1) = 0.00010507

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Mu1-

Calculation of ultimate curvature φ_u according to 4.1, Biskinis/Fardis 2013:
φ_u = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
b = 670.00
d = 357.00
d' = 43.00
ν = 0.0003219
N = 2309.834
fc = 30.00
ε_{co} (5A.5, TBDY) = 0.002
Final value of ε_{cu}: ε_{cu}* = shear_factor * Max(ε_{cu}, ε_{cc}) = 0.00680405
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: ε_{cu} = 0.00680405

we (5.4c) = 0.00682295
ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
  ase1 = 0.14776895
    bo_1 = 340.00
    ho_1 = 610.00
     bi2_1 = 975400.00
  ase2 = Max(ase1,ase2) = 0.14776895
    bo_2 = 192.00
    ho_2 = 492.00
     bi2_2 = 557856.00
psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519

----

psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
  ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
    Ash1 = Astir_1*ns_1 = 157.0796
     No stirups, ns_1 = 2.00
    h1 = 670.00
  ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
    Ash2 = Astir_2*ns_2 = 100.531
     No stirups, ns_2 = 2.00
    h2 = 500.00

----

psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
  ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
    Ash1 = Astir_1*ns_1 = 157.0796
     No stirups, ns_1 = 2.00
    h1 = 400.00
  ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
    Ash2 = Astir_2*ns_2 = 100.531
     No stirups, ns_2 = 2.00
    h2 = 200.00

  Asec = 268000.00
  s1 = 150.00
  s2 = 300.00
fywe1 = 781.25
fywe2 = 656.25
fce = 30.00
From ((5.A5), TBDY), TBDY: cc = 0.00242514
  c = confinement factor = 1.04251
y1 = 0.0025
sh1 = 0.008
ft1 = 886.8103
fy1 = 739.0086
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
  with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 886.8103
fy2 = 739.0086
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
  with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 895.9746
fyv = 746.6455
 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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
   with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
     c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002

Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
         ase1 = 0.14776895
            bo_1 = 340.00
            ho_1 = 610.00
             bi2_1 = 975400.00
         ase2 = Max(ase1,ase2) = 0.14776895
            bo_2 = 192.00
            ho_2 = 492.00
             bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
   ----
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
         ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
            Ash1 = Astir_1*ns_1 = 157.0796
               No stirups, ns_1 = 2.00
            h1 = 670.00
         ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
            Ash2 = Astir_2*ns_2 = 100.531
               No stirups, ns_2 = 2.00
            h2 = 500.00
   ----
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
         ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
            Ash1 = Astir_1*ns_1 = 157.0796
               No stirups, ns_1 = 2.00
            h1 = 400.00
         ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
            Ash2 = Astir_2*ns_2 = 100.531
               No stirups, ns_2 = 2.00
            h2 = 200.00

         Asec = 268000.00
         s1 = 150.00
         s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce = 30.00
   From ((5.A5), TBDY), TBDY: cc = 0.00242514
         c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
  with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 895.9746
fyv = 746.6455
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
   with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
     c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219

```
     N = 2309.834
 fc = 30.00
  co (5A.5, TBDY) = 0.002
 Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.00680405
      we (5.4c) = 0.00682295
       ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
             bo_1 = 340.00
             ho_1 = 610.00
              bi2_1 = 975400.00
         ase2 = Max(ase1,ase2) = 0.14776895
             bo_2 = 192.00
             ho_2 = 492.00
              bi2_2 = 557856.00
       psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ------------------------------------------------------------------
       psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 670.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 500.00
    ------------------------------------------------------------------
       psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 400.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 200.00
    ------------------------------------------------------------------
          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c  = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
     with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
 with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 895.9746
fyv = 746.6455
 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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
 with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
 2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
 v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
 b = 610.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
 cc (5A.5, TBDY) = 0.00242514
 c = confinement factor = 1.04251
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
 2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
 v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 390183.487

Calculation of Shear Strength at edge 1, Vr1 = 390183.487
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 = 180743.977

$\quad$ = 1 (normal-weight concrete)

$\quad$ Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

$\quad$ pw = As/(bw*d) = 0.00331157

$\qquad$ As (tension reinf.) = 709.9999

$\qquad$ bw = 670.00

$\qquad$ d = 320.00

$\quad$ Vu*d/Mu < 1 = 0.00

$\qquad$ Mu = 2.1102257E-011

$\qquad$ Vu = 6.9728406E-015

From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51

Vs1 = 209439.51 is calculated for jacket, with:

$\quad$ d = 320.00

$\quad$ Av = 157079.633

$\quad$ fy = 625.00

$\quad$ s = 150.00

Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)

Vs2 = 0.00 is calculated for jacket, with:

$\quad$ d2 = 160.00

$\quad$ Av = 100530.965

$\quad$ fy = 525.00

$\quad$ s = 300.00

Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)

Vf ((11-3)-(11.4), ACI 440) = 0.00

From (11-11), ACI 440: Vs + Vf <= 750430.726

Calculation of Shear Strength at edge 2, Vr2 = 390183.487

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).

$\quad$ From Table (22.5.5.1), ACI 318-14: Vc = 180743.977

$\qquad$ = 1 (normal-weight concrete)

$\qquad$ Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)

$\quad$ pw = As/(bw*d) = 0.00331157

$\qquad$ As (tension reinf.) = 709.9999

$\qquad$ bw = 670.00

$\qquad$ d = 320.00

$\quad$ Vu*d/Mu < 1 = 0.00

$\qquad$ Mu = 1.8034731E-013

$\qquad$ Vu = 6.9728406E-015

From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51

Vs1 = 209439.51 is calculated for jacket, with:

$\quad$ d = 320.00

$\quad$ Av = 157079.633

$\quad$ fy = 625.00

$\quad$ s = 150.00

Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)

Vs2 = 0.00 is calculated for jacket, with:

$\quad$ d = 160.00

$\quad$ Av = 100530.965

$\quad$ fy = 525.00

$\quad$ s = 300.00

Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)

Vf ((11-3)-(11.4), ACI 440) = 0.00

From (11-11), ACI 440: Vs + Vf <= 750430.726

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1

At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1

At local axis: 3

Integration Section: (a)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -8.4907098E-011
Shear Force, V2 = -5.4911670E-014
Shear Force, V3 = 4044.434
Axial Force, F = -7188.634
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 709.9999
     -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 911.0619
     -Compression: Asl,com = 911.0619
        -Middle: Asl,mid = 556.0619
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten,jacket = 603.1858
     -Compression: Asl,com,jacket = 603.1858
        -Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten,core = 307.8761
     -Compression: Asl,com,core = 307.8761
        -Middle: Asl,mid,core = 153.938
Mean Diameter of Tension Reinforcement, DbL = 15.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta u,R = \phi * \theta u = 0.00910271$
 $\theta u = \theta y + \theta p = 0.00910271$

 - Calculation of θy -

 $\theta y = (My*Ls/3)/EIeff = 0.00410271$ ((4.29),Biskinis Phd))

My = 2.1250E+008
Ls = M/V (with Ls > 0.1*L and Ls < 2*L) = 1500.00
From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 2.5898E+013

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
  y = Min(y_ten, y_com)
  y_ten = 1.0750437E-005
 with fy = 625.00
    d = 357.00
     y = 0.22791832
    A = 0.00999338
    B = 0.00562083
     with pt = 0.00380895
        pc = 0.00380895
        pv = 0.00232477
        N = 7188.634
        b = 670.00
         " = 0.12044818
   y_comp = 2.5846378E-005
 with fc = 27.76119
    Ec = 25742.96
     y = 0.22733556
    A = 0.00987103
    B = 0.00557012
     with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of p -
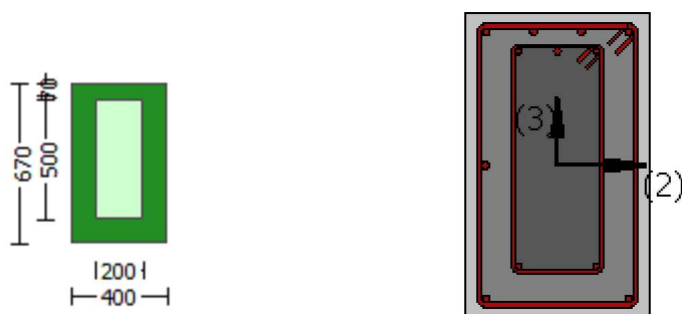---
From table 10-7: p = 0.005
with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1
   shear control ratio Vp/Vo = 0.55914272
 - Transverse Reinforcement: NC
 - Stirrup Spacing > d/3
 - Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
       = 8.0465315E-022
 - Stirrup Spacing <= d/2
  d = d_external = 357.00
  s = s_external = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
  Vs = 237588.18,already given in calculation of shear control ratio
  design Shear = 5.4911670E-014
 - (- ')/ bal = -0.33327376
     = Aslt/(bw*d) = 0.00296835
   Tension Reinf Area: Aslt = 709.9999
   ' = Aslc/(bw*d) = 0.00697431
   Compression Reinf Area: Aslc = 1668.186
  From (B-1), ACI 318-11: bal = 0.01202003
   fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 27.76119
   fy = fy_jacket_bars = 625.00
   From 10.2.7.3, ACI 318-11: 1 = 0.65
   From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.48979592
       y = 0.003125
 - V/(bw*d*fc^0.5) = 5.2471780E-019, NOTE: units in lb & in
   bw = 670.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 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 JB1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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

External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -8.4907098E-011
Shear Force, Va = -5.4911670E-014
EDGE -B-
Bending Moment, Mb = -7.9998090E-011
Shear Force, Vb = 5.4911670E-014
BOTH EDGES
Axial Force, F = -7188.634
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 911.0619
     -Compression: Asl,com = 911.0619
        -Middle: Asl,mid = 556.0619
Mean Diameter of Tension Reinforcement, DbL,ten = 15.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 315128.448
Vn ((22.5.1.1), ACI 318-14) = 315128.448

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 = 147576.839
      = 1 (normal-weight concrete)
     Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 18.50746, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
       As (tension reinf.) = 709.9999
       bw = 670.00
       d = 320.00
    Vu*d/Mu < 1 = 0.00
       Mu = 7.9998090E-011
       Vu = 5.4911670E-014
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 167551.608
  Vs1 = 167551.608 is calculated for jacket, with:
     d = 320.00
     Av = 157079.633
     fy = 500.00
     s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 0.00 is calculated for core, with:
     d = 160.00
     Av = 100530.965
     fy = 420.00
     s = 300.00
  Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)

Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 612724.122

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)

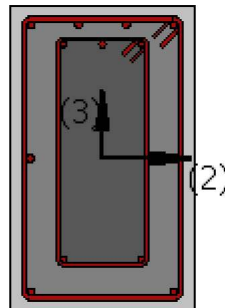
Calculation No. 6

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 JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 709.9999
     -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 709.9999
     -Compression: Asl,com = 1266.062
        -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.92480584
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 = 535287.788
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.8817E+008
  Mu1+ = 4.6479E+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- = 7.8817E+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-) = 7.8817E+008
  Mu2+ = 4.6479E+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- = 7.8817E+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 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
  V2 = 9840.634, 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 = 5.6369735E-005
 Mu = 4.6479E+008
-------------------------------------------------------------------------
 with full section properties:
   b = 400.00
   d = 627.00
   d' = 43.00
   v = 0.000307
     N = 2309.834
  fc = 30.00
    co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.00680405
        we (5.4c) = 0.00682295
        ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
           ase1 = 0.14776895
              bo_1 = 340.00
              ho_1 = 610.00
               bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
              bo_2 = 192.00
              ho_2 = 492.00
               bi2_2 = 557856.00
        psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
        ----------------------------------------------------------------
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
              Ash1 = Astir_1*ns_1 = 157.0796
                 No stirups, ns_1 = 2.00
              h1 = 670.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
              Ash2 = Astir_2*ns_2 = 100.531
                 No stirups, ns_2 = 2.00
              h2 = 500.00
        ----------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
              Ash1 = Astir_1*ns_1 = 157.0796
                 No stirups, ns_1 = 2.00
              h1 = 400.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
              Ash2 = Astir_2*ns_2 = 100.531
                 No stirups, ns_2 = 2.00
              h2 = 200.00
        ----------------------------------------------------------------
           Asec = 268000.00
           s1 = 150.00
           s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c  = confinement factor = 1.04251
    y1 = 0.0025
   sh1 = 0.008
  ft1 = 872.4558
  fy1 = 727.0465
   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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
   with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 882.7854
 fy2 = 735.6545
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
     with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 937.50
 fyv = 781.25
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
     with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
  2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
  u =   su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00680405
       we (5.4c) = 0.00682295
       ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
             bo_1 = 340.00
             ho_1 = 610.00
              bi2_1 = 975400.00
         ase2 = Max(ase1,ase2) = 0.14776895
             bo_2 = 192.00
             ho_2 = 492.00
              bi2_2 = 557856.00
       psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
       ----
       psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 670.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 500.00
       ----
       psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 400.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 200.00

          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce = 30.00
     From ((5.A5), TBDY), TBDY: cc = 0.00242514
         c = confinement factor = 1.04251
   y1 = 0.0025
  sh1 = 0.008
 ft1 = 882.7854
 fy1 = 735.6545
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
  with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
 $y2$ = 0.0025
 $sh2$ = 0.008
$ft2$ = 872.4558
$fy2$ = 727.0465
 $su2$ = 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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
  with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 937.50
fyv = 781.25
 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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
  with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
 2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
 v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
 b = 340.00
 d = 597.00
 d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
   c = confinement factor = 1.04251
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
  2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
 u = su (4.1) = 6.0907698E-005

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 = 5.6369735E-005
Mu = 4.6479E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00680405
      ωwe (5.4c) = 0.00682295
      αse ((5.4d), TBDY) = (αse1*Aext+αse2*Aint)/Asec = 0.14776895
        αse1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           Σbi2_1 = 975400.00
        αse2 = Max(αse1,αse2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           Σbi2_2 = 557856.00
      ρsh,min*Fywe = Min(ρsh,x*Fywe , ρsh,y*Fywe) = 1.38519

      ρsh_x*Fywe = ρsh1*Fywe1+ρs2*Fywe2 = 2.45559
        ρs1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 670.00
        ρs2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 500.00

      ρsh_y*Fywe = ρsh1*Fywe1+ρs2*Fywe2 = 1.38519
        ρs1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 400.00
        ρs2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce = 30.00
    From ((5.A5), TBDY), TBDY: εcc = 0.00242514
        εc = confinement factor = 1.04251
  εy1 = 0.0025
  εsh1 = 0.008
 ft1 = 872.4558

fy1 = 727.0465
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
    with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 882.7854
 fy2 = 735.6545
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
    with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 937.50
 fyv = 781.25
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
  2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
    c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
   v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
 u =   su (4.1) = 5.6369735E-005

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

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 = 6.0907698E-005
Mu = 7.8817E+008
---------------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
         ase1 = 0.14776895
            bo_1 = 340.00
            ho_1 = 610.00
             bi2_1 = 975400.00
      ase2 = Max(ase1,ase2) = 0.14776895
            bo_2 = 192.00
            ho_2 = 492.00
             bi2_2 = 557856.00
     psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ----------------------------------------------------------------
     psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
       ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 670.00
       ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 500.00
    ----------------------------------------------------------------
     psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
       ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 400.00
       ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 200.00
    ----------------------------------------------------------------
         Asec = 268000.00
         s1 = 150.00
         s2 = 300.00
       fywe1 = 781.25
       fywe2 = 656.25
       fce  = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c  = confinement factor = 1.04251
```

$y1 = 0.0025$
$sh1 = 0.008$
$ft1 = 882.7854$
$fy1 = 735.6545$
$su1 = 0.032$
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
    with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
$y2 = 0.0025$
$sh2 = 0.008$
$ft2 = 872.4558$
$fy2 = 727.0465$
$su2 = 0.032$
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
    with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
$yv = 0.0025$
$shv = 0.008$
$ftv = 937.50$
$fyv = 781.25$
$suv = 0.032$
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
  2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
    cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
    2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->

v < vs,c - RHS eq.(4.5) is satisfied
--->
  su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
  u =   su (4.1) = 6.0907698E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 578810.994

Calculation of Shear Strength at edge 1, Vr1 = 578810.994
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 = 192813.976
      = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 400.00
        d = 536.00
     Vu*d/Mu < 1 = 1.00
        Mu = 1.1510E+006
        Vu = 9840.632
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
  Vs1 = 350811.18 is calculated for jacket, with:
     d = 536.00
     Av = 157079.633
     fy = 625.00
     s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 35185.838 is calculated for jacket, with:
     d2 = 400.00
     Av = 100530.965
     fy = 525.00
     s = 300.00
   Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 750430.726

Calculation of Shear Strength at edge 2, Vr2 = 578810.994
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 = 192813.976
      = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 400.00
        d = 536.00
     Vu*d/Mu < 1 = 1.00
        Mu = 1.1510E+006
        Vu = 9840.634

From (11.5.4.8), ACI 318-14: $V_{s1} + V_{s2} = 385997.017$
$V_{s1} = 350811.18$ is calculated for jacket, with:
   $d = 536.00$
   $A_v = 157079.633$
   $f_y = 625.00$
   $s = 150.00$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
$V_{s2} = 35185.838$ is calculated for jacket, with:
   $d = 400.00$
   $A_v = 100530.965$
   $f_y = 525.00$
   $s = 300.00$
 V_{s2} has been multiplied by 2(1-s/d) ($s > d/2$, according to ASCE 41-17,10.3.4)
 $2(1-s/d) = 0.50$
 V_f ((11-3)-(11.4), ACI 440) = 0.00
 From (11-11), ACI 440: $V_s + V_f <= 750430.726$

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, $f_c = f_{cm} = 30.00$
New material of Primary Member: Steel Strength, $f_s = f_{sm} = 625.00$
Concrete Elasticity, $E_c = 25742.96$
Steel Elasticity, $E_s = 200000.00$
Existing Column
Existing material of Primary Member: Concrete Strength, $f_c = f_{cm} = 24.00$
Existing material of Primary Member: Steel Strength, $f_s = f_{sm} = 525.00$
Concrete Elasticity, $E_c = 23025.204$
Steel Elasticity, $E_s = 200000.00$
##
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
Jacket
New material: Steel Strength, $f_s = 1.25*f_{sm} = 781.25$
Existing Column
Existing material: Steel Strength, $f_s = 1.25*f_{sm} = 656.25$
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = -6.9728406E-015
EDGE -B-
Shear Force, Vb = 6.9728406E-015
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 911.0619
    -Compression: Asl,com = 911.0619
       -Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.55914272
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 = 218168.257
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.2725E+008
  Mu1+ = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
  Mu1- = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.2725E+008
  Mu2+ = 3.2725E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
  Mu2- = 3.2725E+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 = -6.9728406E-015, is the shear force acting at edge 1 for the the static loading combination
  V2 = 6.9728406E-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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
      ase2 = Max(ase1,ase2) = 0.14776895

```
              bo_2 = 192.00
              ho_2 = 492.00
               bi2_2 = 557856.00
       psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ------------------------------------------------------------------
       psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 670.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 500.00
    ------------------------------------------------------------------
       psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 400.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 200.00
    ------------------------------------------------------------------
          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
     From ((5.A5), TBDY):  cc = 0.00242514
          c  = confinement factor = 1.04251
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 886.8103
  fy1 = 739.0086
   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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
        with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
   y2 = 0.0025
   sh2 = 0.008
  ft2 = 886.8103
  fy2 = 739.0086
   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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
        with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
   yv = 0.0025
   shv = 0.008
```

ftv = 895.9746
fyv = 746.6455
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
     with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
       ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
             bo_1 = 340.00

```
                ho_1 = 610.00
                  bi2_1 = 975400.00
           ase2 = Max(ase1,ase2) = 0.14776895
                bo_2 = 192.00
                ho_2 = 492.00
                  bi2_2 = 557856.00
         psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ------------------------------------------------------------------
         psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
               Ash1 = Astir_1*ns_1 = 157.0796
                  No stirups, ns_1 = 2.00
               h1 = 670.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
               Ash2 = Astir_2*ns_2 = 100.531
                  No stirups, ns_2 = 2.00
               h2 = 500.00
      ------------------------------------------------------------------
         psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
               Ash1 = Astir_1*ns_1 = 157.0796
                  No stirups, ns_1 = 2.00
               h1 = 400.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
               Ash2 = Astir_2*ns_2 = 100.531
                  No stirups, ns_2 = 2.00
               h2 = 200.00
      ------------------------------------------------------------------
            Asec = 268000.00
            s1 = 150.00
            s2 = 300.00
         fywe1 = 781.25
         fywe2 = 656.25
         fce  = 30.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00242514
            c  = confinement factor = 1.04251
    y1 = 0.0025
    sh1 = 0.008
  ft1 = 886.8103
  fy1 = 739.0086
    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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
       with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
    y2 = 0.0025
    sh2 = 0.008
  ft2 = 886.8103
  fy2 = 739.0086
    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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
```

with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
    yv = 0.0025
    shv = 0.008
   ftv = 895.9746
   fyv = 746.6455
    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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
      with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
   b = 610.00
   d = 327.00
   d' = 13.00
   fcc (5A.2, TBDY) = 31.27541
    cc (5A.5, TBDY) = 0.00242514
       c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
   b = 670.00
   d = 357.00
   d' = 43.00
   v = 0.0003219
     N = 2309.834
   fc = 30.00
    co (5A.5, TBDY) = 0.002
   Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.00680405
        we (5.4c) = 0.00682295

```
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
         ase1 = 0.14776895
            bo_1 = 340.00
            ho_1 = 610.00
             bi2_1 = 975400.00
         ase2 = Max(ase1,ase2) = 0.14776895
            bo_2 = 192.00
            ho_2 = 492.00
             bi2_2 = 557856.00
       psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
       ------------------------------------------------------------------
       psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
         ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
            Ash1 = Astir_1*ns_1 = 157.0796
               No stirups, ns_1 = 2.00
            h1 = 670.00
         ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
            Ash2 = Astir_2*ns_2 = 100.531
               No stirups, ns_2 = 2.00
            h2 = 500.00
       ------------------------------------------------------------------
       psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
         ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
            Ash1 = Astir_1*ns_1 = 157.0796
               No stirups, ns_1 = 2.00
            h1 = 400.00
         ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
            Ash2 = Astir_2*ns_2 = 100.531
               No stirups, ns_2 = 2.00
            h2 = 200.00
       ------------------------------------------------------------------
         Asec = 268000.00
         s1 = 150.00
         s2 = 300.00
       fywe1 = 781.25
       fywe2 = 656.25
       fce  = 30.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00242514
         c = confinement factor = 1.04251
   y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
     with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
   y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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 $f_{sy2} = f_{s2}/1.2$, from table 5.1, TBDY.
     $y1$, $sh1$,$ft1$,$fy1$, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with f_{s2} = (fs,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
     with E_{s2} = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
   $y_v = 0.0025$
   $sh_v = 0.008$
  $ft_v = 895.9746$
  $fy_v = 746.6455$
   $su_v = 0.032$
    using (30) in Biskinis/Fardis (2013) multiplied with shear_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
     $su_v = 0.4*esuv\_nominal$ ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value $f_{syv} = f_{sv}/1.2$, from table 5.1, TBDY
    For calculation of esuv_nominal and y_v, sh_v,ft_v,fy_v, it is considered
    characteristic value $f_{syv} = f_{sv}/1.2$, from table 5.1, TBDY.
     $y1$, $sh1$,$ft1$,$fy1$, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
     with f_{sv} = (fs,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
     with E_{sv} = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
   2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
   v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
    c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
   N = 2309.834
  fc = 30.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405

The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: cu = 0.00680405
   we (5.4c) = 0.00682295
    ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
      ase1 = 0.14776895
        bo_1 = 340.00
        ho_1 = 610.00
         bi2_1 = 975400.00
      ase2 = Max(ase1,ase2) = 0.14776895
        bo_2 = 192.00
        ho_2 = 492.00
         bi2_2 = 557856.00
    psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
----
    psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
      ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
        Ash1 = Astir_1*ns_1 = 157.0796
          No stirups, ns_1 = 2.00
        h1 = 670.00
      ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
        Ash2 = Astir_2*ns_2 = 100.531
          No stirups, ns_2 = 2.00
        h2 = 500.00
----
    psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
      ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
        Ash1 = Astir_1*ns_1 = 157.0796
          No stirups, ns_1 = 2.00
        h1 = 400.00
      ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
        Ash2 = Astir_2*ns_2 = 100.531
          No stirups, ns_2 = 2.00
        h2 = 200.00

    Asec = 268000.00
    s1 = 150.00
    s2 = 300.00
   fywe1 = 781.25
   fywe2 = 656.25
   fce = 30.00
From ((5.A5), TBDY), TBDY: cc = 0.00242514
   c = confinement factor = 1.04251
y1 = 0.0025
sh1 = 0.008
ft1 = 886.8103
fy1 = 739.0086
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
  with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 886.8103
fy2 = 739.0086
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
    with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 895.9746
 fyv = 746.6455
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
   2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
   v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
     c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  u =   su (4.1) = 0.00010507

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 390183.487

Calculation of Shear Strength at edge 1, Vr1 = 390183.487
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 = 180743.977
     = 1 (normal-weight concrete)
     Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157

As (tension reinf.) = 709.9999
   bw = 670.00
   d = 320.00
Vu*d/Mu < 1 = 0.00
   Mu = 2.1102257E-011
   Vu = 6.9728406E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
Vs1 = 209439.51 is calculated for jacket, with:
   d = 320.00
   Av = 157079.633
   fy = 625.00
   s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
   d2 = 160.00
   Av = 100530.965
   fy = 525.00
   s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 750430.726

Calculation of Shear Strength at edge 2, Vr2 = 390183.487
Vr2 = Vn ((22.5.1.1), ACI 318-14)

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 = 180743.977
     = 1 (normal-weight concrete)
   Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
   pw = As/(bw*d) = 0.00331157
      As (tension reinf.) = 709.9999
      bw = 670.00
      d = 320.00
   Vu*d/Mu < 1 = 0.00
      Mu = 1.8034731E-013
      Vu = 6.9728406E-015
From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
Vs1 = 209439.51 is calculated for jacket, with:
   d = 320.00
   Av = 157079.633
   fy = 625.00
   s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 0.00 is calculated for jacket, with:
   d = 160.00
   Av = 100530.965
   fy = 525.00
   s = 300.00
Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 750430.726

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 1.1729E+007
Shear Force, V2 = 5.4911670E-014
Shear Force, V3 = 15636.832
Axial Force, F = -7188.634
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 709.9999
     -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 709.9999
     -Compression: Asl,com = 1266.062
        -Middle: Asl,mid = 402.1239
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten,jacket = 402.1239
     -Compression: Asl,com,jacket = 804.2477
        -Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten,core = 307.8761
     -Compression: Asl,com,core = 461.8141
        -Middle: Asl,mid,core = 0.00
Mean Diameter of Tension Reinforcement, DbL = 15.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta u,R = \phi * \theta u = 0.01096533$
 $\theta u = \theta y + \theta p = 0.01096533$

 - Calculation of θy -

 $\theta y = (My*Ls/3)/EIeff = 0.00096533$ ((4.29),Biskinis Phd))
  My = 2.9231E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 750.0722
  From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 7.5708E+013

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

Calculation of Yielding Moment My
---------------------------------------------------------------
Calculation of  y and My according to Annex 7   -
---------------------------------------------------------------
   y = Min(  y_ten,  y_com)
   y_ten = 5.8234912E-006
 with fy = 625.00
     d = 627.00
      y = 0.18846616
     A = 0.00953076
     B = 0.00408217
      with pt = 0.00283094
         pc = 0.00504809
         pv = 0.00160336
         N = 7188.634
         b = 400.00
          " = 0.06858054
   y_comp = 1.7825663E-005
 with fc = 27.76119
     Ec = 25742.96
      y = 0.18768175
     A = 0.00941408
     B = 0.0040338
      with Es = 200000.00
--------------------------------------------------------------

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


--------------------------------------------------------------
 - Calculation of   p -
--------------------------------------------------------------
From table 10-7:   p = 0.01
with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1
   shear control ratio Vp/Vo = 0.92480584
 - Transverse Reinforcement: C
 - Stirrup Spacing <= d/3
 - Low ductility demand,   /  y < 2 (table 10-6, ASCE 41-17)
        = 4.9990391E-006
 - Stirrup Spacing <= d/2
   d = d_external = 627.00
   s = s_external = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
   Vs = 421182.855,already given in calculation of shear control ratio
   design Shear = 15636.832
 - (  -  ')/  bal = -0.3178459
     = Aslt/(bw*d) = 0.00283094
    Tension Reinf Area: Aslt = 709.9999
    ' = Aslc/(bw*d) = 0.00665146
    Compression Reinf Area: Aslc = 1668.186
   From (B-1), ACI 318-11:   bal = 0.01202003
    fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 27.76119
    fy = fy_jacket_bars = 625.00
    From 10.2.7.3, ACI 318-11:  1 = 0.65
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.48979592
        y = 0.003125
 - V/(bw*d*fc^0.5) = 0.14250345, NOTE: units in lb & in
    bw = 400.00
--------------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)
```
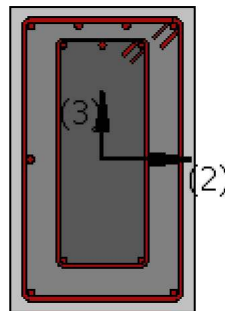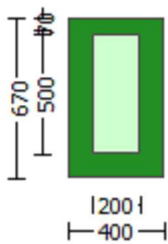

Calculation No. 7

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 JB1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00

Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 5.6603E+006
Shear Force, Va = 4044.434
EDGE -B-
Bending Moment, Mb = 1.1729E+007
Shear Force, Vb = 15636.832
BOTH EDGES
Axial Force, F = -7188.634
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 709.9999
    -Compression: Asl,com = 1266.062
        -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 15.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 464999.649
Vn ((22.5.1.1), ACI 318-14) = 464999.649
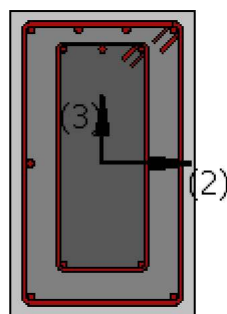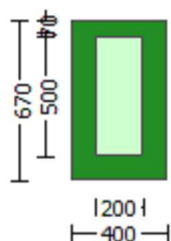--
NOTE: In expression (22.5.1.1) 'Vw' is replaced by 'Vw+ f*Vf'
where Vf is the contribution of FRPs (11.3), ACI 440).

   From Table (22.5.5.1), ACI 318-14: Vc = 156202.035
       = 1 (normal-weight concrete)
     Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 18.50746, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
         As (tension reinf.) = 709.9999
         bw = 400.00
         d = 536.00
     Vu*d/Mu < 1 = 0.71459785
         Mu = 1.1729E+007
         Vu = 15636.832
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 308797.614
   Vs1 = 280648.944 is calculated for jacket, with:
       d = 536.00
       Av = 157079.633
       fy = 500.00
       s = 150.00
    Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 28148.67 is calculated for core, with:
       d = 400.00
       Av = 100530.965
       fy = 420.00
       s = 300.00
    Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
     2(1-s/d) = 0.50
    Vf ((11-3)-(11.4), ACI 440) = 0.00
    From (11-11), ACI 440: Vs + Vf <= 612724.122

End Of Calculation of Shear Capacity for element: beam JB1 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 (u)

Edge: End

Local Axis: (3)

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket

New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 709.9999
     -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 709.9999
     -Compression: Asl,com = 1266.062
        -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.92480584
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 = 535287.788
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.8817E+008
   Mu1+ = 4.6479E+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- = 7.8817E+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-) = 7.8817E+008
   Mu2+ = 4.6479E+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- = 7.8817E+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 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
   V2 = 9840.634, 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 = 5.6369735E-005

Mu = 4.6479E+008

----

with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00680405
        we (5.4c) = 0.00682295
        ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
           ase1 = 0.14776895
              bo_1 = 340.00
              ho_1 = 610.00
               bi2_1 = 975400.00
           ase2 = Max(ase1,ase2) = 0.14776895
              bo_2 = 192.00
              ho_2 = 492.00
               bi2_2 = 557856.00
        psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
     ----
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
              Ash1 = Astir_1*ns_1 = 157.0796
                 No stirups, ns_1 = 2.00
              h1 = 670.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
              Ash2 = Astir_2*ns_2 = 100.531
                 No stirups, ns_2 = 2.00
              h2 = 500.00
     ----
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
              Ash1 = Astir_1*ns_1 = 157.0796
                 No stirups, ns_1 = 2.00
              h1 = 400.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
              Ash2 = Astir_2*ns_2 = 100.531
                 No stirups, ns_2 = 2.00
              h2 = 200.00

           Asec = 268000.00
           s1 = 150.00
           s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce = 30.00
     From ((5A5), TBDY), TBDY: cc = 0.00242514
         c = confinement factor = 1.04251
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 872.4558
  fy1 = 727.0465
   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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 882.7854
fy2 = 735.6545
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
cc (5A.5, TBDY) = 0.00242514
c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
u = su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ----
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 500.00
      ----
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 200.00

          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce = 30.00
    From ((5.A5), TBDY), TBDY: cc = 0.00242514
        c = confinement factor = 1.04251
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 882.7854
  fy1 = 735.6545
   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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 872.4558
fy2 = 727.0465
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
cc (5A.5, TBDY) = 0.00242514
c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
u =   su (4.1) = 6.0907698E-005

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 = 5.6369735E-005
Mu = 4.6479E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00680405
      ωwe (5.4c) = 0.00682295
      αse ((5.4d), TBDY) = (αse1*Aext+αse2*Aint)/Asec = 0.14776895
        αse1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
      αse2 = Max(αse1,αse2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           bi2_2 = 557856.00
      ρsh,min*Fywe = Min(ρsh,x*Fywe , ρsh,y*Fywe) = 1.38519

      ρsh_x*Fywe = ρsh1*Fywe1+ρs2*Fywe2 = 2.45559
        ρs1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 670.00
        ρs2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 500.00

      ρsh_y*Fywe = ρsh1*Fywe1+ρs2*Fywe2 = 1.38519
        ρs1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 400.00
        ρs2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce = 30.00
    From ((5A.5), TBDY), TBDY: εcc = 0.00242514
        εc = confinement factor = 1.04251
  εy1 = 0.0025
  εsh1 = 0.008
  ft1 = 872.4558
  fy1 = 727.0465
  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

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

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

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

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

 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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465

 with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00

y2 = 0.0025

sh2 = 0.008

ft2 = 882.7854

fy2 = 735.6545

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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545

 with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00

yv = 0.0025

shv = 0.008

ftv = 937.50

fyv = 781.25

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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25

 with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00

1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752

2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842

v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429

and confined core properties:

b = 340.00

d = 597.00

d' = 13.00

fcc (5A.2, TBDY) = 31.27541

cc (5A.5, TBDY) = 0.00242514

 c = confinement factor = 1.04251

1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074

2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169

v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117

Case/Assumption: Unconfinesd full section - Steel rupture

' satisfies Eq. (4.3)

--->

v < vs,y2 - LHS eq.(4.5) is satisfied

--->

su (4.9) = 0.09460844

Mu = MRc (4.14) = 4.6479E+008

u = su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
--------------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ------------------------------------------------------------------
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 500.00
    ------------------------------------------------------------------
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 200.00
    ------------------------------------------------------------------
          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00242514
          c  = confinement factor = 1.04251
    y1 = 0.0025
    sh1 = 0.008
  ft1 = 882.7854
```

fy1 = 735.6545
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
   y2 = 0.0025
   sh2 = 0.008
  ft2 = 872.4558
  fy2 = 727.0465
   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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
   yv = 0.0025
   shv = 0.008
  ftv = 937.50
  fyv = 781.25
   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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
      with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
    2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
    v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
    2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.16206515

Mu = MRc (4.15) = 7.8817E+008
 u =   su (4.1) = 6.0907698E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 578810.994

Calculation of Shear Strength at edge 1, Vr1 = 578810.994
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 = 192813.976
       = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 400.00
        d = 536.00
     Vu*d/Mu < 1 = 1.00
        Mu = 1.1510E+006
        Vu = 9840.632
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
   Vs1 = 350811.18 is calculated for jacket, with:
     d = 536.00
     Av = 157079.633
     fy = 625.00
     s = 150.00
    Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 35185.838 is calculated for jacket, with:
     d2 = 400.00
     Av = 100530.965
     fy = 525.00
     s = 300.00
    Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 750430.726

Calculation of Shear Strength at edge 2, Vr2 = 578810.994
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 = 192813.976
       = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 400.00
        d = 536.00
     Vu*d/Mu < 1 = 1.00
        Mu = 1.1510E+006
        Vu = 9840.634
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
   Vs1 = 350811.18 is calculated for jacket, with:
     d = 536.00

Av = 157079.633
fy = 625.00
s = 150.00
Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
Vs2 = 35185.838 is calculated for jacket, with:
d = 400.00
Av = 100530.965
fy = 525.00
s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 750430.726

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = -6.9728406E-015
EDGE -B-
Shear Force, Vb = 6.9728406E-015
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
       -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
       -Tension: Asl,ten = 911.0619
    -Compression: Asl,com = 911.0619
       -Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.55914272
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 = 218168.257
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.2725E+008
   Mu1+ = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
   Mu1- = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.2725E+008
   Mu2+ = 3.2725E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
   Mu2- = 3.2725E+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 = -6.9728406E-015, is the shear force acting at edge 1 for the the static loading combination
  V2 = 6.9728406E-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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00680405
       we (5.4c) = 0.00682295
       ase ((5.4d), TBDY) = (ase1*Aext+ ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
             bo_1 = 340.00
             ho_1 = 610.00
              bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
             bo_2 = 192.00
             ho_2 = 492.00
              bi2_2 = 557856.00

```
        psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
        ------------------------------------------------------------------
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
              Ash1 = Astir_1*ns_1 = 157.0796
                 No stirups, ns_1 = 2.00
              h1 = 670.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
              Ash2 = Astir_2*ns_2 = 100.531
                 No stirups, ns_2 = 2.00
              h2 = 500.00
        ------------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
              Ash1 = Astir_1*ns_1 = 157.0796
                 No stirups, ns_1 = 2.00
              h1 = 400.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
              Ash2 = Astir_2*ns_2 = 100.531
                 No stirups, ns_2 = 2.00
              h2 = 200.00
        ------------------------------------------------------------------
        Asec = 268000.00
         s1 = 150.00
         s2 = 300.00
       fywe1 = 781.25
       fywe2 = 656.25
       fce  = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
         c  = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 895.9746
 fyv = 746.6455
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
  with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
 2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
 v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
 b = 610.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
    c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
 b = 670.00
 d = 357.00
 d' = 43.00
 v = 0.0003219
   N = 2309.834
 fc = 30.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00680405
     we (5.4c) = 0.00682295
     ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
       ase2 = Max(ase1,ase2) = 0.14776895

```
                bo_2 = 192.00
                ho_2 = 492.00
                 bi2_2 = 557856.00
         psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
   ------------------------------------------------------------------
         psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
               Ash1 = Astir_1*ns_1 = 157.0796
                  No stirups, ns_1 = 2.00
               h1 = 670.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
               Ash2 = Astir_2*ns_2 = 100.531
                  No stirups, ns_2 = 2.00
               h2 = 500.00
   ------------------------------------------------------------------
         psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
               Ash1 = Astir_1*ns_1 = 157.0796
                  No stirups, ns_1 = 2.00
               h1 = 400.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
               Ash2 = Astir_2*ns_2 = 100.531
                  No stirups, ns_2 = 2.00
               h2 = 200.00
   ------------------------------------------------------------------
          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
     From ((5.A5), TBDY):  cc = 0.00242514
          c  = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
       with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
       with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
```

ftv = 895.9746
fyv = 746.6455
 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 εyv, shv,ftv,fyv, it is considered
   characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
  ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
  ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   εcc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
    ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
    ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
ωv < ωs,c - RHS eq.(4.5) is satisfied
--->
 εsu (4.9) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  φu = φsu (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  ν = 0.0003219
    N = 2309.834
  fc = 30.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00680405
      ωwe (5.4c) = 0.00682295
       αse ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
             bo_1 = 340.00

```
            ho_1 = 610.00
              bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
            bo_2 = 192.00
            ho_2 = 492.00
              bi2_2 = 557856.00
        psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ---------------------------------------------------------------
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 670.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 500.00
    ---------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 400.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 200.00
    ---------------------------------------------------------------
        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
     with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
```

with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 895.9746
fyv = 746.6455
 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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
 b = 610.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
 b = 670.00
 d = 357.00
 d' = 43.00
 v = 0.0003219
    N = 2309.834
 fc = 30.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
     we (5.4c) = 0.00682295

```
        ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
            ase1 = 0.14776895
                bo_1 = 340.00
                ho_1 = 610.00
                 bi2_1 = 975400.00
            ase2 = Max(ase1,ase2) = 0.14776895
                bo_2 = 192.00
                ho_2 = 492.00
                 bi2_2 = 557856.00
        psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
        ------------------------------------------------------------------
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 670.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 500.00
        ------------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 400.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 200.00
        ------------------------------------------------------------------
            Asec = 268000.00
            s1 = 150.00
            s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c = confinement factor = 1.04251
    y1 = 0.0025
    sh1 = 0.008
    ft1 = 886.8103
    fy1 = 739.0086
    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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
        with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
    y2 = 0.0025
    sh2 = 0.008
    ft2 = 886.8103
    fy2 = 739.0086
    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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
   with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 895.9746
 fyv = 746.6455
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
    c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  u = su (4.1) = 0.00010507

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 390183.487

Calculation of Shear Strength at edge 1, Vr1 = 390183.487
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 = 180743.977
      = 1 (normal-weight concrete)
     Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
       As (tension reinf.) = 709.9999
       bw = 670.00
       d = 320.00

```
      Vu*d/Mu < 1 = 0.00
         Mu = 2.1102257E-011
         Vu = 6.9728406E-015
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
   Vs1 = 209439.51 is calculated for jacket, with:
      d = 320.00
      Av = 157079.633
      fy = 625.00
      s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 0.00 is calculated for jacket, with:
      d2 = 160.00
      Av = 100530.965
      fy = 525.00
      s = 300.00
   Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 750430.726
------------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 390183.487
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 = 180743.977
         = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00331157
         As (tension reinf.) = 709.9999
         bw = 670.00
         d = 320.00
      Vu*d/Mu < 1 = 0.00
         Mu = 1.8034731E-013
         Vu = 6.9728406E-015
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
   Vs1 = 209439.51 is calculated for jacket, with:
      d = 320.00
      Av = 157079.633
      fy = 625.00
      s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 0.00 is calculated for jacket, with:
      d = 160.00
      Av = 100530.965
      fy = 525.00
      s = 300.00
   Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 750430.726
-----------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2


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


Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -7.9998090E-011
Shear Force, V2 = 5.4911670E-014
Shear Force, V3 = 15636.832
Axial Force, F = -7188.634
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 911.0619
    -Compression: Asl,com = 911.0619
      -Middle: Asl,mid = 556.0619
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten,jacket = 603.1858
    -Compression: Asl,com,jacket = 603.1858
      -Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten,core = 307.8761
    -Compression: Asl,com,core = 307.8761
      -Middle: Asl,mid,core = 153.938
Mean Diameter of Tension Reinforcement, DbL = 15.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity θu,R = * θu = 0.00910271
 θu = θy + θp = 0.00910271

 - Calculation of θy -

 θy = (My*Ls/3)/Eleff = 0.00410271 ((4.29),Biskinis Phd))
  My = 2.1250E+008
  Ls = M/V (with Ls>0.1*L and Ls < 2*L) = 1500.00
  From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 2.5898E+013

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
  y = Min(y_ten, y_com)
  y_ten = 1.0750437E-005
 with fy = 625.00
    d = 357.00
     y = 0.22791832
    A = 0.00999338
    B = 0.00562083
     with pt = 0.00380895
        pc = 0.00380895
        pv = 0.00232477
        N = 7188.634
        b = 670.00
        " = 0.12044818
  y_comp = 2.5846378E-005
 with fc = 27.76119
    Ec = 25742.96
     y = 0.22733556
    A = 0.00987103
    B = 0.00557012
     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 = 0.55914272
 - Transverse Reinforcement: NC
 - Stirrup Spacing > d/3
 - Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
        = -2.6687906E-023
 - Stirrup Spacing <= d/2
  d = d_external = 357.00
  s = s_external = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
  Vs = 237588.18,already given in calculation of shear control ratio
  design Shear = 5.4911670E-014
 - (- ')/ bal = -0.33327376
     = Aslt/(bw*d) = 0.00296835
    Tension Reinf Area: Aslt = 709.9999
    ' = Aslc/(bw*d) = 0.00697431
    Compression Reinf Area: Aslc = 1668.186
  From (B-1), ACI 318-11: bal = 0.01202003
    fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 27.76119
    fy = fy_jacket_bars = 625.00
    From 10.2.7.3, ACI 318-11: 1 = 0.65
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.48979592
        y = 0.003125
 - V/(bw*d*fc^0.5) = 5.2471780E-019, NOTE: units in lb & in
    bw = 670.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)

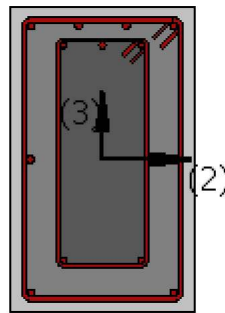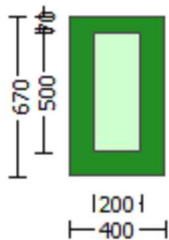
Calculation No. 9

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 JB1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -7.2842051E-011
Shear Force, Va = -4.5846775E-014
EDGE -B-
Bending Moment, Mb = -6.4836912E-011
Shear Force, Vb = 4.5846775E-014
BOTH EDGES
Axial Force, F = -6266.087
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 911.0619
    -Compression: Asl,com = 911.0619
     -Middle: Asl,mid = 556.0619
Mean Diameter of Tension Reinforcement, DbL,ten = 15.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 315128.448
Vn ((22.5.1.1), ACI 318-14) = 315128.448

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 = 147576.839
        = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 18.50746, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 670.00
        d = 320.00
     Vu*d/Mu < 1 = 0.00
        Mu = 7.2842051E-011
        Vu = 4.5846775E-014
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 167551.608
   Vs1 = 167551.608 is calculated for jacket, with:
      d = 320.00
      Av = 157079.633
      fy = 500.00
      s = 150.00
    Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 0.00 is calculated for core, with:
      d = 160.00
      Av = 100530.965
      fy = 420.00
      s = 300.00
    Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
    Vf ((11-3)-(11.4), ACI 440) = 0.00
    From (11-11), ACI 440: Vs + Vf <= 612724.122

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)
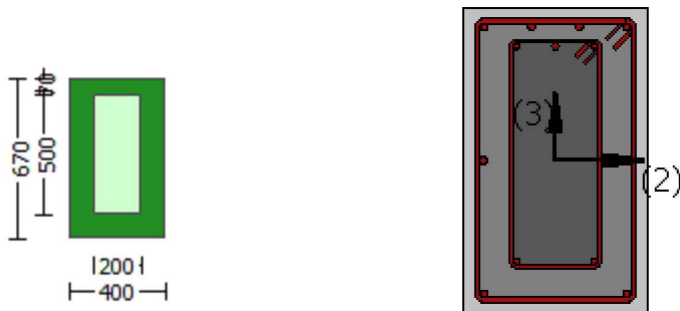
Calculation No. 10

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 JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##

External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 709.9999
    -Compression: Asl,com = 1266.062
      -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.92480584
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 = 535287.788
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.8817E+008
  Mu1+ = 4.6479E+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- = 7.8817E+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-) = 7.8817E+008
  Mu2+ = 4.6479E+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- = 7.8817E+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 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
  V2 = 9840.634, 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 = 5.6369735E-005
Mu = 4.6479E+008
----
with full section properties:
  b = 400.00

```
d = 627.00
d' = 43.00
v = 0.000307
   N = 2309.834
fc = 30.00
 co (5A.5, TBDY) = 0.002
Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY:  cu = 0.00680405
     we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
           bo_1 = 340.00
           ho_1 = 610.00
            bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
           bo_2 = 192.00
           ho_2 = 492.00
            bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ----------------------------------------------------------------
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
           Ash1 = Astir_1*ns_1 = 157.0796
             No stirups, ns_1 = 2.00
           h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
           Ash2 = Astir_2*ns_2 = 100.531
             No stirups, ns_2 = 2.00
           h2 = 500.00
      ----------------------------------------------------------------
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
           Ash1 = Astir_1*ns_1 = 157.0796
             No stirups, ns_1 = 2.00
           h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
           Ash2 = Astir_2*ns_2 = 100.531
             No stirups, ns_2 = 2.00
           h2 = 200.00
      ----------------------------------------------------------------
        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce  = 30.00
   From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c = confinement factor = 1.04251
 y1 = 0.0025
 sh1 = 0.008
ft1 = 872.4558
fy1 = 727.0465
 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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
    with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
 y2 = 0.0025
 sh2 = 0.008
```

ft2 = 882.7854
fy2 = 735.6545
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 937.50
 fyv = 781.25
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
      with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
    2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
    v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
  u =   su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008

```
----------------------------------------------------------------
with full section properties:
   b = 400.00
   d = 627.00
   d' = 43.00
   v = 0.000307
      N = 2309.834
   fc = 30.00
    co (5A.5, TBDY) = 0.002
   Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY:  cu = 0.00680405
         we (5.4c) = 0.00682295
         ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
            ase1 = 0.14776895
               bo_1 = 340.00
               ho_1 = 610.00
                bi2_1 = 975400.00
            ase2 = Max(ase1,ase2) = 0.14776895
               bo_2 = 192.00
               ho_2 = 492.00
                bi2_2 = 557856.00
         psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ----------------------------------------------------------------
         psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
               Ash1 = Astir_1*ns_1 = 157.0796
                  No stirups, ns_1 = 2.00
               h1 = 670.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
               Ash2 = Astir_2*ns_2 = 100.531
                  No stirups, ns_2 = 2.00
               h2 = 500.00
      ----------------------------------------------------------------
         psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
               Ash1 = Astir_1*ns_1 = 157.0796
                  No stirups, ns_1 = 2.00
               h1 = 400.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
               Ash2 = Astir_2*ns_2 = 100.531
                  No stirups, ns_2 = 2.00
               h2 = 200.00
      ----------------------------------------------------------------
            Asec = 268000.00
            s1 = 150.00
            s2 = 300.00
         fywe1 = 781.25
         fywe2 = 656.25
         fce  = 30.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00242514
          c  = confinement factor = 1.04251
    y1 = 0.0025
    sh1 = 0.008
   ft1 = 882.7854
   fy1 = 735.6545
    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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
```

with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00

y2 = 0.0025

sh2 = 0.008

ft2 = 872.4558

fy2 = 727.0465

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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465

with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00

yv = 0.0025

shv = 0.008

ftv = 937.50

fyv = 781.25

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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25

with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00

1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842

2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752

v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429

and confined core properties:

b = 340.00

d = 597.00

d' = 13.00

fcc (5A.2, TBDY) = 31.27541

cc (5A.5, TBDY) = 0.00242514

c = confinement factor = 1.04251

1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169

2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074

v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117

Case/Assumption: Unconfinesd full section - Steel rupture

' satisfies Eq. (4.3)

--->

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

--->

v < vs,c - RHS eq.(4.5) is satisfied

--->

su (4.8) = 0.16206515

Mu = MRc (4.15) = 7.8817E+008

u =   su (4.1) = 6.0907698E-005

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 = 5.6369735E-005
Mu = 4.6479E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ----
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 500.00
    ----
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce = 30.00
    From ((5.A5), TBDY), TBDY: cc = 0.00242514
        c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 872.4558
 fy1 = 727.0465
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
  with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 882.7854
fy2 = 735.6545
 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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
   with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 937.50
fyv = 781.25
 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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
   with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
  2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
     c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
   v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
 u =   su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  ν = 0.000307
    N = 2309.834
  fc = 30.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00680405
      ωwe (5.4c) = 0.00682295
      αse ((5.4d), TBDY) = (αse1*Aext+αse2*Aint)/Asec = 0.14776895
        αse1 = 0.14776895
            bo_1 = 340.00
            ho_1 = 610.00
             bi2_1 = 975400.00
        αse2 = Max(αse1,αse2) = 0.14776895
            bo_2 = 192.00
            ho_2 = 492.00
             bi2_2 = 557856.00
      ρsh,min*Fywe = Min(ρsh,x*Fywe , ρsh,y*Fywe) = 1.38519

      ρsh_x*Fywe = ρsh1*Fywe1+ρs2*Fywe2 = 2.45559
        ρs1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
            Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
            h1 = 670.00
        ρs2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
            Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
            h2 = 500.00

      ρsh_y*Fywe = ρsh1*Fywe1+ρs2*Fywe2 = 1.38519
        ρs1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
            Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
            h1 = 400.00
        ρs2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
            Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
            h2 = 200.00

          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce = 30.00
      From ((5.A5), TBDY), TBDY: εcc = 0.00242514
          εc = confinement factor = 1.04251
  εy1 = 0.0025
  εsh1 = 0.008
  ft1 = 882.7854
  fy1 = 735.6545
  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
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 872.4558
fy2 = 727.0465
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
cc (5A.5, TBDY) = 0.00242514
c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
u = su (4.1) = 6.0907698E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 578810.994

Calculation of Shear Strength at edge 1, Vr1 = 578810.994
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 = 192813.976
       = 1 (normal-weight concrete)
       Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
       pw = As/(bw*d) = 0.00331157
          As (tension reinf.) = 709.9999
          bw = 400.00
          d = 536.00
       Vu*d/Mu < 1 = 1.00
          Mu = 1.1510E+006
          Vu = 9840.632
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
   Vs1 = 350811.18 is calculated for jacket, with:
      d = 536.00
      Av = 157079.633
      fy = 625.00
      s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 35185.838 is calculated for jacket, with:
      d2 = 400.00
      Av = 100530.965
      fy = 525.00
      s = 300.00
   Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 750430.726

Calculation of Shear Strength at edge 2, Vr2 = 578810.994
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 = 192813.976
       = 1 (normal-weight concrete)
       Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
       pw = As/(bw*d) = 0.00331157
          As (tension reinf.) = 709.9999
          bw = 400.00
          d = 536.00
       Vu*d/Mu < 1 = 1.00
          Mu = 1.1510E+006
          Vu = 9840.634
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
   Vs1 = 350811.18 is calculated for jacket, with:
      d = 536.00
      Av = 157079.633
      fy = 625.00
      s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)

Vs2 = 35185.838 is calculated for jacket, with:
    d = 400.00
    Av = 100530.965
    fy = 525.00
    s = 300.00
  Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
  2(1-s/d) = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = -6.9728406E-015
EDGE -B-
Shear Force, Vb = 6.9728406E-015

BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
    -Tension: Aslt = 709.9999
  -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
    -Tension: Asl,ten = 911.0619
  -Compression: Asl,com = 911.0619
    -Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.55914272
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 = 218168.257
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.2725E+008
  Mu1+ = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
  Mu1- = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.2725E+008
  Mu2+ = 3.2725E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
  Mu2- = 3.2725E+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 = -6.9728406E-015, is the shear force acting at edge 1 for the the static loading combination
  V2 = 6.9728406E-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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
     ----
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799

```
            Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
            h1 = 670.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
              Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
            h2 = 500.00
    -------------------------------------------------------------------
       psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
              Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
            h1 = 400.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
              Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
            h2 = 200.00
    -------------------------------------------------------------------
          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
     with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
     with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 895.9746
 fyv = 746.6455
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
 with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
 b = 610.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
    c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
 b = 670.00
 d = 357.00
 d' = 43.00
 v = 0.0003219
   N = 2309.834
 fc = 30.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.00680405
   we (5.4c) = 0.00682295
   ase ((5.4d), TBDY) = (ase1*Aext+ ase2*Aint)/Asec = 0.14776895
     ase1 = 0.14776895
       bo_1 = 340.00
       ho_1 = 610.00
        bi2_1 = 975400.00
     ase2 = Max(ase1,ase2) = 0.14776895
       bo_2 = 192.00
       ho_2 = 492.00
        bi2_2 = 557856.00
    psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519

```
-------------------------------------------------------------------
    psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
            Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
            h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
            Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
            h2 = 500.00
    -------------------------------------------------------------------
    psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
            Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
            h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
            Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
            h2 = 200.00
    -------------------------------------------------------------------
        Asec = 268000.00
         s1 = 150.00
         s2 = 300.00
       fywe1 = 781.25
       fywe2 = 656.25
       fce  = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
         c = confinement factor = 1.04251
  y1 = 0.0025
 sh1 = 0.008
ft1 = 886.8103
fy1 = 739.0086
 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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
 sh2 = 0.008
ft2 = 886.8103
fy2 = 739.0086
 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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
 shv = 0.008
ftv = 895.9746
fyv = 746.6455
 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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
   2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
   v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
     c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
       ase ((5.4d), TBDY) = (ase1*Aext+ ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
             bo_1 = 340.00
             ho_1 = 610.00
              bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
             bo_2 = 192.00

```
                ho_2 = 492.00
                   bi2_2 = 557856.00
          psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
       ----------------------------------------------------------------
          psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
             ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
                Ash1 = Astir_1*ns_1 = 157.0796
                   No stirups, ns_1 = 2.00
                h1 = 670.00
             ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
                Ash2 = Astir_2*ns_2 = 100.531
                   No stirups, ns_2 = 2.00
                h2 = 500.00
       ----------------------------------------------------------------
          psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
             ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                Ash1 = Astir_1*ns_1 = 157.0796
                   No stirups, ns_1 = 2.00
                h1 = 400.00
             ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                Ash2 = Astir_2*ns_2 = 100.531
                   No stirups, ns_2 = 2.00
                h2 = 200.00
       ----------------------------------------------------------------
             Asec = 268000.00
             s1 = 150.00
             s2 = 300.00
          fywe1 = 781.25
          fywe2 = 656.25
          fce = 30.00
       From ((5.A5), TBDY):  cc = 0.00242514
            c  = confinement factor = 1.04251
    y1 = 0.0025
    sh1 = 0.008
   ft1 = 886.8103
   fy1 = 739.0086
    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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
        with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
    y2 = 0.0025
    sh2 = 0.008
   ft2 = 886.8103
   fy2 = 739.0086
    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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
        with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
    yv = 0.0025
    shv = 0.008
   ftv = 895.9746
```

fyv = 746.6455
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
      with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
     c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
       ase ((5.4d), TBDY) = (ase1*Aext+ ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
             bo_1 = 340.00
             ho_1 = 610.00

bi2_1 = 975400.00
           ase2 = Max(ase1,ase2) = 0.14776895
                    bo_2 = 192.00
                    ho_2 = 492.00
                     bi2_2 = 557856.00
           psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
         ----
           psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
              ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
                  Ash1 = Astir_1*ns_1 = 157.0796
                     No stirups, ns_1 = 2.00
                  h1 = 670.00
              ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
                  Ash2 = Astir_2*ns_2 = 100.531
                     No stirups, ns_2 = 2.00
                  h2 = 500.00
         ----
           psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
              ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                  Ash1 = Astir_1*ns_1 = 157.0796
                     No stirups, ns_1 = 2.00
                  h1 = 400.00
              ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                  Ash2 = Astir_2*ns_2 = 100.531
                     No stirups, ns_2 = 2.00
                  h2 = 200.00

              Asec = 268000.00
              s1 = 150.00
              s2 = 300.00
            fywe1 = 781.25
            fywe2 = 656.25
            fce = 30.00
       From ((5.A5), TBDY), TBDY: cc = 0.00242514
            c = confinement factor = 1.04251
    y1 = 0.0025
   sh1 = 0.008
  ft1 = 886.8103
  fy1 = 739.0086
   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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
    y2 = 0.0025
   sh2 = 0.008
  ft2 = 886.8103
  fy2 = 739.0086
   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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00

```
      yv = 0.0025
     shv = 0.008
    ftv = 895.9746
    fyv = 746.6455
     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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
         with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
      2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
      v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
    b = 610.00
    d = 327.00
    d' = 13.00
    fcc (5A.2, TBDY) = 31.27541
     cc (5A.5, TBDY) = 0.00242514
         c  = confinement factor = 1.04251
      1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
      2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
      v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
   u =    su (4.1) = 0.00010507
------------------------------------------------------------

Calculation of ratio lb/ld
------------------------------------------------------------
Adequate Lap Length: lb/ld >= 1
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
----------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 390183.487
----------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 390183.487
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 = 180743.977
        = 1 (normal-weight concrete)
       Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00331157
         As (tension reinf.) = 709.9999
         bw = 670.00
         d = 320.00
      Vu*d/Mu < 1 = 0.00
         Mu = 2.1102257E-011
         Vu = 6.9728406E-015
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
```

Vs1 = 209439.51 is calculated for jacket, with:
   d = 320.00
   Av = 157079.633
   fy = 625.00
   s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 0.00 is calculated for jacket, with:
   d2 = 160.00
   Av = 100530.965
   fy = 525.00
   s = 300.00
  Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726

Calculation of Shear Strength at edge 2, Vr2 = 390183.487
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 = 180743.977
    = 1 (normal-weight concrete)
    Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
     As (tension reinf.) = 709.9999
     bw = 670.00
     d = 320.00
    Vu*d/Mu < 1 = 0.00
     Mu = 1.8034731E-013
     Vu = 6.9728406E-015
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
  Vs1 = 209439.51 is calculated for jacket, with:
   d = 320.00
   Av = 157079.633
   fy = 625.00
   s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 0.00 is calculated for jacket, with:
   d = 160.00
   Av = 100530.965
   fy = 525.00
   s = 300.00
  Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00

New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 4.3723E+006
Shear Force, V2 = -4.5846775E-014
Shear Force, V3 = 5140.455
Axial Force, F = -6266.087
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 709.9999
     -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 709.9999
     -Compression: Asl,com = 1266.062
        -Middle: Asl,mid = 402.1239
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten,jacket = 402.1239
     -Compression: Asl,com,jacket = 804.2477
        -Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten,core = 307.8761
     -Compression: Asl,com,core = 461.8141
        -Middle: Asl,mid,core = 0.00
Mean Diameter of Tension Reinforcement, DbL = 15.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity u,R = * u = 0.02609372
  u = y + p = 0.02609372

 - Calculation of y -
----
 y = (My*Ls/3)/EIeff = 0.00109372 ((4.29),Biskinis Phd))
  My = 2.9205E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 850.5703
  From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 7.5708E+013

Calculation of Yielding Moment My

Calculation of y and My according to Annex 7 -
----
  y = Min(y_ten, y_com)

y_ten = 5.8224212E-006
with fy = 625.00
    d = 627.00
     y = 0.18831702
    A = 0.00952456
    B = 0.00407596
     with pt = 0.00283094
        pc = 0.00504809
        pv = 0.00160336
        N = 6266.087
        b = 400.00
        " = 0.06858054
  y_comp = 1.7830319E-005
with fc = 27.76119
    Ec = 25742.96
     y = 0.18763274
    A = 0.00942285
    B = 0.0040338
     with Es = 200000.00

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

 - Calculation of p -

From table 10-7: p = 0.025
with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1
   shear control ratio Vp/Vo = 0.92480584
 - Transverse Reinforcement: C
 - Stirrup Spacing <= d/3
 - Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
        = 5.2671840E-005
 - Stirrup Spacing <= d/2
  d = d_external = 627.00
  s = s_external = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
  Vs = 421182.855,already given in calculation of shear control ratio
  design Shear = 5140.455
 - (- ')/ bal = -0.3178459
     = Aslt/(bw*d) = 0.00283094
    Tension Reinf Area: Aslt = 709.9999
    ' = Aslc/(bw*d) = 0.00665146
    Compression Reinf Area: Aslc = 1668.186
  From (B-1), ACI 318-11: bal = 0.01202003
    fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 27.76119
    fy = fy_jacket_bars = 625.00
    From 10.2.7.3, ACI 318-11: 1 = 0.65
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.48979592
        y = 0.003125
 - V/(bw*d*fc^0.5) = 0.04684661, NOTE: units in lb & in
    bw = 400.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (a)

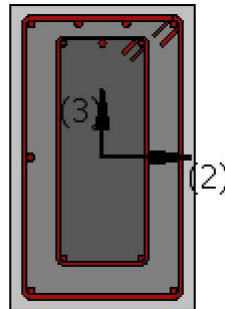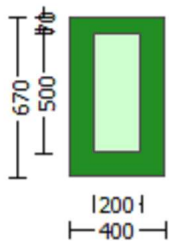
Calculation No. 11

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 JB1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 4.3723E+006
Shear Force, Va = 5140.455
EDGE -B-
Bending Moment, Mb = 9.7286E+006
Shear Force, Vb = 14540.811
BOTH EDGES
Axial Force, F = -6266.087
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 709.9999
      -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 709.9999
       -Compression: Asl,com = 1266.062
         -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 15.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 463980.549
Vn ((22.5.1.1), ACI 318-14) = 463980.549

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 = 155182.936
        = 1 (normal-weight concrete)
       Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 18.50746, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 400.00
        d = 536.00
     Vu*d/Mu < 1 = 0.63016543
        Mu = 4.3723E+006
        Vu = 5140.455
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 308797.614
   Vs1 = 280648.944 is calculated for jacket, with:
     d = 536.00
     Av = 157079.633
     fy = 500.00
     s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 28148.67 is calculated for core, with:
     d = 400.00
     Av = 100530.965
     fy = 420.00
     s = 300.00
   Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 612724.122

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (a)

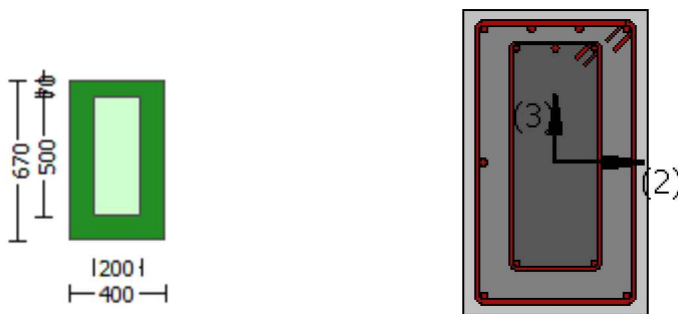
Calculation No. 12

beam B1, Floor 1

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

Analysis: Uniform +X

Check: Chord rotation capacity (u)

Edge: Start

Local Axis: (3)

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
###
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00

Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 709.9999
   -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 709.9999
   -Compression: Asl,com = 1266.062
      -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.92480584
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 = 535287.788
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.8817E+008
   Mu1+ = 4.6479E+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- = 7.8817E+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-) = 7.8817E+008
   Mu2+ = 4.6479E+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- = 7.8817E+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 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
   V2 = 9840.634, 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 = 5.6369735E-005
Mu = 4.6479E+008
----
with full section properties:
   b = 400.00
   d = 627.00
   d' = 43.00
   v = 0.000307
      N = 2309.834

fc = 30.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00680405
     we (5.4c) = 0.00682295
     ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
           bo_1 = 340.00
           ho_1 = 610.00
            bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
           bo_2 = 192.00
           ho_2 = 492.00
            bi2_2 = 557856.00
     psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
   ----
     psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
           Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
           h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
           Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
           h2 = 500.00
   ----
     psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
           Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
           h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
           Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
           h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
     fywe1 = 781.25
     fywe2 = 656.25
     fce = 30.00
   From ((5.A5), TBDY), TBDY: cc = 0.00242514
        c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 872.4558
 fy1 = 727.0465
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
    with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 882.7854
 fy2 = 735.6545
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
     with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
   yv = 0.0025
   shv = 0.008
  ftv = 937.50
  fyv = 781.25
   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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
     with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
    2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
    v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
   b = 340.00
   d = 597.00
   d' = 13.00
   fcc (5A.2, TBDY) = 31.27541
    cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
  u =   su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
----
with full section properties:
   b = 400.00
   d = 627.00

d' = 43.00
v = 0.000307
  N = 2309.834
fc = 30.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00680405
     we (5.4c) = 0.00682295
     ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
           bo_1 = 340.00
           ho_1 = 610.00
            bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
           bo_2 = 192.00
           ho_2 = 492.00
            bi2_2 = 557856.00
     psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
     ----
     psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
           Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
           h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
           Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
           h2 = 500.00
     ----
     psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
           Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
           h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
           Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
           h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce = 30.00
   From ((5.A5), TBDY), TBDY: cc = 0.00242514
        c = confinement factor = 1.04251
 y1 = 0.0025
 sh1 = 0.008
ft1 = 882.7854
fy1 = 735.6545
 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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
     with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 872.4558

fy2 = 727.0465
 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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
    with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 937.50
 fyv = 781.25
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
  2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
     c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
   2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
   v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
 u =   su (4.1) = 6.0907698E-005

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 = 5.6369735E-005

Mu = 4.6479E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ----
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 500.00
    ----
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce = 30.00
    From ((5.A5), TBDY), TBDY: cc = 0.00242514
      c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 872.4558
 fy1 = 727.0465
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 882.7854
fy2 = 735.6545
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
cc (5A.5, TBDY) = 0.00242514
c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
u = su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
 Mu = 7.8817E+008
------------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
 fc = 30.00
   co (5A.5, TBDY) = 0.002
 Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ------------------------------------------------------------------
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 500.00
    ------------------------------------------------------------------
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 200.00
    ------------------------------------------------------------------
          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c  = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 882.7854
 fy1 = 735.6545
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
  with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 872.4558
fy2 = 727.0465
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
    with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
  2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
    c = confinement factor = 1.04251
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
  2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
u =   su (4.1) = 6.0907698E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

```
-------------------------------------------------------------------
-------------------------------------------------------------------
-------------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 578810.994
-------------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 578810.994
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 = 192813.976
        = 1 (normal-weight concrete)
     Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 400.00
        d = 536.00
     Vu*d/Mu < 1 = 1.00
        Mu = 1.1510E+006
        Vu = 9840.632
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
   Vs1 = 350811.18 is calculated for jacket, with:
     d = 536.00
     Av = 157079.633
     fy = 625.00
     s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 35185.838 is calculated for jacket, with:
     d2 = 400.00
     Av = 100530.965
     fy = 525.00
     s = 300.00
   Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 750430.726
-------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 578810.994
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 = 192813.976
        = 1 (normal-weight concrete)
     Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 400.00
        d = 536.00
     Vu*d/Mu < 1 = 1.00
        Mu = 1.1510E+006
        Vu = 9840.634
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
   Vs1 = 350811.18 is calculated for jacket, with:
     d = 536.00
     Av = 157079.633
     fy = 625.00
     s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 35185.838 is calculated for jacket, with:
     d = 400.00
     Av = 100530.965
     fy = 525.00
```

```
    s =  300.00
   Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
   2(1-s/d) = 0.50
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 750430.726
------------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3


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


Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties
------------------------------------------------------------
Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
############################################################
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = -6.9728406E-015
EDGE -B-
Shear Force, Vb = 6.9728406E-015
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 709.9999
```

-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 911.0619
     -Compression: Asl,com = 911.0619
          -Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.55914272
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 = 218168.257
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.2725E+008
   Mu1+ = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
   Mu1- = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.2725E+008
   Mu2+ = 3.2725E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
   Mu2- = 3.2725E+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 = -6.9728406E-015, is the shear force acting at edge 1 for the the static loading combination
   V2 = 6.9728406E-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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
   b = 670.00
   d = 357.00
   d' = 43.00
   v = 0.0003219
      N = 2309.834
   fc = 30.00
     co (5A.5, TBDY) = 0.002
   Final value of   cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.00680405
         we (5.4c) = 0.00682295
         ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
            ase1 = 0.14776895
               bo_1 = 340.00
               ho_1 = 610.00
                bi2_1 = 975400.00
         ase2 = Max(ase1,ase2) = 0.14776895
               bo_2 = 192.00
               ho_2 = 492.00
                bi2_2 = 557856.00
         psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ----
         psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
               Ash1 = Astir_1*ns_1 = 157.0796
                  No stirups, ns_1 = 2.00
               h1 = 670.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519

```
            Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
            h2 = 500.00
        ------------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 400.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 200.00
        ------------------------------------------------------------------
            Asec = 268000.00
            s1 = 150.00
            s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
    From ((5.A5), TBDY):  cc = 0.00242514
            c  = confinement factor = 1.04251
```

$y1 = 0.0025$
$sh1 = 0.008$
$ft1 = 886.8103$
$fy1 = 739.0086$
$su1 = 0.032$
   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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
   with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
$y2 = 0.0025$
$sh2 = 0.008$
$ft2 = 886.8103$
$fy2 = 739.0086$
$su2 = 0.032$
   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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
   with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
$yv = 0.0025$
$shv = 0.008$
$ftv = 895.9746$
$fyv = 746.6455$
$suv = 0.032$
   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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
  with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
    c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
   N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
     we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
       ase1 = 0.14776895
        bo_1 = 340.00
        ho_1 = 610.00
         bi2_1 = 975400.00
      ase2 = Max(ase1,ase2) = 0.14776895
        bo_2 = 192.00
        ho_2 = 492.00
         bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ----
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
       ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
        Ash1 = Astir_1*ns_1 = 157.0796

No stirups, ns_1 = 2.00
          h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
          h2 = 500.00
    ----
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
          h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
          h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
       fce = 30.00
    From ((5.A5), TBDY), TBDY: cc = 0.00242514
        c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
     with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
     with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 895.9746
 fyv = 746.6455
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
 with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
     N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
           bo_1 = 340.00
           ho_1 = 610.00
             bi2_1 = 975400.00
       ase2 = Max(ase1,ase2) = 0.14776895
            bo_2 = 192.00
            ho_2 = 492.00
             bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ----

psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
   ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
     Ash1 = Astir_1*ns_1 = 157.0796
       No stirups, ns_1 = 2.00
     h1 = 670.00
   ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
     Ash2 = Astir_2*ns_2 = 100.531
       No stirups, ns_2 = 2.00
     h2 = 500.00
----
   psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
    ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
     Ash1 = Astir_1*ns_1 = 157.0796
       No stirups, ns_1 = 2.00
     h1 = 400.00
    ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
     Ash2 = Astir_2*ns_2 = 100.531
       No stirups, ns_2 = 2.00
     h2 = 200.00

    Asec = 268000.00
    s1 = 150.00
    s2 = 300.00
   fywe1 = 781.25
   fywe2 = 656.25
   fce = 30.00
 From ((5.A5), TBDY), TBDY: cc = 0.00242514
   c = confinement factor = 1.04251
y1 = 0.0025
sh1 = 0.008
ft1 = 886.8103
fy1 = 739.0086
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
  with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 886.8103
fy2 = 739.0086
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
  with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 895.9746
fyv = 746.6455
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
 with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
 1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
 2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
 v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
    c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
   N = 2309.834
  fc = 30.00
  co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00680405
    we (5.4c) = 0.00682295
     ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
      ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00

```
              bi2_2 = 557856.00
        psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ------------------------------------------------------------------
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
              Ash1 = Astir_1*ns_1 = 157.0796
                 No stirups, ns_1 = 2.00
              h1 = 670.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
              Ash2 = Astir_2*ns_2 = 100.531
                 No stirups, ns_2 = 2.00
              h2 = 500.00
      ------------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
              Ash1 = Astir_1*ns_1 = 157.0796
                 No stirups, ns_1 = 2.00
              h1 = 400.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
              Ash2 = Astir_2*ns_2 = 100.531
                 No stirups, ns_2 = 2.00
              h2 = 200.00
      ------------------------------------------------------------------
        Asec = 268000.00
         s1 = 150.00
         s2 = 300.00
       fywe1 = 781.25
       fywe2 = 656.25
       fce = 30.00
    From ((5.A5), TBDY):  cc = 0.00242514
         c  = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 895.9746
 fyv = 746.6455
```

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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
    c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 390183.487

Calculation of Shear Strength at edge 1, Vr1 = 390183.487
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 = 180743.977
    = 1 (normal-weight concrete)
    Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
     As (tension reinf.) = 709.9999
     bw = 670.00
     d = 320.00
    Vu*d/Mu < 1 = 0.00
     Mu = 2.1102257E-011
     Vu = 6.9728406E-015
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
  Vs1 = 209439.51 is calculated for jacket, with:
   d = 320.00
   Av = 157079.633
   fy = 625.00

s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 0.00 is calculated for jacket, with:
    d2 = 160.00
    Av = 100530.965
    fy = 525.00
    s = 300.00
  Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726

Calculation of Shear Strength at edge 2, Vr2 = 390183.487
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 = 180743.977
      = 1 (normal-weight concrete)
    Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
      As (tension reinf.) = 709.9999
      bw = 670.00
      d = 320.00
    Vu*d/Mu < 1 = 0.00
      Mu = 1.8034731E-013
      Vu = 6.9728406E-015
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
  Vs1 = 209439.51 is calculated for jacket, with:
    d = 320.00
    Av = 157079.633
    fy = 625.00
    s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 0.00 is calculated for jacket, with:
    d = 160.00
    Av = 100530.965
    fy = 525.00
    s = 300.00
  Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (a)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column

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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -7.2842051E-011
Shear Force, V2 = -4.5846775E-014
Shear Force, V3 = 5140.455
Axial Force, F = -6266.087
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 911.0619
    -Compression: Asl,com = 911.0619
        -Middle: Asl,mid = 556.0619
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten,jacket = 603.1858
    -Compression: Asl,com,jacket = 603.1858
        -Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten,core = 307.8761
    -Compression: Asl,com,core = 307.8761
        -Middle: Asl,mid,core = 153.938
Mean Diameter of Tension Reinforcement, DbL = 15.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity   u,R =   * u = 0.02409992
  u =   y +   p = 0.02409992

 - Calculation of   y -
----
 y = (My*Ls/3)/Eleff = 0.00409992 ((4.29),Biskinis Phd))
  My = 2.1236E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1500.00
  From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 2.5898E+013

Calculation of Yielding Moment My

Calculation of   y and My according to Annex 7   -
----
  y = Min(y_ten,   y_com)
  y_ten = 1.0748658E-005
 with fy = 625.00
    d = 357.00
    y = 0.22779052

```
      A = 0.00998687
      B = 0.00561432
       with pt = 0.00380895
           pc = 0.00380895
           pv = 0.00232477
           N = 6266.087
           b = 670.00
            " = 0.12044818
    y_comp = 2.5852450E-005
  with fc = 27.76119
      Ec = 25742.96
       y = 0.22728216
      A = 0.00988022
      B = 0.00557012
       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 = 0.55914272
 - Transverse Reinforcement: NC
 - Stirrup Spacing > d/3
 - Low ductility demand, / y < 2 (table 10-6, ASCE 41-17)
        = 6.2952160E-022
 - Stirrup Spacing <= d/2
  d = d_external = 357.00
  s = s_external = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
  Vs = 237588.18,already given in calculation of shear control ratio
  design Shear = 4.5846775E-014
 - (- ')/ bal = -0.33327376
    = Aslt/(bw*d) = 0.00296835
   Tension Reinf Area: Aslt = 709.9999
   ' = Aslc/(bw*d) = 0.00697431
   Compression Reinf Area: Aslc = 1668.186
  From (B-1), ACI 318-11: bal = 0.01202003
   fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 27.76119
   fy = fy_jacket_bars = 625.00
   From 10.2.7.3, ACI 318-11: 1 = 0.65
   From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.48979592
        y = 0.003125
 - V/(bw*d*fc^0.5) = 4.3809665E-019, NOTE: units in lb & in
   bw = 670.00

End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (a)

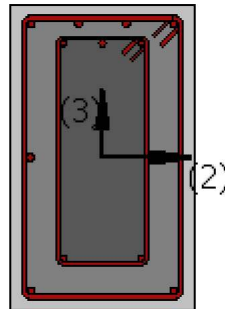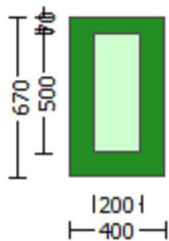---

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 JB1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -7.2842051E-011
Shear Force, Va = -4.5846775E-014
EDGE -B-
Bending Moment, Mb = -6.4836912E-011
Shear Force, Vb = 4.5846775E-014
BOTH EDGES
Axial Force, F = -6266.087
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 709.9999
     -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 911.0619
     -Compression: Asl,com = 911.0619
         -Middle: Asl,mid = 556.0619
Mean Diameter of Tension Reinforcement, DbL,ten = 15.20

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 315128.448
Vn ((22.5.1.1), ACI 318-14) = 315128.448

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 = 147576.839
       = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 18.50746, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 670.00
        d = 320.00
     Vu*d/Mu < 1 = 0.00
        Mu = 6.4836912E-011
        Vu = 4.5846775E-014
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 167551.608
  Vs1 = 167551.608 is calculated for jacket, with:
     d = 320.00
     Av = 157079.633
     fy = 500.00
     s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 0.00 is calculated for core, with:
     d = 160.00
     Av = 100530.965
     fy = 420.00
     s = 300.00
  Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 612724.122

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)

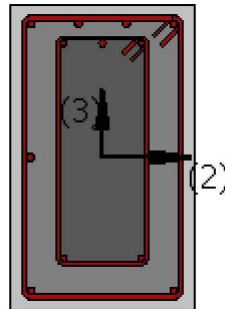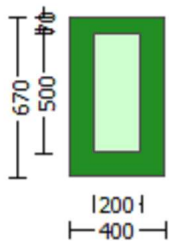
beam B1, Floor 1

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 JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00

Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
     -Tension: Aslt = 709.9999
   -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
     -Tension: Asl,ten = 709.9999
   -Compression: Asl,com = 1266.062
      -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.92480584
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 = 535287.788
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.8817E+008
  Mu1+ = 4.6479E+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- = 7.8817E+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-) = 7.8817E+008
  Mu2+ = 4.6479E+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- = 7.8817E+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 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
  V2 = 9840.634, 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 = 5.6369735E-005
Mu = 4.6479E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
     N = 2309.834

fc = 30.00
  co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00680405
    we (5.4c) = 0.00682295
    ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
     ase1 = 0.14776895
      bo_1 = 340.00
      ho_1 = 610.00
      bi2_1 = 975400.00
     ase2 = Max(ase1,ase2) = 0.14776895
      bo_2 = 192.00
      ho_2 = 492.00
      bi2_2 = 557856.00
    psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
   ----
    psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
     ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
      Ash1 = Astir_1*ns_1 = 157.0796
       No stirups, ns_1 = 2.00
      h1 = 670.00
     ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
      Ash2 = Astir_2*ns_2 = 100.531
       No stirups, ns_2 = 2.00
      h2 = 500.00
   ----
    psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
     ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
      Ash1 = Astir_1*ns_1 = 157.0796
       No stirups, ns_1 = 2.00
      h1 = 400.00
     ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
      Ash2 = Astir_2*ns_2 = 100.531
       No stirups, ns_2 = 2.00
      h2 = 200.00

    Asec = 268000.00
    s1 = 150.00
    s2 = 300.00
   fywe1 = 781.25
   fywe2 = 656.25
   fce = 30.00
  From ((5.A5), TBDY), TBDY: cc = 0.00242514
    c = confinement factor = 1.04251
y1 = 0.0025
sh1 = 0.008
ft1 = 872.4558
fy1 = 727.0465
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
  with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 882.7854
fy2 = 735.6545
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
     with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 937.50
 fyv = 781.25
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
     with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
    2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
    v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
    2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
  u =   su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
----
with full section properties:
  b = 400.00
  d = 627.00

d' = 43.00
v = 0.000307
   N = 2309.834
fc = 30.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00680405
     we (5.4c) = 0.00682295
     ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
       ase1 = 0.14776895
         bo_1 = 340.00
         ho_1 = 610.00
          bi2_1 = 975400.00
      ase2 = Max(ase1,ase2) = 0.14776895
         bo_2 = 192.00
         ho_2 = 492.00
          bi2_2 = 557856.00
     psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
     ----
     psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
       ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
         Ash1 = Astir_1*ns_1 = 157.0796
           No stirups, ns_1 = 2.00
         h1 = 670.00
       ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
         Ash2 = Astir_2*ns_2 = 100.531
           No stirups, ns_2 = 2.00
         h2 = 500.00
     ----
     psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
       ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
         Ash1 = Astir_1*ns_1 = 157.0796
           No stirups, ns_1 = 2.00
         h1 = 400.00
       ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
         Ash2 = Astir_2*ns_2 = 100.531
           No stirups, ns_2 = 2.00
         h2 = 200.00

       Asec = 268000.00
       s1 = 150.00
       s2 = 300.00
     fywe1 = 781.25
     fywe2 = 656.25
     fce = 30.00
   From ((5.A5), TBDY), TBDY: cc = 0.00242514
     c = confinement factor = 1.04251
 y1 = 0.0025
 sh1 = 0.008
ft1 = 882.7854
fy1 = 735.6545
 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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
   with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 872.4558

fy2 = 727.0465
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 937.50
 fyv = 781.25
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
      with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
    2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
    v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
    2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
  u =   su (4.1) = 6.0907698E-005

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 = 5.6369735E-005

Mu = 4.6479E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00680405
       we (5.4c) = 0.00682295
       ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
             bo_1 = 340.00
             ho_1 = 610.00
              bi2_1 = 975400.00
          ase2 = Max(ase1,ase2) = 0.14776895
             bo_2 = 192.00
             ho_2 = 492.00
              bi2_2 = 557856.00
       psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
     ----
       psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 670.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 500.00
     ----
       psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
             Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
             h1 = 400.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
             Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
             h2 = 200.00

          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce = 30.00
     From ((5A5), TBDY), TBDY: cc = 0.00242514
          c = confinement factor = 1.04251
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 872.4558
  fy1 = 727.0465
   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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 882.7854
fy2 = 735.6545
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
cc (5A.5, TBDY) = 0.00242514
c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
u = su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
-------------------------------------------------------------------------------
with full section properties:
  b =  400.00
  d =  627.00
  d' =  43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY:  cu = 0.00680405
       we (5.4c) = 0.00682295
       ase ((5.4d), TBDY) = (ase1*Aext+ ase2*Aint)/Asec = 0.14776895
          ase1 = 0.14776895
             bo_1 = 340.00
             ho_1 = 610.00
              bi2_1 = 975400.00
          ase2 = Max(ase1,ase2) = 0.14776895
             bo_2 = 192.00
             ho_2 = 492.00
              bi2_2 = 557856.00
       psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
     ----------------------------------------------------------------
       psh_x*Fywe = psh1*Fywe1+ ps2*Fywe2 = 2.45559
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
             Ash1 = Astir_1*ns_1 = 157.0796
               No stirups, ns_1 = 2.00
             h1 = 670.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
             Ash2 = Astir_2*ns_2 = 100.531
               No stirups, ns_2 = 2.00
             h2 = 500.00
     ----------------------------------------------------------------
       psh_y*Fywe = psh1*Fywe1+ ps2*Fywe2 = 1.38519
          ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
             Ash1 = Astir_1*ns_1 = 157.0796
               No stirups, ns_1 = 2.00
             h1 = 400.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
             Ash2 = Astir_2*ns_2 = 100.531
               No stirups, ns_2 = 2.00
             h2 = 200.00
     ----------------------------------------------------------------
          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
     From ((5.A5), TBDY), TBDY:  cc = 0.00242514
         c  = confinement factor = 1.04251
   y1 = 0.0025
  sh1 = 0.008
 ft1 = 882.7854
 fy1 = 735.6545
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
  with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 872.4558
fy2 = 727.0465
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
   with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
   with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
 cc (5A.5, TBDY) = 0.00242514
  c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
u =   su (4.1) = 6.0907698E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

```
-----------------------------------------------------------------
-----------------------------------------------------------------
-----------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 578810.994
-----------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 578810.994
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 = 192813.976
      = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
       As (tension reinf.) = 709.9999
       bw = 400.00
       d = 536.00
    Vu*d/Mu < 1 = 1.00
       Mu = 1.1510E+006
       Vu = 9840.632
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
  Vs1 = 350811.18 is calculated for jacket, with:
     d = 536.00
     Av = 157079.633
     fy = 625.00
     s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 35185.838 is calculated for jacket, with:
     d2 = 400.00
     Av = 100530.965
     fy = 525.00
     s = 300.00
  Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
  2(1-s/d) = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726
-----------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 578810.994
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 = 192813.976
      = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
       As (tension reinf.) = 709.9999
       bw = 400.00
       d = 536.00
    Vu*d/Mu < 1 = 1.00
       Mu = 1.1510E+006
       Vu = 9840.634
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
  Vs1 = 350811.18 is calculated for jacket, with:
     d = 536.00
     Av = 157079.633
     fy = 625.00
     s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 35185.838 is calculated for jacket, with:
     d = 400.00
     Av = 100530.965
     fy = 525.00
```

s = 300.00
Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
2(1-s/d) = 0.50
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 750430.726

End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = -6.9728406E-015
EDGE -B-
Shear Force, Vb = 6.9728406E-015
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 709.9999

-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 911.0619
    -Compression: Asl,com = 911.0619
        -Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.55914272
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 = 218168.257
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.2725E+008
  Mu1+ = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
  Mu1- = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.2725E+008
  Mu2+ = 3.2725E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
  Mu2- = 3.2725E+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 = -6.9728406E-015, is the shear force acting at edge 1 for the the static loading combination
  V2 = 6.9728406E-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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: cu = 0.00680405
       we (5.4c) = 0.00682295
        ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
           ase1 = 0.14776895
              bo_1 = 340.00
              ho_1 = 610.00
               bi2_1 = 975400.00
         ase2 = Max(ase1,ase2) = 0.14776895
              bo_2 = 192.00
              ho_2 = 492.00
               bi2_2 = 557856.00
       psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ----
         psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
           ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
              Ash1 = Astir_1*ns_1 = 157.0796
                 No stirups, ns_1 = 2.00
              h1 = 670.00
           ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519

```
            Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
            h2 = 500.00
        -----------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 400.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 200.00
        -----------------------------------------------------------------
            Asec = 268000.00
            s1 = 150.00
            s2 = 300.00
          fywe1 = 781.25
          fywe2 = 656.25
          fce  = 30.00
      From ((5.A5), TBDY):  cc = 0.00242514
            c  = confinement factor = 1.04251
    y1 = 0.0025
   sh1 = 0.008
  ft1 = 886.8103
  fy1 = 739.0086
   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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
       with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
    y2 = 0.0025
   sh2 = 0.008
  ft2 = 886.8103
  fy2 = 739.0086
   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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
       with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
    yv = 0.0025
   shv = 0.008
  ftv = 895.9746
  fyv = 746.6455
   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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
  with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
    c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u = su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
   N = 2309.834
  fc = 30.00
  co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00680405
    we (5.4c) = 0.00682295
    ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
     ase1 = 0.14776895
      bo_1 = 340.00
      ho_1 = 610.00
       bi2_1 = 975400.00
    ase2 = Max(ase1,ase2) = 0.14776895
      bo_2 = 192.00
      ho_2 = 492.00
       bi2_2 = 557856.00
    psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ----
    psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
     ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
      Ash1 = Astir_1*ns_1 = 157.0796

No stirups, ns_1 = 2.00
            h1 = 670.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
              Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
              h2 = 500.00
     ----
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
         ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
              Ash1 = Astir_1*ns_1 = 157.0796
                No stirups, ns_1 = 2.00
              h1 = 400.00
          ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
              Ash2 = Astir_2*ns_2 = 100.531
                No stirups, ns_2 = 2.00
              h2 = 200.00

          Asec = 268000.00
           s1 = 150.00
           s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
         fce = 30.00
    From ((5.A5), TBDY), TBDY: cc = 0.00242514
         c = confinement factor = 1.04251
   y1 = 0.0025
   sh1 = 0.008
  ft1 = 886.8103
  fy1 = 739.0086
   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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
   y2 = 0.0025
   sh2 = 0.008
  ft2 = 886.8103
  fy2 = 739.0086
   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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
   yv = 0.0025
   shv = 0.008
  ftv = 895.9746
  fyv = 746.6455
   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 εyv, εshv,εftv,εfyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1, εsh1,εft1,εfy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fsv = (fs,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   εcc (5A.5, TBDY) = 0.00242514
     αc = confinement factor = 1.04251
   ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
Case/Assumption: Unconfinesd full section - Steel rupture
 ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 εsu (4.9) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 φu = φsu (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
    N = 2309.834
  fc = 30.00
   εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: εcu = 0.00680405
      αwe (5.4c) = 0.00682295
      αse ((5.4d), TBDY) = (αse1*Aext+αse2*Aint)/Asec = 0.14776895
        αse1 = 0.14776895
           bo_1 = 340.00
           ho_1 = 610.00
            Σbi2_1 = 975400.00
        αse2 = Max(αse1,αse2) = 0.14776895
           bo_2 = 192.00
           ho_2 = 492.00
            Σbi2_2 = 557856.00
      ρsh,min*Fywe = Min(ρsh,x*Fywe , ρsh,y*Fywe) = 1.38519

```
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 670.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 500.00
        ----------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 400.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 200.00
        ----------------------------------------------------------------
            Asec = 268000.00
            s1 = 150.00
            s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
     with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
     with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 895.9746
 fyv = 746.6455
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
 with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
 b = 610.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
   c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
 b = 670.00
 d = 357.00
 d' = 43.00
 v = 0.0003219
   N = 2309.834
 fc = 30.00
 co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00680405
     we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
         ase1 = 0.14776895
            bo_1 = 340.00
            ho_1 = 610.00
             bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
            bo_2 = 192.00
            ho_2 = 492.00

```
                    bi2_2 = 557856.00
         psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
       -------------------------------------------------------------------
         psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
             ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
                Ash1 = Astir_1*ns_1 = 157.0796
                   No stirups, ns_1 = 2.00
                h1 = 670.00
             ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
                Ash2 = Astir_2*ns_2 = 100.531
                   No stirups, ns_2 = 2.00
                h2 = 500.00
       -------------------------------------------------------------------
         psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
             ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                Ash1 = Astir_1*ns_1 = 157.0796
                   No stirups, ns_1 = 2.00
                h1 = 400.00
             ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                Ash2 = Astir_2*ns_2 = 100.531
                   No stirups, ns_2 = 2.00
                h2 = 200.00
       -------------------------------------------------------------------
          Asec = 268000.00
           s1 = 150.00
           s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
         fce = 30.00
      From ((5.A5), TBDY), TBDY:  cc = 0.00242514
          c  = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 895.9746
 fyv = 746.6455
```

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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
  with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
  2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932

and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
  c = confinement factor = 1.04251
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
  2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
  v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071

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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 390183.487

Calculation of Shear Strength at edge 1, Vr1 = 390183.487
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 = 180743.977
    = 1 (normal-weight concrete)
    Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
     As (tension reinf.) = 709.9999
     bw = 670.00
     d = 320.00
    Vu*d/Mu < 1 = 0.00
     Mu = 2.1102257E-011
     Vu = 6.9728406E-015
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
  Vs1 = 209439.51 is calculated for jacket, with:
   d = 320.00
   Av = 157079.633
   fy = 625.00

```
    s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 0.00 is calculated for jacket, with:
    d2 = 160.00
    Av = 100530.965
    fy = 525.00
    s = 300.00
  Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726
--------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 390183.487
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 = 180743.977
      = 1 (normal-weight concrete)
    Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
      As (tension reinf.) = 709.9999
      bw = 670.00
      d = 320.00
    Vu*d/Mu < 1 = 0.00
      Mu = 1.8034731E-013
      Vu = 6.9728406E-015
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
  Vs1 = 209439.51 is calculated for jacket, with:
    d = 320.00
    Av = 157079.633
    fy = 625.00
    s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 0.00 is calculated for jacket, with:
    d = 160.00
    Av = 100530.965
    fy = 525.00
    s = 300.00
  Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726
-----------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2


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


Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
```

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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 9.7286E+006
Shear Force, V2 = 4.5846775E-014
Shear Force, V3 = 14540.811
Axial Force, F = -6266.087
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 709.9999
     -Compression: Asl,com = 1266.062
        -Middle: Asl,mid = 402.1239
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten,jacket = 402.1239
     -Compression: Asl,com,jacket = 804.2477
        -Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten,core = 307.8761
     -Compression: Asl,com,core = 461.8141
        -Middle: Asl,mid,core = 0.00
Mean Diameter of Tension Reinforcement, DbL = 15.00

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta_{u,R}$ =   * θ_u = 0.02586031
 θ_u = θ_y + θ_p = 0.02586031

 - Calculation of θ_y -

 θ_y = (My*Ls/3)/Eleff = 0.00086031 ((4.29),Biskinis Phd))
  My = 2.9205E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 669.0526
  From table 10.5, ASCE 41_17: Eleff = 0.3*Ec*Ig = 7.5708E+013

Calculation of Yielding Moment My

Calculation of ϕ_y and My according to Annex 7 -

 ϕ_y = Min(ϕ_y_ten, ϕ_y_com)
  ϕ_y_ten = 5.8224212E-006
 with fy = 625.00
    d = 627.00
     ξ_y = 0.18831702

```
      A = 0.00952456
      B = 0.00407596
       with pt = 0.00283094
          pc = 0.00504809
          pv = 0.00160336
          N = 6266.087
          b = 400.00
          " = 0.06858054
    y_comp = 1.7830319E-005
  with fc = 27.76119
      Ec = 25742.96
       y = 0.18763274
      A = 0.00942285
      B = 0.0040338
       with Es = 200000.00
-----------------------------------------------------------

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

-----------------------------------------------------------
 - Calculation of   p -
-----------------------------------------------------------
From table 10-7:   p = 0.025
with:
 - Condition i occured
   Beam controlled by flexure: Vp/Vo <= 1
   shear control ratio Vp/Vo = 0.92480584
 - Transverse Reinforcement: C
 - Stirrup Spacing <= d/3
 - Low ductility demand,   / y < 2 (table 10-6, ASCE 41-17)
        = -6.6185134E-008
 - Stirrup Spacing <= d/2
   d = d_external = 627.00
   s = s_external = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
   Vs = 421182.855,already given in calculation of shear control ratio
   design Shear = 14540.811
 - (  -  ')/  bal = -0.3178459
     = Aslt/(bw*d) = 0.00283094
    Tension Reinf Area: Aslt = 709.9999
    ' = Aslc/(bw*d) = 0.00665146
    Compression Reinf Area: Aslc = 1668.186
   From (B-1), ACI 318-11:   bal = 0.01202003
    fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 27.76119
    fy = fy_jacket_bars = 625.00
    From 10.2.7.3, ACI 318-11:  1 = 0.65
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.48979592
         y = 0.003125
 - V/(bw*d*fc^0.5) = 0.13251507, NOTE: units in lb & in
    bw = 400.00
-----------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 2
Integration Section: (b)


-----------------------------------------------------------
```
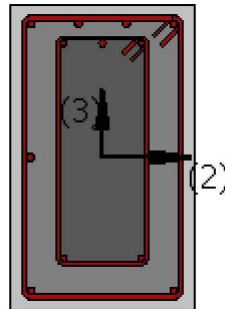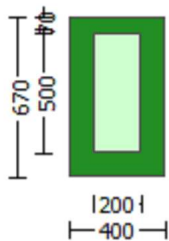
Calculation No. 15

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 JB1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fc_lower_bound = 20.00
New material of Primary Member: Steel Strength, fs = fs_lower_bound = 500.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = 4.3723E+006
Shear Force, Va = 5140.455
EDGE -B-
Bending Moment, Mb = 9.7286E+006
Shear Force, Vb = 14540.811
BOTH EDGES
Axial Force, F = -6266.087
Longitudinal Reinforcement Area Distribution (in 2 divisions)
        -Tension: Aslt = 709.9999
     -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 709.9999
      -Compression: Asl,com = 1266.062
        -Middle: Asl,mid = 402.1239
Mean Diameter of Tension Reinforcement, DbL,ten = 15.00

Existing component: From table 7-7, ASCE 41_17: Final Shear Capacity VR =   *Vn = 466044.126
Vn ((22.5.1.1), ACI 318-14) = 466044.126

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 = 157246.512
      = 1 (normal-weight concrete)
     Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 18.50746, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
     pw = As/(bw*d) = 0.00331157
        As (tension reinf.) = 709.9999
        bw = 400.00
        d = 536.00
     Vu*d/Mu < 1 = 0.80113283
        Mu = 9.7286E+006
        Vu = 14540.811
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 308797.614
  Vs1 = 280648.944 is calculated for jacket, with:
     d = 536.00
     Av = 157079.633
     fy = 500.00
     s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 28148.67 is calculated for core, with:
     d = 400.00
     Av = 100530.965
     fy = 420.00
     s = 300.00
  Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
  2(1-s/d) = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 612724.122

End Of Calculation of Shear Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)

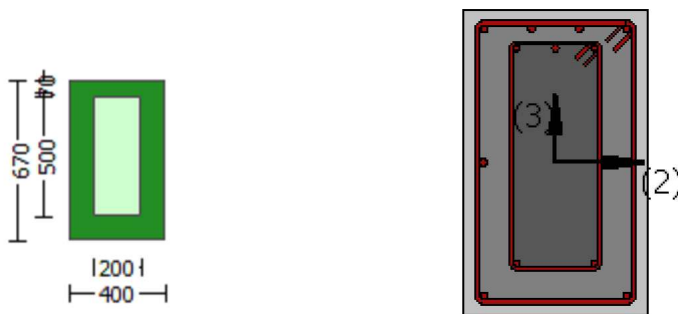
Calculation No. 16

beam B1, Floor 1

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

Analysis: Uniform +X

Check: Chord rotation capacity (u)

Edge: End

Local Axis: (3)

Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 3
(Bending local axis: 2)
Section Type: rcjars

Constant Properties

Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
##
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00

Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = 9840.632
EDGE -B-
Shear Force, Vb = 9840.634
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 709.9999
    -Compression: Asl,com = 1266.062
       -Middle: Asl,mid = 402.1239

Calculation of Shear Capacity ratio , Ve/Vr = 0.92480584
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 = 535287.788
with
Mpr1 = Max(Mu1+ , Mu1-) = 7.8817E+008
  Mu1+ = 4.6479E+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- = 7.8817E+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-) = 7.8817E+008
  Mu2+ = 4.6479E+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- = 7.8817E+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 = 9840.632, is the shear force acting at edge 1 for the the static loading combination
  V2 = 9840.634, 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 = 5.6369735E-005
Mu = 4.6479E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834

fc = 30.00
  co (5A.5, TBDY) = 0.002
Final value of cu: $cu^* = shear\_factor * Max(cu, cc) = 0.00680405$
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
  ----
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 500.00
  ----
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce = 30.00
    From ((5.A5), TBDY), TBDY: cc = 0.00242514
        c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
ft1 = 872.4558
fy1 = 727.0465
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
    with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
ft2 = 882.7854
fy2 = 735.6545
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
    with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 937.50
 fyv = 781.25
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
  2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
   2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
   v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
  ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
 su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
  u =   su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
----
with full section properties:
  b = 400.00
  d = 627.00

d' = 43.00
v = 0.000307
  N = 2309.834
fc = 30.00
 co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
  The Shear_factor is considered equal to 1 (pure moment strength)
  From (5.4b), TBDY: cu = 0.00680405
   we (5.4c) = 0.00682295
   ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
    ase1 = 0.14776895
     bo_1 = 340.00
     ho_1 = 610.00
      bi2_1 = 975400.00
    ase2 = Max(ase1,ase2) = 0.14776895
     bo_2 = 192.00
     ho_2 = 492.00
      bi2_2 = 557856.00
   psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
   ----
   psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
    ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
     Ash1 = Astir_1*ns_1 = 157.0796
      No stirups, ns_1 = 2.00
     h1 = 670.00
    ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
     Ash2 = Astir_2*ns_2 = 100.531
      No stirups, ns_2 = 2.00
     h2 = 500.00
   ----
   psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
    ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
     Ash1 = Astir_1*ns_1 = 157.0796
      No stirups, ns_1 = 2.00
     h1 = 400.00
    ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
     Ash2 = Astir_2*ns_2 = 100.531
      No stirups, ns_2 = 2.00
     h2 = 200.00

    Asec = 268000.00
    s1 = 150.00
    s2 = 300.00
   fywe1 = 781.25
   fywe2 = 656.25
   fce = 30.00
  From ((5.A5), TBDY), TBDY: cc = 0.00242514
   c = confinement factor = 1.04251
y1 = 0.0025
sh1 = 0.008
ft1 = 882.7854
fy1 = 735.6545
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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
  with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 872.4558

fy2 = 727.0465
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
    with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 937.50
 fyv = 781.25
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
  2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
  b = 340.00
  d = 597.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
    c = confinement factor = 1.04251
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
  2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
  v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
 u =   su (4.1) = 6.0907698E-005

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 = 5.6369735E-005

Mu = 4.6479E+008
----
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
  co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
          bo_1 = 340.00
          ho_1 = 610.00
           bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
          bo_2 = 192.00
          ho_2 = 492.00
           bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ----
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 500.00
    ----
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
          Ash1 = Astir_1*ns_1 = 157.0796
            No stirups, ns_1 = 2.00
          h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
          Ash2 = Astir_2*ns_2 = 100.531
            No stirups, ns_2 = 2.00
          h2 = 200.00

        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
      fywe1 = 781.25
      fywe2 = 656.25
      fce = 30.00
    From ((5.A5), TBDY), TBDY: cc = 0.00242514
        c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
  ft1 = 872.4558
  fy1 = 727.0465
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 727.0465
with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 882.7854
fy2 = 735.6545
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 735.6545
with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.06860752
2 = Asl,com/(b*d)*(fs2/fc) = 0.12378842
v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
b = 340.00
d = 597.00
d' = 13.00
fcc (5A.2, TBDY) = 31.27541
cc (5A.5, TBDY) = 0.00242514
c = confinement factor = 1.04251
1 = Asl,ten/(b*d)*(fs1/fc) = 0.08477074
2 = Asl,com/(b*d)*(fs2/fc) = 0.15295169
v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.09460844
Mu = MRc (4.14) = 4.6479E+008
u = su (4.1) = 5.6369735E-005

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 = 6.0907698E-005
Mu = 7.8817E+008
----------------------------------------------------------------------
with full section properties:
  b = 400.00
  d = 627.00
  d' = 43.00
  v = 0.000307
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of  cu:  cu* = shear_factor * Max( cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY:  cu = 0.00680405
      we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
         ase1 = 0.14776895
            bo_1 = 340.00
            ho_1 = 610.00
             bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
            bo_2 = 192.00
            ho_2 = 492.00
             bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
    ------------------------------------------------------------------
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
            Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
            h1 = 670.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
            Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
            h2 = 500.00
    ------------------------------------------------------------------
      psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
            Ash1 = Astir_1*ns_1 = 157.0796
              No stirups, ns_1 = 2.00
            h1 = 400.00
        ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
            Ash2 = Astir_2*ns_2 = 100.531
              No stirups, ns_2 = 2.00
            h2 = 200.00
    ------------------------------------------------------------------
          Asec = 268000.00
          s1 = 150.00
          s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c  = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
  ft1 = 882.7854
  fy1 = 735.6545
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 735.6545
  with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
y2 = 0.0025
sh2 = 0.008
ft2 = 872.4558
fy2 = 727.0465
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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 727.0465
    with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
yv = 0.0025
shv = 0.008
ftv = 937.50
fyv = 781.25
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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 781.25
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.12378842
  2 = Asl,com/(b*d)*(fs2/fc) = 0.06860752
  v = Asl,mid/(b*d)*(fsv/fc) = 0.04175429
and confined core properties:
 b = 340.00
 d = 597.00
 d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
     c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.15295169
   2 = Asl,com/(b*d)*(fs2/fc) = 0.08477074
   v = Asl,mid/(b*d)*(fsv/fc) = 0.05159117
Case/Assumption: Unconfinesd full section - Steel rupture
 ' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is not satisfied
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
 su (4.8) = 0.16206515
Mu = MRc (4.15) = 7.8817E+008
 u =   su (4.1) = 6.0907698E-005

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

```
----------------------------------------------------------------
----------------------------------------------------------------
----------------------------------------------------------------
Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 578810.994
----------------------------------------------------------------
Calculation of Shear Strength at edge 1, Vr1 = 578810.994
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 = 192813.976
       = 1 (normal-weight concrete)
     Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
       As (tension reinf.) = 709.9999
       bw = 400.00
       d = 536.00
    Vu*d/Mu < 1 = 1.00
       Mu = 1.1510E+006
       Vu = 9840.632
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
  Vs1 = 350811.18 is calculated for jacket, with:
    d = 536.00
    Av = 157079.633
    fy = 625.00
    s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 35185.838 is calculated for jacket, with:
    d2 = 400.00
    Av = 100530.965
    fy = 525.00
    s = 300.00
  Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
  2(1-s/d) = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726
----------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 578810.994
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 = 192813.976
       = 1 (normal-weight concrete)
     Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
       As (tension reinf.) = 709.9999
       bw = 400.00
       d = 536.00
    Vu*d/Mu < 1 = 1.00
       Mu = 1.1510E+006
       Vu = 9840.634
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 385997.017
  Vs1 = 350811.18 is calculated for jacket, with:
    d = 536.00
    Av = 157079.633
    fy = 625.00
    s = 150.00
  Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
  Vs2 = 35185.838 is calculated for jacket, with:
    d = 400.00
    Av = 100530.965
    fy = 525.00
```

```
    s =  300.00
  Vs2 has been multiplied by 2(1-s/d) (s>d/2, according to ASCE 41-17,10.3.4)
  2(1-s/d) = 0.50
  Vf ((11-3)-(11.4), ACI 440) = 0.00
  From (11-11), ACI 440: Vs + Vf <= 750430.726
-----------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 3


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


Start Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcjars

Constant Properties
-----------------------------------------------------------
Knowledge Factor,   = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
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
Jacket
New material: Steel Strength, fs = 1.25*fsm = 781.25
Existing Column
Existing material: Steel Strength, fs = 1.25*fsm = 656.25
############################################################
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.04251
Element Length, L = 3000.00
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 = -6.9728406E-015
EDGE -B-
Shear Force, Vb = 6.9728406E-015
BOTH EDGES
Axial Force, F = -2309.834
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 709.9999
```

-Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
        -Tension: Asl,ten = 911.0619
      -Compression: Asl,com = 911.0619
         -Middle: Asl,mid = 556.0619

Calculation of Shear Capacity ratio , Ve/Vr = 0.55914272
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 = 218168.257
with
Mpr1 = Max(Mu1+ , Mu1-) = 3.2725E+008
   Mu1+ = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
which is defined for the static loading combination
   Mu1- = 3.2725E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 3.2725E+008
   Mu2+ = 3.2725E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
which is defined for the the static loading combination
   Mu2- = 3.2725E+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 = -6.9728406E-015, is the shear force acting at edge 1 for the the static loading combination
   V2 = 6.9728406E-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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
   b = 670.00
   d = 357.00
   d' = 43.00
   v = 0.0003219
      N = 2309.834
   fc = 30.00
     co (5A.5, TBDY) = 0.002
   Final value of   cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
      The Shear_factor is considered equal to 1 (pure moment strength)
      From (5.4b), TBDY: cu = 0.00680405
         we (5.4c) = 0.00682295
         ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
            ase1 = 0.14776895
               bo_1 = 340.00
               ho_1 = 610.00
                bi2_1 = 975400.00
         ase2 = Max(ase1,ase2) = 0.14776895
               bo_2 = 192.00
               ho_2 = 492.00
                bi2_2 = 557856.00
         psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ----
         psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
               Ash1 = Astir_1*ns_1 = 157.0796
                  No stirups, ns_1 = 2.00
               h1 = 670.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519

```
                    Ash2 = Astir_2*ns_2 = 100.531
                        No stirups, ns_2 = 2.00
                    h2 = 500.00
           --------------------------------------------------------------
            psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
                ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                    Ash1 = Astir_1*ns_1 = 157.0796
                        No stirups, ns_1 = 2.00
                    h1 = 400.00
                ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                    Ash2 = Astir_2*ns_2 = 100.531
                        No stirups, ns_2 = 2.00
                    h2 = 200.00
           --------------------------------------------------------------
                Asec = 268000.00
                s1 = 150.00
                s2 = 300.00
            fywe1 = 781.25
            fywe2 = 656.25
            fce  = 30.00
          From ((5.A5), TBDY):  cc = 0.00242514
              c  = confinement factor = 1.04251
      y1 = 0.0025
     sh1 = 0.008
    ft1 = 886.8103
    fy1 = 739.0086
     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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
          with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
      y2 = 0.0025
     sh2 = 0.008
    ft2 = 886.8103
    fy2 = 739.0086
     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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
          with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
      yv = 0.0025
     shv = 0.008
    ftv = 895.9746
    fyv = 746.6455
     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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
    with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
   2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
   v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
     c = confinement factor = 1.04251
   1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
   2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
   v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
    N = 2309.834
  fc = 30.00
   co (5A.5, TBDY) = 0.002
  Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
    The Shear_factor is considered equal to 1 (pure moment strength)
    From (5.4b), TBDY: cu = 0.00680405
     we (5.4c) = 0.00682295
      ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
        ase1 = 0.14776895
           bo_1 = 340.00
           ho_1 = 610.00
            bi2_1 = 975400.00
        ase2 = Max(ase1,ase2) = 0.14776895
           bo_2 = 192.00
           ho_2 = 492.00
            bi2_2 = 557856.00
      psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
      ----
      psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
        ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
           Ash1 = Astir_1*ns_1 = 157.0796

```
                    No stirups, ns_1 = 2.00
                h1 = 670.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 500.00
    ------------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 400.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 200.00
    ------------------------------------------------------------------
        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
     fywe1 = 781.25
     fywe2 = 656.25
      fce  = 30.00
   From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c  = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
 ft1 = 886.8103
 fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
 ft2 = 886.8103
 fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
 ftv = 895.9746
 fyv = 746.6455
  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 εyv, εshv,εftv,εfyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
εy1, εsh1,εft1,εfy1, are also multiplied by Min(1,1.25*(lb/ld)^2/3), from 10.3.5, ASCE 41-17.
with fsv = (fs,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
ω2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
ωv = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
  εcc (5A.5, TBDY) = 0.00242514
     αc = confinement factor = 1.04251
  ω1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
  ω2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
  ωv = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
Case/Assumption: Unconfinesd full section - Steel rupture
  ' does not satisfy Eq. (4.3)
--->
v < vs,c - RHS eq.(4.5) is satisfied
--->
εsu (4.9) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
φu = φsu (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
  b = 670.00
  d = 357.00
  d' = 43.00
  v = 0.0003219
     N = 2309.834
  fc = 30.00
  εco (5A.5, TBDY) = 0.002
  Final value of εcu: εcu* = shear_factor * Max(εcu, εcc) = 0.00680405
     The Shear_factor is considered equal to 1 (pure moment strength)
     From (5.4b), TBDY: εcu = 0.00680405
        ωwe (5.4c) = 0.00682295
        αse ((5.4d), TBDY) = (αse1*Aext+αse2*Aint)/Asec = 0.14776895
           αse1 = 0.14776895
              bo_1 = 340.00
              ho_1 = 610.00
                Σbi2_1 = 975400.00
           αse2 = Max(αse1,αse2) = 0.14776895
              bo_2 = 192.00
              ho_2 = 492.00
                Σbi2_2 = 557856.00
        ρsh,min*Fywe = Min(ρsh,x*Fywe , ρsh,y*Fywe) = 1.38519

```
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 670.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 500.00
        ------------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 400.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 200.00
        ------------------------------------------------------------------
            Asec = 268000.00
            s1 = 150.00
            s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce  = 30.00
    From ((5.A5), TBDY), TBDY:  cc = 0.00242514
        c = confinement factor = 1.04251
  y1 = 0.0025
  sh1 = 0.008
ft1 = 886.8103
fy1 = 739.0086
  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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
  y2 = 0.0025
  sh2 = 0.008
ft2 = 886.8103
fy2 = 739.0086
  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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
  yv = 0.0025
  shv = 0.008
ftv = 895.9746
fyv = 746.6455
  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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
 with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
 b = 610.00
 d = 327.00
 d' = 13.00
 fcc (5A.2, TBDY) = 31.27541
  cc (5A.5, TBDY) = 0.00242514
   c = confinement factor = 1.04251
  1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
  2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
  v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
 u =   su (4.1) = 0.00010507

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 = 0.00010507
Mu = 3.2725E+008
----
with full section properties:
 b = 670.00
 d = 357.00
 d' = 43.00
 v = 0.0003219
   N = 2309.834
 fc = 30.00
  co (5A.5, TBDY) = 0.002
 Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.00680405
   The Shear_factor is considered equal to 1 (pure moment strength)
   From (5.4b), TBDY: cu = 0.00680405
     we (5.4c) = 0.00682295
     ase ((5.4d), TBDY) = (ase1*Aext+ase2*Aint)/Asec = 0.14776895
       ase1 = 0.14776895
         bo_1 = 340.00
         ho_1 = 610.00
          bi2_1 = 975400.00
     ase2 = Max(ase1,ase2) = 0.14776895
         bo_2 = 192.00
         ho_2 = 492.00

```
                bi2_2 = 557856.00
        psh,min*Fywe = Min(psh,x*Fywe , psh,y*Fywe) = 1.38519
        -------------------------------------------------------------------
        psh_x*Fywe = psh1*Fywe1+ps2*Fywe2 = 2.45559
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00261799
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 670.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00062519
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 500.00
        -------------------------------------------------------------------
        psh_y*Fywe = psh1*Fywe1+ps2*Fywe2 = 1.38519
            ps1 (external) = (Ash1*h1/s1)/Asec = 0.00156298
                Ash1 = Astir_1*ns_1 = 157.0796
                    No stirups, ns_1 = 2.00
                h1 = 400.00
            ps2 (internal) = (Ash2*h2/s2)/Asec = 0.00025008
                Ash2 = Astir_2*ns_2 = 100.531
                    No stirups, ns_2 = 2.00
                h2 = 200.00
        -------------------------------------------------------------------
        Asec = 268000.00
        s1 = 150.00
        s2 = 300.00
        fywe1 = 781.25
        fywe2 = 656.25
        fce = 30.00
    From ((5.A5), TBDY):  cc = 0.00242514
        c  = confinement factor = 1.04251
 y1 = 0.0025
 sh1 = 0.008
ft1 = 886.8103
fy1 = 739.0086
 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,jacket*Asl,ten,jacket + fs,core*Asl,ten,core)/Asl,ten = 739.0086
      with Es1 = (Es,jacket*Asl,ten,jacket + Es,core*Asl,ten,core)/Asl,ten = 200000.00
 y2 = 0.0025
 sh2 = 0.008
ft2 = 886.8103
fy2 = 739.0086
 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,jacket*Asl,com,jacket + fs,core*Asl,com,core)/Asl,com = 739.0086
      with Es2 = (Es,jacket*Asl,com,jacket + Es,core*Asl,com,core)/Asl,com = 200000.00
 yv = 0.0025
 shv = 0.008
ftv = 895.9746
fyv = 746.6455
```

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,jacket*Asl,mid,jacket + fs,mid*Asl,mid,core)/Asl,mid = 746.6455
     with Esv = (Es,jacket*Asl,mid,jacket + Es,mid*Asl,mid,core)/Asl,mid = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.09382814
    2 = Asl,com/(b*d)*(fs2/fc) = 0.09382814
    v = Asl,mid/(b*d)*(fsv/fc) = 0.05785932
and confined core properties:
  b = 610.00
  d = 327.00
  d' = 13.00
  fcc (5A.2, TBDY) = 31.27541
   cc (5A.5, TBDY) = 0.00242514
      c = confinement factor = 1.04251
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.11251192
    2 = Asl,com/(b*d)*(fs2/fc) = 0.11251192
    v = Asl,mid/(b*d)*(fsv/fc) = 0.06938071
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) = 0.1468828
Mu = MRc (4.14) = 3.2725E+008
  u =   su (4.1) = 0.00010507

Calculation of ratio lb/ld

Adequate Lap Length: lb/ld >= 1

Calculation of Shear Strength Vr = Min(Vr1,Vr2) = 390183.487

Calculation of Shear Strength at edge 1, Vr1 = 390183.487
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 = 180743.977
      = 1 (normal-weight concrete)
    Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
    pw = As/(bw*d) = 0.00331157
      As (tension reinf.) = 709.9999
      bw = 670.00
      d = 320.00
    Vu*d/Mu < 1 = 0.00
      Mu = 2.1102257E-011
      Vu = 6.9728406E-015
  From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
  Vs1 = 209439.51 is calculated for jacket, with:
    d = 320.00
    Av = 157079.633
    fy = 625.00

```
      s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 0.00 is calculated for jacket, with:
      d2 = 160.00
      Av = 100530.965
      fy = 525.00
      s = 300.00
   Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 750430.726
-----------------------------------------------------------------------
Calculation of Shear Strength at edge 2, Vr2 = 390183.487
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 = 180743.977
        = 1 (normal-weight concrete)
      Mean concrete strength: fc' = (fc'_jacket*Area_jacket + fc'_core*Area_core)/Area_section = 27.76119, but fc^0.5 <=
8.3 MPa (22.5.3.1, ACI 318-14)
      pw = As/(bw*d) = 0.00331157
         As (tension reinf.) = 709.9999
         bw = 670.00
         d = 320.00
      Vu*d/Mu < 1 = 0.00
         Mu = 1.8034731E-013
         Vu = 6.9728406E-015
   From (11.5.4.8), ACI 318-14: Vs1 + Vs2 = 209439.51
   Vs1 = 209439.51 is calculated for jacket, with:
      d = 320.00
      Av = 157079.633
      fy = 625.00
      s = 150.00
   Vs1 has been multiplied by 1 (s<d/2, according to ASCE 41-17,10.3.4)
   Vs2 = 0.00 is calculated for jacket, with:
      d = 160.00
      Av = 100530.965
      fy = 525.00
      s = 300.00
   Vs2 is considered 0 (s>d, according to ASCE 41-17,10.3.4)
   Vf ((11-3)-(11.4), ACI 440) = 0.00
   From (11-11), ACI 440: Vs + Vf <= 750430.726
------------------------------------------------------------------
End Of Calculation of Shear Capacity ratio for element: beam JB1 of floor 1
At local axis: 2


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


Start Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcjars

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:
Jacket
New material of Primary Member: Concrete Strength, fc = fcm = 30.00
New material of Primary Member: Steel Strength, fs = fsm = 625.00
Concrete Elasticity, Ec = 25742.96
Steel Elasticity, Es = 200000.00
Existing Column
```

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
External Height, H = 670.00
External Width, W = 400.00
Internal Height, H = 500.00
Internal Width, W = 200.00
Cover Thickness, c = 25.00
Element Length, L = 3000.00
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 = -6.4836912E-011
Shear Force, V2 = 4.5846775E-014
Shear Force, V3 = 14540.811
Axial Force, F = -6266.087
Longitudinal Reinforcement Area Distribution (in 2 divisions)
      -Tension: Aslt = 709.9999
    -Compression: Aslc = 1668.186
Longitudinal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten = 911.0619
     -Compression: Asl,com = 911.0619
       -Middle: Asl,mid = 556.0619
Longitudinal External Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten,jacket = 603.1858
     -Compression: Asl,com,jacket = 603.1858
       -Middle: Asl,mid,jacket = 402.1239
Longitudinal Internal Reinforcement Area Distribution (in 3 divisions)
      -Tension: Asl,ten,core = 307.8761
     -Compression: Asl,com,core = 307.8761
       -Middle: Asl,mid,core = 153.938
Mean Diameter of Tension Reinforcement, DbL = 15.20

Existing component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $\theta u,R = $ * $\theta u = 0.02409992$
 $\theta u = \theta y + \theta p = 0.02409992$

 - Calculation of θy -

 $\theta y = (My*Ls/3)/EIeff = 0.00409992$ ((4.29),Biskinis Phd))
  My = 2.1236E+008
  Ls = M/V (with Ls >0.1*L and Ls < 2*L) = 1500.00
  From table 10.5, ASCE 41_17: EIeff = 0.3*Ec*Ig = 2.5898E+013

Calculation of Yielding Moment My

Calculation of ϕy and My according to Annex 7 -

 $\phi y = Min(\phi y\_ten, \phi y\_com)$
  $\phi y\_ten = 1.0748658E-005$
 with fy = 625.00
    d = 357.00
     $\xi y = 0.22779052$

```
      A = 0.00998687
      B = 0.00561432
       with pt = 0.00380895
           pc = 0.00380895
           pv = 0.00232477
           N = 6266.087
           b = 670.00
            " = 0.12044818
    y_comp = 2.5852450E-005
  with fc = 27.76119
      Ec = 25742.96
       y = 0.22728216
      A = 0.00988022
      B = 0.00557012
       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 = 0.55914272
 - Transverse Reinforcement: NC
 - Stirrup Spacing > d/3
 - Low ductility demand,   / y < 2 (table 10-6, ASCE 41-17)
        = -7.5574920E-023
 - Stirrup Spacing <= d/2
   d = d_external = 357.00
   s = s_external = 150.00
 - Strength provided by hoops Vs < 3/4*design Shear
   Vs = 237588.18,already given in calculation of shear control ratio
   design Shear = 4.5846775E-014
 - (  -  ')/  bal = -0.33327376
     = Aslt/(bw*d) = 0.00296835
    Tension Reinf Area: Aslt = 709.9999
    ' = Aslc/(bw*d) = 0.00697431
    Compression Reinf Area: Aslc = 1668.186
   From (B-1), ACI 318-11:   bal = 0.01202003
    fc = (fc_jacket*Area_jacket+fc_core*Area_core)/section_area = 27.76119
    fy = fy_jacket_bars = 625.00
    From 10.2.7.3, ACI 318-11:  1 = 0.65
    From fig R10.3.3, ACI 318-11 (Ence 454, too): 87000/(87000+fy) = cb/dt = 0.003/(0.003+ y) = 0.48979592
        y = 0.003125
 - V/(bw*d*fc^0.5) = 4.3809665E-019, NOTE: units in lb & in
    bw = 670.00
-----------------------------------------------------------
End Of Calculation of Chord Rotation Capacity for element: beam JB1 of floor 1
At local axis: 3
Integration Section: (b)


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