

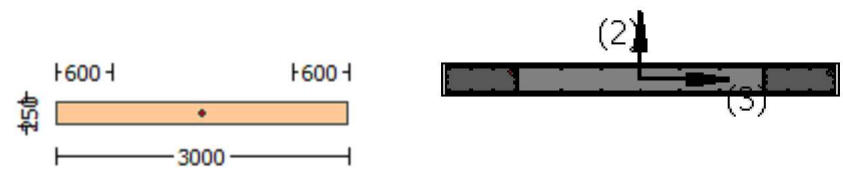
Detailed Member Calculations

Units: N&mm

Regulation: ASCE 41-17

Calculation No. 1

- wall W1, 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: wall W1 of floor 1
- At local axis: 2
- Integration Section: (a)
- Section Type: rcrws
- Constant Properties
- Knowledge Factor, $\gamma = 1.00$
- 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:
- New material of Secondary Member: Concrete Strength, $f_c = f_{c_lower_bound} = 25.00$
- New material of Secondary Member: Steel Strength, $f_s = f_{s_lower_bound} = 500.00$
- Concrete Elasticity, $E_c = 26999.444$

Steel Elasticity, $E_s = 200000.00$
 Total Height, $H_{tot} = 3000.00$
 Edges Width, $W_{edg} = 250.00$
 Edges Height, $H_{edg} = 600.00$
 Web Width, $W_{web} = 250.00$
 Cover Thickness, $c = 25.00$
 Element Length, $L = 3000.00$
 Secondary 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
 Lap Length $l_o = l_b = 300.00$
 No FRP Wrapping

Stepwise Properties

EDGE -A-
 Bending Moment, $M_a = -1.8438483E-010$
 Shear Force, $V_a = -9.9179258E-014$
 EDGE -B-
 Bending Moment, $M_b = -1.1366247E-010$
 Shear Force, $V_b = 9.9179258E-014$
 BOTH EDGES
 Axial Force, $F = -27925.142$
 Longitudinal Reinforcement Area Distribution (in 2 divisions)
 -Tension: $A_{sl,t} = 0.00$
 -Compression: $A_{sl,c} = 7269.645$
 Longitudinal Reinforcement Area Distribution (in 3 divisions)
 -Tension: $A_{sl,ten} = 2830.575$
 -Compression: $A_{sl,com} = 2830.575$
 -Middle: $A_{sl,mid} = 1608.495$
 Mean Diameter of Tension Reinforcement, $Db_{L,ten} = 16.46154$

New component: From table 7-7, ASCE 41_17: Final Shear Capacity $V_R = 1.0 \cdot V_n = 508053.336$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_n < 0.83 \cdot f_c' \cdot 0.5 \cdot h \cdot d = 508053.336$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
 where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 193894.07$
 $\mu_u / \mu_u - l_w / 2 = 1734.107 > 0$
 = 1 (normal-weight concrete)
 $f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 3000.00$
 $d = 200.00$
 $l_w = 250.00$
 $\mu_u = 1.8438483E-010$
 $V_u = 9.9179258E-014$
 $N_u = 27925.142$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$
 $V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

d = 200.00

Av = 0.00

s = 200.00

fy = 500.00

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$2(1-s/d) = 0.00$

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

From (11-11), ACI 440: Vs + Vf <= 1.9929E+006

bw = 3000.00

End Of Calculation of Shear Capacity for element: wall W1 of floor 1

At local axis: 2

Integration Section: (a)

Calculation No. 2

wall W1, 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: wall W1 of floor 1

At Shear local axis: 3

(Bending local axis: 2)

Section Type: rcwvs

Constant Properties

Knowledge Factor, = 1.00

Mean strength values are used for both shear and moment calculations.

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 33.00$

New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 555.56$

Concrete Elasticity, $E_c = 26999.444$

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Steel Elasticity, Es = 200000.00
#####
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 694.45
#####
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary 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
Lap Length lo = 300.00
No FRP Wrapping
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Stepwise Properties
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At local axis: 3
EDGE -A-
Shear Force, Va = 1.5016185E-058
EDGE -B-
Shear Force, Vb = -1.5016185E-058
BOTH EDGES
Axial Force, F = -27588.841
Longitudinal Reinforcement Area Distribution (in 2 divisions)
  -Tension: Aslt = 0.00
  -Compression: Aslc = 7269.645
Longitudinal Reinforcement Area Distribution (in 3 divisions)
  -Tension: Asl,ten = 2865.133
  -Compression: Asl,com = 2865.133
  -Middle: Asl,mid = 0.00
  (According to 10.7.2.3 Asl,mid is setted equal to zero)
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Calculation of Shear Capacity ratio , Ve/Vr = 0.69050088
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 1.6587E+006
with
Mpr1 = Max(Mu1+ , Mu1-) = 2.4881E+009
  Mu1+ = 2.1705E+009, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
  which is defined for the static loading combination
  Mu1- = 2.4881E+009, 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-) = 2.4881E+009
  Mu2+ = 2.1705E+009, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
  which is defined for the the static loading combination
  Mu2- = 2.4881E+009, 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
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Calculation of Mu1+
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Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
  u = 1.2902105E-006
  Mu = 2.1705E+009
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with full section properties:

$$b = 250.00$$

$$d = 2957.00$$

$$d' = 43.00$$

$$v = 0.00113091$$

$$N = 27588.841$$

$$f_c = 33.00$$

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

$$\text{Final value of } cu: cu^* = \text{shear_factor} * \text{Max}(cu, cc) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } cu = 0.0035$$

$$we(5.4c) = 0.00$$

$$ase((5.4d), TBDY) = (ase1 * Acol1 + ase2 * Acol2 + ase3 * Aweb) / Asec = 0.00$$

$$ase1 = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$ase2 = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$ase3 = 0 \text{ (grid does not provide confinement)}$$

$$psh, \min = \text{Min}(psh, x, psh, y) = 0.0010472$$

$$psh, x = ps1, x + ps2, x + ps3, x = 0.00439823$$

$$ps1, x \text{ (column 1)} = (As1 * h1 / s_1) / Ac = 0.00125664$$

$$h1 = 600.00$$

$$As1 = Astir1 * ns1 = 157.0796$$

$$\text{No stirups, } ns1 = 2.00$$

$$ps2, x \text{ (column 2)} = (As2 * h2 / s_2) / Ac = 0.00125664$$

$$h2 = 600.00$$

$$As2 = Astir2 * ns2 = 157.0796$$

$$\text{No stirups, } ns2 = 2.00$$

$$ps3, x \text{ (web)} = (As3 * h3 / s_3) / Ac = 0.00188496$$

$$h3 = 1800.00$$

$$As3 = Astir3 * ns3 = 0.00$$

$$\text{No stirups, } ns3 = 2.00$$

$$psh, y = ps1, y + ps2, y + ps3, y = 0.0010472$$

$$ps1, y \text{ (column 1)} = (As1 * h1 / s_1) / Ac = 0.0005236$$

$$h1 = 250.00$$

$$As1 = Astir1 * ns1 = 157.0796$$

$$\text{No stirups, } ns1 = 2.00$$

$$ps2, y \text{ (column 2)} = (As2 * h2 / s_2) / Ac = 0.0005236$$

$$h2 = 250.00$$

$$As2 = Astir2 * ns2 = 157.0796$$

$$\text{No stirups, } ns2 = 2.00$$

$$ps3, y \text{ (web)} = (As3 * h3 / s_3) / Ac = 0.00$$

$$h3 = 250.00$$

$$As3 = Astir3 * ns3 = 157.0796$$

$$\text{No stirups, } ns3 = 0.00$$

$$Asec = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$fywe = 694.45$$

$$f_{ce} = 33.00$$

$$\text{From ((5.A5), TBDY), TBDY: } cc = 0.002$$

$$c = \text{confinement factor} = 1.00$$

$$y1 = 0.00096384$$

$$sh1 = 0.00308428$$

$$ft1 = 321.2814$$

$$fy1 = 267.7345$$

$$su1 = 0.00308428$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $l_o/l_{ou,min} = l_b/l_d = 0.17128923$
 $su_1 = 0.4 * esu_{1,nominal} ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu_{1,nominal} = 0.08$,
 For calculation of $esu_{1,nominal}$ and y_1, sh_1, ft_1, fy_1 , it is considered
 characteristic value $fsy_1 = fs_1/1.2$, from table 5.1, TBDY.
 y_1, sh_1, ft_1, fy_1 , are also multiplied by $Min(1, 1.25 * (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs_1 = fs = 267.7345$
 with $Es_1 = Es = 200000.00$
 $y_2 = 0.00096384$
 $sh_2 = 0.00308428$
 $ft_2 = 321.2814$
 $fy_2 = 267.7345$
 $su_2 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $l_o/l_{ou,min} = l_b/l_{b,min} = 0.17128923$
 $su_2 = 0.4 * esu_{2,nominal} ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu_{2,nominal} = 0.08$,
 For calculation of $esu_{2,nominal}$ and y_2, sh_2, ft_2, fy_2 , it is considered
 characteristic value $fsy_2 = fs_2/1.2$, from table 5.1, TBDY.
 y_1, sh_1, ft_1, fy_1 , are also multiplied by $Min(1, 1.25 * (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs_2 = fs = 267.7345$
 with $Es_2 = Es = 200000.00$
 $y_v = 0.00096384$
 $sh_v = 0.00308428$
 $ft_v = 321.2814$
 $fy_v = 267.7345$
 $suv = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $l_o/l_{ou,min} = l_b/l_d = 0.17128923$
 $suv = 0.4 * esuv_{nominal} ((5.5), TBDY) = 0.032$
 From table 5A.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, sh_v, ft_v, fy_v , it is considered
 characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
 y_1, sh_1, ft_1, fy_1 , are also multiplied by $Min(1, 1.25 * (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fsv = fs = 267.7345$
 with $Es_v = Es = 200000.00$
 $1 = Asl_{ten}/(b*d) * (fs_1/fc) = 0.03144444$
 $2 = Asl_{com}/(b*d) * (fs_2/fc) = 0.03144444$
 $v = Asl_{mid}/(b*d) * (fsv/fc) = 0.00$
 and confined core properties:
 $b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $f_{cc} (5A.2, TBDY) = 33.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = Asl_{ten}/(b*d) * (fs_1/fc) = 0.04179832$
 $2 = Asl_{com}/(b*d) * (fs_2/fc) = 0.04179832$
 $v = Asl_{mid}/(b*d) * (fsv/fc) = 0.00$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)
 --->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.19157175$
 $Mu = MRc (4.14) = 2.1705E+009$
 $u = su (4.1) = 1.2902105E-006$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$

$l_b = 300.00$

$l_d = 1751.424$

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

l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$= 1$

$db = 16.35294$

Mean strength value of all re-bars: $f_y = 694.45$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$cb = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_{u1}

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

$\mu_u = 1.2974768E-006$

$\mu_u = 2.4881E+009$

with full section properties:

$b = 250.00$

$d = 2957.00$

$d' = 43.00$

$v = 0.00113091$

$N = 27588.841$

$f_c = 33.00$

ϕ_c (5A.5, TBDY) = 0.002

Final value of ϕ_{cu} : $\phi_{cu}^* = \text{shear_factor} * \text{Max}(\phi_{cu}, \phi_c) = 0.0035$

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

From (5.4b), TBDY: $\phi_{cu} = 0.0035$

ϕ_{we} (5.4c) = 0.00

ϕ_{ase} ((5.4d), TBDY) = $(\phi_{ase1} * A_{col1} + \phi_{ase2} * A_{col2} + \phi_{ase3} * A_{web}) / A_{sec} = 0.00$

$\phi_{ase1} = 0.00$

$sh_1 = 100.00$

$bo_1 = 190.00$

$ho_1 = 540.00$

$bi2_1 = 655400.00$

$\phi_{ase2} = 0.00$

$sh_2 = 100.00$

$bo_2 = 190.00$

$ho_2 = 540.00$

$bi2_2 = 655400.00$

$\phi_{ase3} = 0$ (grid does not provide confinement)

$\phi_{psh,min} = \text{Min}(\phi_{psh,x}, \phi_{psh,y}) = 0.0010472$

$\phi_{psh,x} = \phi_{ps1,x} + \phi_{ps2,x} + \phi_{ps3,x} = 0.00439823$

$\phi_{ps1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$\phi_{ps2,x}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$\phi_{ps3,x}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$

$h_3 = 1800.00$

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

$psh,y = ps1,y + ps2,y + ps3,y = 0.0010472$
 $ps1,y \text{ (column 1)} = (As1 \cdot h1 / s_1) / Ac = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 \cdot ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2,y \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 \cdot ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,y \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 \cdot ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

Asec = 750000.00

$s_1 = 100.00$

$s_2 = 100.00$

$s_3 = 200.00$

$fywe = 694.45$

$fce = 33.00$

From ((5.A5), TBDY), TBDY: $cc = 0.002$

$c = \text{confinement factor} = 1.00$

$y1 = 0.00096384$

$sh1 = 0.00308428$

$ft1 = 321.2814$

$fy1 = 267.7345$

$su1 = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$lo/lou,min = lb/ld = 0.17128923$

$su1 = 0.4 \cdot esu1_nominal \text{ ((5.5), TBDY)} = 0.032$

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

For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered
characteristic value $fsy1 = fs1/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs1 = fs = 267.7345$

with $Es1 = Es = 200000.00$

$y2 = 0.00096384$

$sh2 = 0.00308428$

$ft2 = 321.2814$

$fy2 = 267.7345$

$su2 = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$lo/lou,min = lb/lb,min = 0.17128923$

$su2 = 0.4 \cdot esu2_nominal \text{ ((5.5), TBDY)} = 0.032$

From table 5A.1, TBDY: $esu2_nominal = 0.08$,

For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered
characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.

$y2, sh2, ft2, fy2$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs2 = fs = 267.7345$

with $Es2 = Es = 200000.00$

$yv = 0.00096384$

$shv = 0.00308428$

$ftv = 321.2814$

$fyv = 267.7345$

$suv = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$lo/lou,min = lb/ld = 0.17128923$

$suv = 0.4 \cdot esuv_nominal \text{ ((5.5), TBDY)} = 0.032$

From table 5A.1, TBDY: $esuv_nominal = 0.08$,

considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
For calculation of $esuv_nominal$ and yv, shv, ftv, fyv , it is considered

characteristic value $f_{syv} = f_{sv}/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $f_{sv} = f_s = 267.7345$
 with $E_{sv} = E_s = 200000.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.03144444$
 $2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.03144444$
 $v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.01689449$

and confined core properties:

$b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $f_{cc} \text{ (5A.2, TBDY)} = 33.00$
 $cc \text{ (5A.5, TBDY)} = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.04179832$
 $2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.04179832$
 $v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.02245743$

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su \text{ (4.9)} = 0.19609924$
 $Mu = MR_c \text{ (4.14)} = 2.4881E+009$
 $u = su \text{ (4.1)} = 1.2974768E-006$

 Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$
 $l_b = 300.00$
 $l_d = 1751.424$
 Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 $l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

 Calculation of Mu_{2+}

 Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 $u = 1.2902105E-006$
 $Mu = 2.1705E+009$

with full section properties:

$b = 250.00$
 $d = 2957.00$
 $d' = 43.00$
 $v = 0.00113091$
 $N = 27588.841$
 $f_c = 33.00$
 $co \text{ (5A.5, TBDY)} = 0.002$
 Final value of cu : $cu^* = \text{shear_factor} \cdot \text{Max}(cu, cc) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)
 From (5.4b), TBDY: $cu = 0.0035$
 $we \text{ (5.4c)} = 0.00$
 $ase \text{ ((5.4d), TBDY)} = (ase1 \cdot A_{col1} + ase2 \cdot A_{col2} + ase3 \cdot A_{web}) / A_{sec} = 0.00$

```

ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
bi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
bi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472

```

```

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00

```

```

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

```

```

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00096384
sh1 = 0.00308428
ft1 = 321.2814
fy1 = 267.7345
su1 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.17128923
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 267.7345
with Es1 = Es = 200000.00
y2 = 0.00096384
sh2 = 0.00308428

```

```

ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.17128923
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 267.7345
    with Es2 = Es = 200000.00
    yv = 0.00096384
    shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb = 0.17128923
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 267.7345
    with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
    2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
    v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
    2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
    v = Asl,mid/(b*d)*(fsv/fc) = 0.00

```

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

```

---->
v < vs,y2 - LHS eq.(4.5) is satisfied
---->
su (4.9) = 0.19157175
Mu = MRc (4.14) = 2.1705E+009
u = su (4.1) = 1.2902105E-006

```

Calculation of ratio lb/lb

```

Lap Length: lb/lb = 0.17128923
lb = 300.00
lb = 1751.424
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
lb,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 694.45
t = 1.00
s = 0.80
e = 1.00

```

cb = 25.00
Ktr = 1.848
n = 34.00

Calculation of Mu2-

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

$\phi_u = 1.2974768E-006$
 $\phi_{Mu} = 2.4881E+009$

with full section properties:

b = 250.00
d = 2957.00
d' = 43.00
v = 0.00113091
N = 27588.841
fc = 33.00
co (5A.5, TBDY) = 0.002
Final value of ϕ_{cu} : $\phi_{cu}^* = \text{shear_factor} * \text{Max}(\phi_{cu}, \phi_{cc}) = 0.0035$
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: $\phi_{cu} = 0.0035$
 ϕ_{we} (5.4c) = 0.00
 ϕ_{ase} ((5.4d), TBDY) = $(\phi_{ase1} * A_{col1} + \phi_{ase2} * A_{col2} + \phi_{ase3} * A_{web}) / A_{sec} = 0.00$
 $\phi_{ase1} = 0.00$
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
bi2_1 = 655400.00
 $\phi_{ase2} = 0.00$
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
bi2_2 = 655400.00
 $\phi_{ase3} = 0$ (grid does not provide confinement)
 $\phi_{psh,min} = \text{Min}(\phi_{psh,x}, \phi_{psh,y}) = 0.0010472$

$\phi_{psh,x} = \phi_{ps1,x} + \phi_{ps2,x} + \phi_{ps3,x} = 0.00439823$
 $\phi_{ps1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$
h1 = 600.00
 $A_{s1} = A_{stir1} * n_{s1} = 157.0796$
No stirups, $n_{s1} = 2.00$
 $\phi_{ps2,x}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$
h2 = 600.00
 $A_{s2} = A_{stir2} * n_{s2} = 157.0796$
No stirups, $n_{s2} = 2.00$
 $\phi_{ps3,x}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$
h3 = 1800.00
 $A_{s3} = A_{stir3} * n_{s3} = 0.00$
No stirups, $n_{s3} = 2.00$

$\phi_{psh,y} = \phi_{ps1,y} + \phi_{ps2,y} + \phi_{ps3,y} = 0.0010472$
 $\phi_{ps1,y}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.0005236$
h1 = 250.00
 $A_{s1} = A_{stir1} * n_{s1} = 157.0796$
No stirups, $n_{s1} = 2.00$
 $\phi_{ps2,y}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.0005236$
h2 = 250.00
 $A_{s2} = A_{stir2} * n_{s2} = 157.0796$
No stirups, $n_{s2} = 2.00$
 $\phi_{ps3,y}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00$
h3 = 250.00
 $A_{s3} = A_{stir3} * n_{s3} = 157.0796$
No stirups, $n_{s3} = 0.00$

```

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 694.45
fce = 33.00
From ((5.A.5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00096384
sh1 = 0.00308428
ft1 = 321.2814
fy1 = 267.7345
su1 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.17128923
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 267.7345
with Es1 = Es = 200000.00
y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.17128923
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 267.7345
with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.17128923
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 267.7345
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.01689449
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002

```

$c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.04179832$
 $2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.04179832$
 $v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02245743$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su(4.9) = 0.19609924$
 $Mu = MRc(4.14) = 2.4881E+009$
 $u = su(4.1) = 1.2974768E-006$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$
 $l_b = 300.00$
 $l_d = 1751.424$
 Calculation of l_b ,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Shear Strength $V_r = \text{Min}(V_{r1}, V_{r2}) = 2.4022E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 2.4022E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f_c'^{0.5}*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$
 $Mu/V_u - l_w/2 = 0.00 \leq 0$
 $= 1$ (normal-weight concrete)
 $f_c' = 33.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $l_w = 3000.00$
 $Mu = 1.2001755E-010$
 $V_u = 1.5016185E-058$
 $Nu = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$
 $V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s2} = 418882.372$ is calculated for pseudo-Column 2, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s3} = 628323.557$ is calculated for web, with:
 $d = 1440.00$

$A_v = 157079.633$

$s = 200.00$

$f_y = 555.56$

V_{s3} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$

From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$

$b_w = 250.00$

Calculation of Shear Strength at edge 2, $V_{r2} = 2.4022E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c' \cdot h \cdot d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$

$\mu_u / \mu_u - l_w / 2 = 0.00 \leq 0$

= 1 (normal-weight concrete)

$f_c' = 33.00$, but $f_c'^{0.5} \leq 8.3 \text{ MPa}$ (22.5.3.1, ACI 318-14)

$h = 250.00$

$d = 2400.00$

$l_w = 3000.00$

$\mu_u = 1.2001755E-010$

$V_u = 1.5016185E-058$

$N_u = 27588.841$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$

$V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:

$d = 480.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 555.56$

V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s2} = 418882.372$ is calculated for pseudo-Column 2, with:

$d = 480.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 555.56$

V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s3} = 628323.557$ is calculated for web, with:

$d = 1440.00$

$A_v = 157079.633$

$s = 200.00$

$f_y = 555.56$

V_{s3} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$

From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$

$b_w = 250.00$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At Shear local axis: 2

(Bending local axis: 3)

Section Type: rcrws

Constant Properties

Knowledge Factor, $\gamma = 1.00$

Mean strength values are used for both shear and moment calculations.

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 25.00$

New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 500.00$

Concrete Elasticity, $E_c = 26999.444$

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

New material: Steel Strength, $f_s = 1.25 \cdot f_{sm} = 625.00$

#####

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Mean Confinement Factor overall section = 1.00

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_o = 300.00$

No FRP Wrapping

Stepwise Properties

At local axis: 2

EDGE -A-

Shear Force, $V_a = 0.00$

EDGE -B-

Shear Force, $V_b = 0.00$

BOTH EDGES

Axial Force, $F = -27588.841$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $A_{sl,t} = 0.00$

-Compression: $A_{sl,c} = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $A_{sl,ten} = 2830.575$

-Compression: $A_{sl,com} = 2830.575$

-Middle: $A_{sl,mid} = 0.00$

(According to 10.7.2.3 $A_{sl,mid}$ is setted equal to zero)

Calculation of Shear Capacity ratio, $V_e/V_r = 0.08521711$

Member Controlled by Flexure ($V_e/V_r < 1$)

Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 $V_e = (M_{pr1} + M_{pr2})/l_n = 96267.817$

with

$M_{pr1} = \max(\mu_{1+}, \mu_{1-}) = 1.4440E+008$

$\mu_{1+} = 1.2341E+008$, 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

$\mu_{1-} = 1.4440E+008$, 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

$M_{pr2} = \max(\mu_{2+}, \mu_{2-}) = 1.4440E+008$

$\mu_{2+} = 1.2341E+008$, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the static loading combination

$\mu_{2-} = 1.4440E+008$, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the static loading combination

Calculation of μ_{1+}

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

$\mu = 1.8630672E-005$

$M_u = 1.2341E+008$

with full section properties:

$b = 3000.00$
 $d = 208.00$
 $d' = 42.00$
 $v = 0.00176852$
 $N = 27588.841$
 $f_c = 25.00$
 $\phi (5A.5, TBDY) = 0.002$
 Final value of ϕ : $\phi^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)
 From (5.4b), TBDY: $\phi_u = 0.0035$
 $\phi_w (5.4c) = 0.00$
 $\phi_{se} ((5.4d), TBDY) = (\phi_{se1} * A_{col1} + \phi_{se2} * A_{col2} + \phi_{se3} * A_{web}) / A_{sec} = 0.00$
 $\phi_{se1} = 0.00$
 $sh_1 = 100.00$
 $bo_1 = 190.00$
 $ho_1 = 540.00$
 $bi2_1 = 655400.00$
 $\phi_{se2} = 0.00$
 $sh_2 = 100.00$
 $bo_2 = 190.00$
 $ho_2 = 540.00$
 $bi2_2 = 655400.00$
 $\phi_{se3} = 0$ (grid does not provide confinement)
 $\phi_{sh,min} = \text{Min}(\phi_{sh,x}, \phi_{sh,y}) = 0.0010472$

$\phi_{sh,x} = \phi_{s1,x} + \phi_{s2,x} + \phi_{s3,x} = 0.00439823$
 $\phi_{s1,x} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$
 $h_1 = 600.00$
 $A_{s1} = A_{stir1} * n_{s1} = 157.0796$
 No stirups, $n_{s1} = 2.00$
 $\phi_{s2,x} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$
 $h_2 = 600.00$
 $A_{s2} = A_{stir2} * n_{s2} = 157.0796$
 No stirups, $n_{s2} = 2.00$
 $\phi_{s3,x} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$
 $h_3 = 1800.00$
 $A_{s3} = A_{stir3} * n_{s3} = 0.00$
 No stirups, $n_{s3} = 2.00$

$\phi_{sh,y} = \phi_{s1,y} + \phi_{s2,y} + \phi_{s3,y} = 0.0010472$
 $\phi_{s1,y} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$
 $h_1 = 250.00$
 $A_{s1} = A_{stir1} * n_{s1} = 157.0796$
 No stirups, $n_{s1} = 2.00$
 $\phi_{s2,y} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$
 $h_2 = 250.00$
 $A_{s2} = A_{stir2} * n_{s2} = 157.0796$
 No stirups, $n_{s2} = 2.00$
 $\phi_{s3,y} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00$
 $h_3 = 250.00$
 $A_{s3} = A_{stir3} * n_{s3} = 157.0796$
 No stirups, $n_{s3} = 0.00$

$A_{sec} = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $f_{ywe} = 625.00$
 $f_{ce} = 25.00$
 From ((5.A.5), TBDY), TBDY: $\phi_c = 0.002$
 $\phi_c = \text{confinement factor} = 1.00$
 $y_1 = 0.00094258$
 $sh_1 = 0.00301626$
 $ft_1 = 282.7748$
 $fy_1 = 235.6456$
 $su_1 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
 $l_o/l_{ou,min} = l_b/l_d = 0.16565482$
 $su_1 = 0.4 * esu_{1,nominal} ((5.5), TBDY) = 0.032$
From table 5A.1, TBDY: $esu_{1,nominal} = 0.08$,
For calculation of $esu_{1,nominal}$ and y_1, sh_1, ft_1, fy_1 , it is considered
characteristic value $fsy_1 = fs_1/1.2$, from table 5.1, TBDY.
 y_1, sh_1, ft_1, fy_1 , are also multiplied by $Min(1, 1.25 * (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
with $fs_1 = fs = 235.6456$
with $Es_1 = Es = 200000.00$
 $y_2 = 0.00094258$
 $sh_2 = 0.00301626$
 $ft_2 = 282.7748$
 $fy_2 = 235.6456$
 $su_2 = 0.00301626$
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
 $l_o/l_{ou,min} = l_b/l_{b,min} = 0.16565482$
 $su_2 = 0.4 * esu_{2,nominal} ((5.5), TBDY) = 0.032$
From table 5A.1, TBDY: $esu_{2,nominal} = 0.08$,
For calculation of $esu_{2,nominal}$ and y_2, sh_2, ft_2, fy_2 , it is considered
characteristic value $fsy_2 = fs_2/1.2$, from table 5.1, TBDY.
 y_1, sh_1, ft_1, fy_1 , are also multiplied by $Min(1, 1.25 * (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
with $fs_2 = fs = 235.6456$
with $Es_2 = Es = 200000.00$
 $y_v = 0.00094258$
 $sh_v = 0.00301626$
 $ft_v = 282.7748$
 $fy_v = 235.6456$
 $suv = 0.00301626$
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
 $l_o/l_{ou,min} = l_b/l_d = 0.16565482$
 $suv = 0.4 * esuv_{nominal} ((5.5), TBDY) = 0.032$
From table 5A.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, sh_v, ft_v, fy_v , it is considered
characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
 y_1, sh_1, ft_1, fy_1 , are also multiplied by $Min(1, 1.25 * (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
with $fsv = fs = 235.6456$
with $Esv = Es = 200000.00$
 $1 = Asl_{ten}/(b * d) * (fs_1/f_c) = 0.04275722$
 $2 = Asl_{com}/(b * d) * (fs_2/f_c) = 0.04275722$
 $v = Asl_{mid}/(b * d) * (fsv/f_c) = 0.00$
and confined core properties:
 $b = 2940.00$
 $d = 178.00$
 $d' = 12.00$
 $f_{cc} (5A.2, TBDY) = 25.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = Asl_{ten}/(b * d) * (fs_1/f_c) = 0.05098316$
 $2 = Asl_{com}/(b * d) * (fs_2/f_c) = 0.05098316$
 $v = Asl_{mid}/(b * d) * (fsv/f_c) = 0.00$
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
--->
 $su (4.9) = 0.22164534$
 $Mu = MRc (4.14) = 1.2341E+008$
 $u = su (4.1) = 1.8630672E-005$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$

$l_b = 300.00$

$l_d = 1810.995$

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

l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$= 1$

$db = 16.35294$

Mean strength value of all re-bars: $f_y = 625.00$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$cb = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_{u1} -

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

$\phi_u = 1.8844503E-005$

$\mu_u = 1.4440E+008$

with full section properties:

$b = 3000.00$

$d = 208.00$

$d' = 42.00$

$v = 0.00176852$

$N = 27588.841$

$f_c = 25.00$

ϕ_u (5A.5, TBDY) = 0.002

Final value of ϕ_u : $\phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$

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

From (5.4b), TBDY: $\phi_u = 0.0035$

w_e (5.4c) = 0.00

a_{se} ((5.4d), TBDY) = $(a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$

$a_{se1} = 0.00$

$sh_1 = 100.00$

$bo_1 = 190.00$

$ho_1 = 540.00$

$bi2_1 = 655400.00$

$a_{se2} = 0.00$

$sh_2 = 100.00$

$bo_2 = 190.00$

$ho_2 = 540.00$

$bi2_2 = 655400.00$

$a_{se3} = 0$ (grid does not provide confinement)

$p_{sh,min} = \text{Min}(p_{sh,x}, p_{sh,y}) = 0.0010472$

$p_{sh,x} = p_{s1,x} + p_{s2,x} + p_{s3,x} = 0.00439823$

$p_{s1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$p_{s2,x}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$p_{s3,x}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$

$h_3 = 1800.00$

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

$p_{sh,y} = p_{s1,y} + p_{s2,y} + p_{s3,y} = 0.0010472$

ps1,y (column 1) = $(As1 \cdot h1 / s_1) / Ac = 0.0005236$

h1 = 250.00

As1 = Astir1*ns1 = 157.0796

No stirups, ns1 = 2.00

ps2,y (column 2) = $(As2 \cdot h2 / s_2) / Ac = 0.0005236$

h2 = 250.00

As2 = Astir2*ns2 = 157.0796

No stirups, ns2 = 2.00

ps3,y (web) = $(As3 \cdot h3 / s_3) / Ac = 0.00$

h3 = 250.00

As3 = Astir3*ns3 = 157.0796

No stirups, ns3 = 0.00

Asec = 750000.00

s_1 = 100.00

s_2 = 100.00

s_3 = 200.00

fywe = 625.00

fce = 25.00

From ((5.A5), TBDY), TBDY: cc = 0.002

c = confinement factor = 1.00

y1 = 0.00094258

sh1 = 0.00301626

ft1 = 282.7748

fy1 = 235.6456

su1 = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb = 0.16565482

su1 = $0.4 \cdot esu1_nominal$ ((5.5), TBDY) = 0.032

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs1 = fs = 235.6456

with Es1 = Es = 200000.00

y2 = 0.00094258

sh2 = 0.00301626

ft2 = 282.7748

fy2 = 235.6456

su2 = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb,min = 0.16565482

su2 = $0.4 \cdot esu2_nominal$ ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs2 = fs = 235.6456

with Es2 = Es = 200000.00

yv = 0.00094258

shv = 0.00301626

ftv = 282.7748

fyv = 235.6456

suv = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb = 0.16565482

suv = $0.4 \cdot esuv_nominal$ ((5.5), TBDY) = 0.032

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

considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

y_1 , $sh_{1,ft1}$, fy_1 , are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $f_{sv} = f_s = 235.6456$
 with $E_{sv} = E_s = 200000.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.04275722$
 $2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.04275722$
 $v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.02429711$
 and confined core properties:
 $b = 2940.00$
 $d = 178.00$
 $d' = 12.00$
 $f_{cc} \text{ (5A.2, TBDY)} = 25.00$
 $cc \text{ (5A.5, TBDY)} = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.05098316$
 $2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.05098316$
 $v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.02897156$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)
 --->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su \text{ (4.9)} = 0.23047746$
 $\mu_u = M_{Rc} \text{ (4.14)} = 1.4440E+008$
 $u = su \text{ (4.1)} = 1.8844503E-005$

 Calculation of ratio lb/ld

 Lap Length: $lb/ld = 0.16565482$
 $lb = 300.00$
 $ld = 1810.995$
 Calculation of lb_{min} according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 ld_{min} from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $fy = 625.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

 Calculation of μ_{u2+}

 Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 $u = 1.8630672E-005$
 $\mu_u = 1.2341E+008$

 with full section properties:
 $b = 3000.00$
 $d = 208.00$
 $d' = 42.00$
 $v = 0.00176852$
 $N = 27588.841$
 $f_c = 25.00$
 $co \text{ (5A.5, TBDY)} = 0.002$
 Final value of cu : $cu^* = \text{shear_factor} \cdot \text{Max}(cu, cc) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)
 From (5.4b), TBDY: $cu = 0.0035$
 $w_e \text{ (5.4c)} = 0.00$
 $ase \text{ ((5.4d), TBDY)} = (ase1 \cdot A_{col1} + ase2 \cdot A_{col2} + ase3 \cdot A_{web}) / A_{sec} = 0.00$
 $ase1 = 0.00$

```

sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
bi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
bi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472

```

```

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00

```

```

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

```

```

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 625.00
fce = 25.00

```

From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00

```

y1 = 0.00094258
sh1 = 0.00301626
ft1 = 282.7748
fy1 = 235.6456
su1 = 0.00301626

```

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb = 0.16565482

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

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^2/3), from 10.3.5, ASCE 41-17.

with fs1 = fs = 235.6456

with Es1 = Es = 200000.00

```

y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748

```

```

fy2 = 235.6456
su2 = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.16565482
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    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 = 235.6456
    with Es2 = Es = 200000.00
    yv = 0.00094258
    shv = 0.00301626
    ftv = 282.7748
    fyv = 235.6456
    suv = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/ld = 0.16565482
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    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 = 235.6456
    with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
    2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
    v = Asl,mid/(b*d)*(fsv/fc) = 0.00
    and confined core properties:
    b = 2940.00
    d = 178.00
    d' = 12.00
    fcc (5A.2, TBDY) = 25.00
    cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
    2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
    v = Asl,mid/(b*d)*(fsv/fc) = 0.00

```

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

```

--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.22164534
Mu = MRc (4.14) = 1.2341E+008
u = su (4.1) = 1.8630672E-005

```

Calculation of ratio lb/ld

```

Lap Length: lb/ld = 0.16565482
lb = 300.00
ld = 1810.995
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 625.00
t = 1.00
s = 0.80
e = 1.00
cb = 25.00

```

Ktr = 1.848
n = 34.00

Calculation of Mu2-

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

$\phi_u = 1.8844503E-005$

$M_u = 1.4440E+008$

with full section properties:

b = 3000.00

d = 208.00

d' = 42.00

v = 0.00176852

N = 27588.841

f_c = 25.00

c_o (5A.5, TBDY) = 0.002

Final value of ϕ_u : $\phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$

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

From (5.4b), TBDY: $\phi_u = 0.0035$

w_e (5.4c) = 0.00

a_{se} ((5.4d), TBDY) = $(a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$

a_{se1} = 0.00

sh₁ = 100.00

bo₁ = 190.00

ho₁ = 540.00

bi_{2_1} = 655400.00

a_{se2} = 0.00

sh₂ = 100.00

bo₂ = 190.00

ho₂ = 540.00

bi_{2_2} = 655400.00

a_{se3} = 0 (grid does not provide confinement)

psh,min = Min(psh,x , psh,y) = 0.0010472

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823

ps1,x (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

h₁ = 600.00

A_{s1} = Astir1*ns1 = 157.0796

No stirups, ns1 = 2.00

ps2,x (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$

h₂ = 600.00

A_{s2} = Astir2*ns2 = 157.0796

No stirups, ns2 = 2.00

ps3,x (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$

h₃ = 1800.00

A_{s3} = Astir3*ns3 = 0.00

No stirups, ns3 = 2.00

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472

ps1,y (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.0005236$

h₁ = 250.00

A_{s1} = Astir1*ns1 = 157.0796

No stirups, ns1 = 2.00

ps2,y (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.0005236$

h₂ = 250.00

A_{s2} = Astir2*ns2 = 157.0796

No stirups, ns2 = 2.00

ps3,y (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00$

h₃ = 250.00

A_{s3} = Astir3*ns3 = 157.0796

No stirups, ns3 = 0.00


```

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 625.00
fce = 25.00
From ((5.A.5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00094258
sh1 = 0.00301626
ft1 = 282.7748
fy1 = 235.6456
su1 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.16565482
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 235.6456
with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.16565482
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 235.6456
with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.16565482
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 235.6456
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.02429711
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00

```

$$1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.05098316$$

$$2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.05098316$$

$$v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02897156$$

Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)

--->

$v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

--->

$$s_u(4.9) = 0.23047746$$

$$\mu_u = M_{Rc}(4.14) = 1.4440E+008$$

$$u = s_u(4.1) = 1.8844503E-005$$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$

$$l_b = 300.00$$

$$l_d = 1810.995$$

Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

$l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$$= 1$$

$$d_b = 16.35294$$

Mean strength value of all re-bars: $f_y = 625.00$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

Calculation of Shear Strength $V_r = \text{Min}(V_{r1}, V_{r2}) = 1.1297E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 1.1297E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f'_c*0.5*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$

$$\mu_u/V_u - l_w/2 = 0.00 \leq 0$$

= 1 (normal-weight concrete)

$$f'_c = 25.00, \text{ but } f'_c*0.5 \leq 8.3 \text{ MPa (22.5.3.1, ACI 318-14)}$$

$$h = 3000.00$$

$$d = 200.00$$

$$l_w = 250.00$$

$$\mu_u = 2.5788780E-012$$

$$V_u = 0.00$$

$$N_u = 27588.841$$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$

$V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s3} = 0.00$ is calculated for web, with:

$$d = 200.00$$

$$A_v = 0.00$$

$$s = 200.00$$

$$f_y = 500.00$$

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$$2(1-s/d) = 0.00$$

$$V_f((11-3)-(11.4), \text{ACI 440}) = 0.00$$

$$\text{From (11-11), ACI 440: } V_s + V_f \leq 1.9929E+006$$

$$b_w = 3000.00$$

Calculation of Shear Strength at edge 2, $V_{r2} = 1.1297E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c' \cdot 0.5 \cdot h \cdot d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$

$$\mu_u/\mu_u - l_w/2 = 0.00 \leq 0$$

= 1 (normal-weight concrete)

$$f_c' = 25.00, \text{ but } f_c'^{0.5} \leq 8.3 \text{ MPa (22.5.3.1, ACI 318-14)}$$

$$h = 3000.00$$

$$d = 200.00$$

$$l_w = 250.00$$

$$\mu_u = 2.5788780E-012$$

$$V_u = 0.00$$

$$N_u = 27588.841$$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$

$V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s3} = 0.00$ is calculated for web, with:

$$d = 200.00$$

$$A_v = 0.00$$

$$s = 200.00$$

$$f_y = 500.00$$

V_{s3} has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$$2(1-s/d) = 0.00$$

$$V_f((11-3)-(11.4), \text{ACI 440}) = 0.00$$

$$\text{From (11-11), ACI 440: } V_s + V_f \leq 1.9929E+006$$

$$b_w = 3000.00$$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1

At local axis: 2

Integration Section: (a)

Section Type: rcrws

Constant Properties

Knowledge Factor, $\gamma = 1.00$

According to 10.7.2.3, ASCE 41-17, shear walls with
transverse reinforcement percentage, $\gamma_n < 0.0015$

are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17

$$\gamma_n = 0.0010472$$

with $n = ps1 + ps2 + ps3$, being the shear reinf. ratio in a plane perpendicular to the shear axis 3

(pseudo-col.1 $ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236$

$h1 = 250.00$

$s1 = 100.00$

total area of hoops perpendicular to shear axis, $As1 = 157.0796$

(pseudo-col.2 $ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236$

$h2 = 250.00$

$s2 = 100.00$

total area of hoops perpendicular to shear axis, $As2 = 157.0796$

(grid $ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00$

$h3 = 250.00$

$s3 = 200.00$

total area of hoops perpendicular to shear axis, $As3 = 0.00$

total section area, $Ac = 750000.00$

Consequently:

New material of Secondary Member: Concrete Strength, $fc = fc_lower_bound = 25.00$

New material of Secondary Member: Steel Strength, $fs = fs_lower_bound = 500.00$

Concrete Elasticity, $Ec = 26999.444$

Steel Elasticity, $Es = 200000.00$

Total Height, $H_{tot} = 3000.00$

Edges Width, $Wedg = 250.00$

Edges Height, $Hedg = 600.00$

Web Width, $Wweb = 250.00$

Cover Thickness, $c = 25.00$

Element Length, $L = 3000.00$

Secondary 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

Lap Length $lb = 300.00$

No FRP Wrapping

Stepwise Properties

Bending Moment, $M = 1.3334E+008$

Shear Force, $V2 = -9.9179258E-014$

Shear Force, $V3 = -44458.437$

Axial Force, $F = -27925.142$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $Asl_t = 0.00$

-Compression: $Asl_c = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $Asl_{ten} = 2865.133$

-Compression: $Asl_{com} = 2865.133$

-Middle: $Asl_{mid} = 1539.38$

Mean Diameter of Tension Reinforcement, $DbL = 17.33333$

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $u_R = 1.0^*$ $u = 0.00446269$

$u = y + p = 0.00446269$

- Calculation of y -

$y = (My*Ip)/(EI)_{Eff} = 0.00046269 ((10-5), ASCE 41-17))$

$My = 2.0495E+009$

$(EI)_{Eff} = 0.35*Ec*I$ (table 10-5)

$Ec*I = 1.5187E+016$

$Ip = 0.5*d = 0.5*(0.8*h) = 1200.00$

Calculation of Yielding Moment M_y

Calculation of γ and M_y according to Annex 7

$y = \text{Min}(y_{\text{ten}}, y_{\text{com}})$
 $y_{\text{ten}} = 4.6949925\text{E-}007$
with $((10.1), \text{ASCE } 41-17) f_y = \text{Min}(f_y, 1.25 \cdot f_y \cdot (l_b/l_d)^{2/3}) = 218.754$
 $d = 2957.00$
 $y = 0.2121567$
 $A = 0.01000649$
 $B = 0.00516109$
with $pt = 0.00387573$
 $pc = 0.00387573$
 $pv = 0.00208235$
 $N = 27925.142$
 $b = 250.00$
 $" = 0.01454177$
 $y_{\text{comp}} = 2.6940114\text{E-}006$
with $fc = 25.00$
 $E_c = 26999.444$
 $y = 0.2092218$
 $A = 0.00972049$
 $B = 0.00498841$
with $E_s = 200000.00$

Calculation of ratio l_b/l_d

Lap Length: $l_d/l_{d,\text{min}} = 0.20706852$
 $l_b = 300.00$
 $l_d = 1448.796$
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 $l_{d,\text{min}}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
 $= 1$
 $db = 16.35294$
Mean strength value of all re-bars: $f_y = 500.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

- Calculation of p

Considering wall controlled by flexure (shear control ratio ≤ 1),
from table 10-19: $p = 0.004$
with:

- Condition i (shear wall and wall segments)

- $(A_s - A_s') \cdot f_y + P / (t_w \cdot l_w \cdot f_c') = -0.19236787$

$A_s = 0.00$

$A_s' = 7269.645$

$f_y = 500.00$

$P = 27925.142$

$t_w = 250.00$

$l_w = 3000.00$

$f_c = 25.00$

- $V / (t_w \cdot l_w \cdot f_c^{0.5}) = 0.14277302$, NOTE: units in lb & in

- Confined Boundary: Yes

Table values have been multiplied by 0.8 according to subnote b

Boundary Trans. Reinf. exceeds 75% of ACI 318 provision ($V_{w1} + V_{w2} > 0.50 \cdot (V - V_c - V_{w3})$)

Boundary hoops spacing does not exceed $8db$ ($s_1 < 8db$ and $s_2 < 8db$)

With

Boundary Element 1:

$V_{w1} = 376991.118$

s1 = 100.00

Boundary Element 2:

Vw2 = 376991.118

s2 = 100.00

Grid Shear Force, Vw3 = 0.00

Concrete Shear Force, Vc = 759253.261

(The variables above have already been given in Shear control ratio calculation)

Mean diameter of all bars, db = 17.33333

Design Shear Force, V = 44458.437

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1

At local axis: 2

Integration Section: (a)

Calculation No. 3

wall W1, 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: wall W1 of floor 1

At local axis: 3

Integration Section: (a)

Section Type: rcrws

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:

New material of Secondary Member: Concrete Strength, $f_c = f_{c_lower_bound} = 25.00$
 New material of Secondary Member: Steel Strength, $f_s = f_{s_lower_bound} = 500.00$
 Concrete Elasticity, $E_c = 26999.444$
 Steel Elasticity, $E_s = 200000.00$
 Total Height, $H_{tot} = 3000.00$
 Edges Width, $W_{edg} = 250.00$
 Edges Height, $H_{edg} = 600.00$
 Web Width, $W_{web} = 250.00$
 Cover Thickness, $c = 25.00$
 Element Length, $L = 3000.00$
 Secondary 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
 Lap Length $l_o = l_b = 300.00$
 No FRP Wrapping

Stepwise Properties

EDGE -A-
 Bending Moment, $M_a = 1.3334E+008$
 Shear Force, $V_a = -44458.437$
 EDGE -B-
 Bending Moment, $M_b = 49279.25$
 Shear Force, $V_b = 44458.437$
 BOTH EDGES
 Axial Force, $F = -27925.142$
 Longitudinal Reinforcement Area Distribution (in 2 divisions)
 -Tension: $A_{sl,t} = 0.00$
 -Compression: $A_{sl,c} = 7269.645$
 Longitudinal Reinforcement Area Distribution (in 3 divisions)
 -Tension: $A_{sl,ten} = 2865.133$
 -Compression: $A_{sl,com} = 2865.133$
 -Middle: $A_{sl,mid} = 1539.38$
 Mean Diameter of Tension Reinforcement, $Db_{L,ten} = 17.33333$

New component: From table 7-7, ASCE 41_17: Final Shear Capacity $V_R = 1.0 \cdot V_n = 2.0787E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_n < 0.83 \cdot f_c'^{0.5} \cdot h \cdot d = 2.0787E+006$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
 where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 759253.261$
 $\mu_u / \nu_u - l_w / 2 = 1499.219 > 0$
 = 1 (normal-weight concrete)
 $f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $l_w = 3000.00$
 $\mu_u = 1.3334E+008$
 $\nu_u = 44458.437$
 $N_u = 27925.142$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.3195E+006$
 $V_{s1} = 376991.118$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)
 $V_{s2} = 376991.118$ is calculated for pseudo-Column 2, with:
 $d = 480.00$
 $A_v = 157079.633$

$$s = 100.00$$

$$f_y = 500.00$$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 565486.678 is calculated for web, with:

$$d = 1440.00$$

$$A_v = 157079.633$$

$$s = 200.00$$

$$f_y = 500.00$$

Vs3 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$$V_f ((11-3)-(11.4), \text{ACI 440}) = 0.00$$

From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$

$$b_w = 250.00$$

End Of Calculation of Shear Capacity for element: wall W1 of floor 1

At local axis: 3

Integration Section: (a)

Calculation No. 4

wall W1, Floor 1

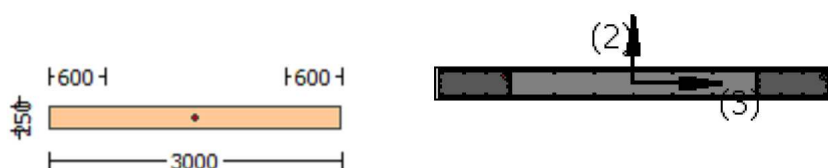
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Chord rotation capacity (ϕ)

Edge: Start

Local Axis: (3)



Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At Shear local axis: 3

(Bending local axis: 2)

Section Type: rcwrs

Constant Properties

Knowledge Factor, $\phi = 1.00$

Mean strength values are used for both shear and moment calculations.

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 33.00$

New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 555.56$

Concrete Elasticity, $E_c = 26999.444$
 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
 New material: Steel Strength, $f_s = 1.25 \cdot f_{sm} = 694.45$
 #####
 Total Height, $H_{tot} = 3000.00$
 Edges Width, $W_{edg} = 250.00$
 Edges Height, $H_{edg} = 600.00$
 Web Width, $W_{web} = 250.00$
 Cover Thickness, $c = 25.00$
 Mean Confinement Factor overall section = 1.00
 Element Length, $L = 3000.00$
 Secondary 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
 Lap Length $l_o = 300.00$
 No FRP Wrapping

Stepwise Properties

At local axis: 3
 EDGE -A-
 Shear Force, $V_a = 1.5016185E-058$
 EDGE -B-
 Shear Force, $V_b = -1.5016185E-058$
 BOTH EDGES
 Axial Force, $F = -27588.841$
 Longitudinal Reinforcement Area Distribution (in 2 divisions)
 -Tension: $A_{sl,t} = 0.00$
 -Compression: $A_{sl,c} = 7269.645$
 Longitudinal Reinforcement Area Distribution (in 3 divisions)
 -Tension: $A_{sl,ten} = 2865.133$
 -Compression: $A_{sl,com} = 2865.133$
 -Middle: $A_{sl,mid} = 0.00$
 (According to 10.7.2.3 $A_{sl,mid}$ is setted equal to zero)

Calculation of Shear Capacity ratio, $V_e/V_r = 0.69050088$
 Member Controlled by Flexure ($V_e/V_r < 1$)
 Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 $V_e = (M_{pr1} + M_{pr2})/l_n = 1.6587E+006$
 with
 $M_{pr1} = \text{Max}(M_{u1+}, M_{u1-}) = 2.4881E+009$
 $M_{u1+} = 2.1705E+009$, 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
 $M_{u1-} = 2.4881E+009$, 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
 $M_{pr2} = \text{Max}(M_{u2+}, M_{u2-}) = 2.4881E+009$
 $M_{u2+} = 2.1705E+009$, 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
 $M_{u2-} = 2.4881E+009$, is the ultimate moment strength at the edge 2 of the member in the opposite moment
 direction which is defined for the the static loading combination

Calculation of M_{u1+}

Calculation of ultimate curvature ϕ_u according to 4.1, Biskinis/Fardis 2013:
 $\phi_u = 1.2902105E-006$
 $M_u = 2.1705E+009$

with full section properties:

$$b = 250.00$$

$$d = 2957.00$$

$$d' = 43.00$$

$$v = 0.00113091$$

$$N = 27588.841$$

$$f_c = 33.00$$

$$\phi (5A.5, \text{TB DY}) = 0.002$$

$$\text{Final value of } \phi: \phi^* = \text{shear_factor} * \text{Max}(\phi, \phi_c) = 0.0035$$

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

$$\text{From (5.4b), TB DY: } \phi = 0.0035$$

$$\phi_e (5.4c) = 0.00$$

$$\phi_{se} ((5.4d), \text{TB DY}) = (\phi_{se1} * A_{col1} + \phi_{se2} * A_{col2} + \phi_{se3} * A_{web}) / A_{sec} = 0.00$$

$$\phi_{se1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$\phi_{se2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$\phi_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$\phi_{sh,min} = \text{Min}(\phi_{sh,x}, \phi_{sh,y}) = 0.0010472$$

$$\phi_{sh,x} = \phi_{s1,x} + \phi_{s2,x} + \phi_{s3,x} = 0.00439823$$

$$\phi_{s1,x} (\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{s2,x} (\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{s3,x} (\text{web}) = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$\phi_{sh,y} = \phi_{s1,y} + \phi_{s2,y} + \phi_{s3,y} = 0.0010472$$

$$\phi_{s1,y} (\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{s2,y} (\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$$

$$h_2 = 250.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{s3,y} (\text{web}) = (A_{s3} * h_3 / s_3) / A_c = 0.00$$

$$h_3 = 250.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 157.0796$$

$$\text{No stirups, } n_{s3} = 0.00$$

$$A_{sec} = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$f_{ywe} = 694.45$$

$$f_{ce} = 33.00$$

$$\text{From ((5.A5), TB DY), TB DY: } \phi_c = 0.002$$

$$\phi_c = \text{confinement factor} = 1.00$$

$$y_1 = 0.00096384$$

$$sh_1 = 0.00308428$$

$$ft_1 = 321.2814$$

$$fy_1 = 267.7345$$

```

su1 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.17128923
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 267.7345
with Es1 = Es = 200000.00
y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.17128923
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 267.7345
with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.17128923
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 267.7345
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.19157175
Mu = MRc (4.14) = 2.1705E+009
u = su (4.1) = 1.2902105E-006

```

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$

$l_b = 300.00$

$l_d = 1751.424$

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

l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$= 1$

$db = 16.35294$

Mean strength value of all re-bars: $f_y = 694.45$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$cb = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_1 -

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

$\mu = 1.2974768E-006$

$\mu = 2.4881E+009$

with full section properties:

$b = 250.00$

$d = 2957.00$

$d' = 43.00$

$v = 0.00113091$

$N = 27588.841$

$f_c = 33.00$

ϕ_c (5A.5, TBDY) = 0.002

Final value of ϕ_c : $\phi_c^* = \text{shear_factor} * \text{Max}(\phi_c, \phi_{cc}) = 0.0035$

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

From (5.4b), TBDY: $\phi_c = 0.0035$

ϕ_{cc} (5.4c) = 0.00

ϕ_{cc} ((5.4d), TBDY) = $(\phi_{cc1} * A_{col1} + \phi_{cc2} * A_{col2} + \phi_{cc3} * A_{web}) / A_{sec} = 0.00$

$\phi_{cc1} = 0.00$

$sh_1 = 100.00$

$bo_1 = 190.00$

$ho_1 = 540.00$

$bi2_1 = 655400.00$

$\phi_{cc2} = 0.00$

$sh_2 = 100.00$

$bo_2 = 190.00$

$ho_2 = 540.00$

$bi2_2 = 655400.00$

$\phi_{cc3} = 0$ (grid does not provide confinement)

$\phi_{psh,min} = \text{Min}(\phi_{psh,x}, \phi_{psh,y}) = 0.0010472$

$\phi_{psh,x} = \phi_{psh1,x} + \phi_{psh2,x} + \phi_{psh3,x} = 0.00439823$

$\phi_{psh1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$\phi_{psh2,x}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$\phi_{psh3,x}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$

$h_3 = 1800.00$

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

```

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

```

```

Asec = 750000.00

```

```

s_1 = 100.00

```

```

s_2 = 100.00

```

```

s_3 = 200.00

```

```

fywe = 694.45

```

```

fce = 33.00

```

```

From ((5.A5), TBDY), TBDY: cc = 0.002

```

```

c = confinement factor = 1.00

```

```

y1 = 0.00096384

```

```

sh1 = 0.00308428

```

```

ft1 = 321.2814

```

```

fy1 = 267.7345

```

```

su1 = 0.00308428

```

```

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

```

```

lo/lou,min = lb/ld = 0.17128923

```

```

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

```

```

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

```

```

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

```

```

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 = 267.7345

```

```

with Es1 = Es = 200000.00

```

```

y2 = 0.00096384

```

```

sh2 = 0.00308428

```

```

ft2 = 321.2814

```

```

fy2 = 267.7345

```

```

su2 = 0.00308428

```

```

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

```

```

lo/lou,min = lb/lb,min = 0.17128923

```

```

su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

```

```

From table 5A.1, TBDY: esu2_nominal = 0.08,

```

```

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

```

```

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 = 267.7345

```

```

with Es2 = Es = 200000.00

```

```

yv = 0.00096384

```

```

shv = 0.00308428

```

```

ftv = 321.2814

```

```

fyv = 267.7345

```

```

suv = 0.00308428

```

```

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

```

```

lo/lou,min = lb/ld = 0.17128923

```

```

suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032

```

```

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

```

```

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

```

For calculation of $\epsilon_{sv_nominal}$ and γ_v , δ_v , f_{tv} , f_{yv} , it is considered characteristic value $f_{sv} = f_{sv}/1.2$, from table 5.1, TBDY.

γ_1 , δ_1 , f_{t1} , f_{y1} , are also multiplied by $\text{Min}(1, 1.25 \cdot (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.

with $f_{sv} = f_s = 267.7345$

with $E_{sv} = E_s = 200000.00$

$1 = A_{s1,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.03144444$

$2 = A_{s1,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.03144444$

$v = A_{s1,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.01689449$

and confined core properties:

$b = 190.00$

$d = 2927.00$

$d' = 13.00$

$f_{cc} \text{ (5A.2, TBDY)} = 33.00$

$cc \text{ (5A.5, TBDY)} = 0.002$

$c = \text{confinement factor} = 1.00$

$1 = A_{s1,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.04179832$

$2 = A_{s1,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.04179832$

$v = A_{s1,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.02245743$

Case/Assumption: Unconfined full section - Steel rupture

' satisfies Eq. (4.3)

--->

$v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

--->

$\mu_u \text{ (4.9)} = 0.19609924$

$\mu_u = M_{Rc} \text{ (4.14)} = 2.4881\text{E}+009$

$u = \mu_u \text{ (4.1)} = 1.2974768\text{E}-006$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$

$l_b = 300.00$

$l_d = 1751.424$

Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

$l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$= 1$

$\delta_b = 16.35294$

Mean strength value of all re-bars: $f_y = 694.45$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$c_b = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_{u2+}

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

$u = 1.2902105\text{E}-006$

$\mu_u = 2.1705\text{E}+009$

with full section properties:

$b = 250.00$

$d = 2957.00$

$d' = 43.00$

$v = 0.00113091$

$N = 27588.841$

$f_c = 33.00$

$cc \text{ (5A.5, TBDY)} = 0.002$

Final value of μ_u : $\mu_u^* = \text{shear_factor} \cdot \text{Max}(\mu_u, cc) = 0.0035$

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

From (5.4b), TBDY: $\mu_u = 0.0035$

$\mu_{ue} \text{ (5.4c)} = 0.00$

$$ase((5.4d), TBDY) = (ase1 \cdot Acol1 + ase2 \cdot Acol2 + ase3 \cdot Aweb) / Asec = 0.00$$

$$ase1 = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$ase2 = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$ase3 = 0 \text{ (grid does not provide confinement)}$$

$$psh,min = \text{Min}(psh,x, psh,y) = 0.0010472$$

$$psh,x = ps1,x + ps2,x + ps3,x = 0.00439823$$

$$ps1,x \text{ (column 1)} = (As1 \cdot h1 / s_1) / Ac = 0.00125664$$

$$h1 = 600.00$$

$$As1 = Astir1 \cdot ns1 = 157.0796$$

$$\text{No stirups, } ns1 = 2.00$$

$$ps2,x \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.00125664$$

$$h2 = 600.00$$

$$As2 = Astir2 \cdot ns2 = 157.0796$$

$$\text{No stirups, } ns2 = 2.00$$

$$ps3,x \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00188496$$

$$h3 = 1800.00$$

$$As3 = Astir3 \cdot ns3 = 0.00$$

$$\text{No stirups, } ns3 = 2.00$$

$$psh,y = ps1,y + ps2,y + ps3,y = 0.0010472$$

$$ps1,y \text{ (column 1)} = (As1 \cdot h1 / s_1) / Ac = 0.0005236$$

$$h1 = 250.00$$

$$As1 = Astir1 \cdot ns1 = 157.0796$$

$$\text{No stirups, } ns1 = 2.00$$

$$ps2,y \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.0005236$$

$$h2 = 250.00$$

$$As2 = Astir2 \cdot ns2 = 157.0796$$

$$\text{No stirups, } ns2 = 2.00$$

$$ps3,y \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00$$

$$h3 = 250.00$$

$$As3 = Astir3 \cdot ns3 = 157.0796$$

$$\text{No stirups, } ns3 = 0.00$$

$$Asec = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$fywe = 694.45$$

$$fce = 33.00$$

$$\text{From ((5.A5), TBDY), TBDY: } cc = 0.002$$

$$c = \text{confinement factor} = 1.00$$

$$y1 = 0.00096384$$

$$sh1 = 0.00308428$$

$$ft1 = 321.2814$$

$$fy1 = 267.7345$$

$$su1 = 0.00308428$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/ld = 0.17128923$$

$$su1 = 0.4 \cdot esu1_nominal \text{ ((5.5), TBDY)} = 0.032$$

$$\text{From table 5A.1, TBDY: } esu1_nominal = 0.08,$$

For calculation of esu1_nominal and y1, sh1, ft1, fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1, ft1, fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

$$\text{with } fs1 = fs = 267.7345$$

$$\text{with } Es1 = Es = 200000.00$$

$$y2 = 0.00096384$$

```

sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lo,min = lb/lb,min = 0.17128923
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    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 = 267.7345
    with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lo,min = lb/ld = 0.17128923
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    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 = 267.7345
    with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.19157175
Mu = MRc (4.14) = 2.1705E+009
u = su (4.1) = 1.2902105E-006

```

Calculation of ratio lb/ld

```

Lap Length: lb/ld = 0.17128923
lb = 300.00
ld = 1751.424
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 694.45
t = 1.00
s = 0.80

```


e = 1.00
cb = 25.00
Ktr = 1.848
n = 34.00

Calculation of Mu2-

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

$\phi_u = 1.2974768E-006$
 $M_u = 2.4881E+009$

with full section properties:

b = 250.00
d = 2957.00
d' = 43.00
v = 0.00113091
N = 27588.841

fc = 33.00
co (5A.5, TBDY) = 0.002

Final value of ϕ_u : $\phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$

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

From (5.4b), TBDY: $\phi_u = 0.0035$

we (5.4c) = 0.00

ase ((5.4d), TBDY) = $(\text{ase1} * A_{col1} + \text{ase2} * A_{col2} + \text{ase3} * A_{web}) / A_{sec} = 0.00$

ase1 = 0.00

sh_1 = 100.00

bo_1 = 190.00

ho_1 = 540.00

bi2_1 = 655400.00

ase2 = 0.00

sh_2 = 100.00

bo_2 = 190.00

ho_2 = 540.00

bi2_2 = 655400.00

ase3 = 0 (grid does not provide confinement)

psh,min = $\text{Min}(psh,x, psh,y) = 0.0010472$

psh,x = $ps1,x + ps2,x + ps3,x = 0.00439823$

ps1,x (column 1) = $(A_{s1} * h1 / s_1) / A_c = 0.00125664$

h1 = 600.00

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

ps2,x (column 2) = $(A_{s2} * h2 / s_2) / A_c = 0.00125664$

h2 = 600.00

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

ps3,x (web) = $(A_{s3} * h3 / s_3) / A_c = 0.00188496$

h3 = 1800.00

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

psh,y = $ps1,y + ps2,y + ps3,y = 0.0010472$

ps1,y (column 1) = $(A_{s1} * h1 / s_1) / A_c = 0.0005236$

h1 = 250.00

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

ps2,y (column 2) = $(A_{s2} * h2 / s_2) / A_c = 0.0005236$

h2 = 250.00

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

ps3,y (web) = $(A_{s3} * h3 / s_3) / A_c = 0.00$

h3 = 250.00

$A_{s3} = A_{stir3} * n_{s3} = 157.0796$

No stirrups, ns3 = 0.00

Asec = 750000.00

s_1 = 100.00

s_2 = 100.00

s_3 = 200.00

fywe = 694.45

fce = 33.00

From ((5A5), TBDY), TBDY: cc = 0.002

c = confinement factor = 1.00

y1 = 0.00096384

sh1 = 0.00308428

ft1 = 321.2814

fy1 = 267.7345

su1 = 0.00308428

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb = 0.17128923

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

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs1 = fs = 267.7345

with Es1 = Es = 200000.00

y2 = 0.00096384

sh2 = 0.00308428

ft2 = 321.2814

fy2 = 267.7345

su2 = 0.00308428

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb,min = 0.17128923

su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs2 = fs = 267.7345

with Es2 = Es = 200000.00

yv = 0.00096384

shv = 0.00308428

ftv = 321.2814

fyv = 267.7345

suv = 0.00308428

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb = 0.17128923

suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032

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

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

For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fsv = fs = 267.7345

with Esv = Es = 200000.00

1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444

2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444

v = Asl,mid/(b*d)*(fsv/fc) = 0.01689449

and confined core properties:

b = 190.00

d = 2927.00

d' = 13.00

fcc (5A.2, TBDY) = 33.00

$cc(5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832$
 $2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832$
 $v = Asl,mid/(b*d)*(fsv/fc) = 0.02245743$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)
 --->
 $v < vs,y2$ - LHS eq.(4.5) is satisfied
 --->
 $su(4.9) = 0.19609924$
 $Mu = MRc(4.14) = 2.4881E+009$
 $u = su(4.1) = 1.2974768E-006$

Calculation of ratio lb/ld

Lap Length: $lb/ld = 0.17128923$
 $lb = 300.00$
 $ld = 1751.424$
 Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $fy = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $Ktr = 1.848$
 $n = 34.00$

Calculation of Shear Strength $Vr = \text{Min}(Vr1, Vr2) = 2.4022E+006$

Calculation of Shear Strength at edge 1, $Vr1 = 2.4022E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $Vr1 = Vn < 0.83*fc'^{0.5}*h*d$

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 (11.5.4.6(d-e)), ACI 318-14: $Vc = 936136.917$
 $Mu/Vu-lw/2 = 0.00 <= 0$
 $= 1$ (normal-weight concrete)
 $fc' = 33.00$, but $fc'^{0.5} <= 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $lw = 3000.00$
 $Mu = 1.2001755E-010$
 $Vu = 1.5016185E-058$
 $Nu = 27588.841$
 From (11.5.4.8), ACI 318-14: $Vs = Vs1 + Vs2 + Vs3 = 1.4661E+006$
 $Vs1 = 418882.372$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $Av = 157079.633$
 $s = 100.00$
 $fy = 555.56$
 $Vs1$ has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $Vs2 = 418882.372$ is calculated for pseudo-Column 2, with:
 $d = 480.00$
 $Av = 157079.633$
 $s = 100.00$
 $fy = 555.56$
 $Vs2$ has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $Vs3 = 628323.557$ is calculated for web, with:

d = 1440.00
Av = 157079.633
s = 200.00
fy = 555.56
Vs3 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$
bw = 250.00

Calculation of Shear Strength at edge 2, $V_{r2} = 2.4022E+006$
From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c' \cdot h \cdot d$

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 (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$
 $M_u/V_u - l_w/2 = 0.00 \leq 0$
= 1 (normal-weight concrete)
 $f_c' = 33.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
 $M_u = 1.2001755E+010$
 $V_u = 1.5016185E+058$
Nu = 27588.841

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$

Vs1 = 418882.372 is calculated for pseudo-Column 1, with:

d = 480.00
Av = 157079.633
s = 100.00
fy = 555.56

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

Vs2 = 418882.372 is calculated for pseudo-Column 2, with:

d = 480.00
Av = 157079.633
s = 100.00
fy = 555.56

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 628323.557 is calculated for web, with:

d = 1440.00
Av = 157079.633
s = 200.00
fy = 555.56

Vs3 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

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

From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$

bw = 250.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcrws

Constant Properties

Knowledge Factor, = 1.00
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 25.00$
New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 500.00$
Concrete Elasticity, $E_c = 26999.444$

```

Steel Elasticity, Es = 200000.00
#####
Note: Especially for the calculation of moment strengths,
the above steel re-bar strengths are multiplied by 1.25 according to R18.6.5, ACI 318-14
New material: Steel Strength, fs = 1.25*fsm = 625.00
#####
Total Height, Htot = 3000.00
Edges Width, Wedg = 250.00
Edges Height, Hedg = 600.00
Web Width, Wweb = 250.00
Cover Thickness, c = 25.00
Mean Confinement Factor overall section = 1.00
Element Length, L = 3000.00
Secondary 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
Lap Length lo = 300.00
No FRP Wrapping
-----

Stepwise Properties
-----
At local axis: 2
EDGE -A-
Shear Force, Va = 0.00
EDGE -B-
Shear Force, Vb = 0.00
BOTH EDGES
Axial Force, F = -27588.841
Longitudinal Reinforcement Area Distribution (in 2 divisions)
  -Tension: Aslt = 0.00
  -Compression: Aslc = 7269.645
Longitudinal Reinforcement Area Distribution (in 3 divisions)
  -Tension: Asl,ten = 2830.575
  -Compression: Asl,com = 2830.575
  -Middle: Asl,mid = 0.00
  (According to 10.7.2.3 Asl,mid is setted equal to zero)
-----
-----

Calculation of Shear Capacity ratio , Ve/Vr = 0.08521711
Member Controlled by Flexure (Ve/Vr < 1)
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 Ve = (Mpr1 + Mpr2)/ln = 96267.817
with
Mpr1 = Max(Mu1+ , Mu1-) = 1.4440E+008
  Mu1+ = 1.2341E+008, is the ultimate moment strength at the edge 1 of the member in the actual moment direction
  which is defined for the static loading combination
  Mu1- = 1.4440E+008, is the ultimate moment strength at the edge 1 of the member in the opposite moment
  direction which is defined for the static loading combination
Mpr2 = Max(Mu2+ , Mu2-) = 1.4440E+008
  Mu2+ = 1.2341E+008, is the ultimate moment strength at the edge 2 of the member in the actual moment direction
  which is defined for the the static loading combination
  Mu2- = 1.4440E+008, is the ultimate moment strength at the edge 2 of the member in the opposite moment
  direction which is defined for the the static loading combination
-----

Calculation of Mu1+
-----

-----

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
u = 1.8630672E-005
Mu = 1.2341E+008
-----

```

with full section properties:

$$b = 3000.00$$

$$d = 208.00$$

$$d' = 42.00$$

$$v = 0.00176852$$

$$N = 27588.841$$

$$f_c = 25.00$$

$$\phi (5A.5, \text{TB DY}) = 0.002$$

$$\text{Final value of } \phi: \phi^* = \text{shear_factor} * \text{Max}(\phi, \phi_c) = 0.0035$$

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

$$\text{From (5.4b), TB DY: } \phi = 0.0035$$

$$\phi_e (5.4c) = 0.00$$

$$\phi_{se} ((5.4d), \text{TB DY}) = (\phi_{se1} * A_{col1} + \phi_{se2} * A_{col2} + \phi_{se3} * A_{web}) / A_{sec} = 0.00$$

$$\phi_{se1} = 0.00$$

$$s_{h1} = 100.00$$

$$b_{o1} = 190.00$$

$$h_{o1} = 540.00$$

$$b_{i21} = 655400.00$$

$$\phi_{se2} = 0.00$$

$$s_{h2} = 100.00$$

$$b_{o2} = 190.00$$

$$h_{o2} = 540.00$$

$$b_{i22} = 655400.00$$

$$\phi_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$\phi_{sh, \min} = \text{Min}(\phi_{sh, x}, \phi_{sh, y}) = 0.0010472$$

$$\phi_{sh, x} = \phi_{s1, x} + \phi_{s2, x} + \phi_{s3, x} = 0.00439823$$

$$\phi_{s1, x} (\text{column 1}) = (A_{s1} * h_1 / s_{h1}) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{s2, x} (\text{column 2}) = (A_{s2} * h_2 / s_{h2}) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{s3, x} (\text{web}) = (A_{s3} * h_3 / s_{h3}) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$\phi_{sh, y} = \phi_{s1, y} + \phi_{s2, y} + \phi_{s3, y} = 0.0010472$$

$$\phi_{s1, y} (\text{column 1}) = (A_{s1} * h_1 / s_{h1}) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{s2, y} (\text{column 2}) = (A_{s2} * h_2 / s_{h2}) / A_c = 0.0005236$$

$$h_2 = 250.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{s3, y} (\text{web}) = (A_{s3} * h_3 / s_{h3}) / A_c = 0.00$$

$$h_3 = 250.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 157.0796$$

$$\text{No stirups, } n_{s3} = 0.00$$

$$A_{sec} = 750000.00$$

$$s_{h1} = 100.00$$

$$s_{h2} = 100.00$$

$$s_{h3} = 200.00$$

$$f_{ywe} = 625.00$$

$$f_{ce} = 25.00$$

$$\text{From ((5.A5), TB DY), TB DY: } \phi_c = 0.002$$

$$\phi_c = \text{confinement factor} = 1.00$$

$$y_1 = 0.00094258$$

$$s_{h1} = 0.00301626$$

$$f_{t1} = 282.7748$$

$$f_{y1} = 235.6456$$

$$s_{u1} = 0.00301626$$

```

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.16565482
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 235.6456
with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.16565482
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 235.6456
with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.16565482
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 235.6456
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.22164534
Mu = MRc (4.14) = 1.2341E+008
u = su (4.1) = 1.8630672E-005

```

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$

$l_b = 300.00$

$l_d = 1810.995$

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

l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$= 1$

$db = 16.35294$

Mean strength value of all re-bars: $f_y = 625.00$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$cb = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_1 -

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

$\mu = 1.8844503E-005$

$\mu = 1.4440E+008$

with full section properties:

$b = 3000.00$

$d = 208.00$

$d' = 42.00$

$v = 0.00176852$

$N = 27588.841$

$f_c = 25.00$

ϕ (5A.5, TBDY) = 0.002

Final value of μ : $\mu^* = \text{shear_factor} * \text{Max}(\mu, \phi) = 0.0035$

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

From (5.4b), TBDY: $\mu = 0.0035$

w_e (5.4c) = 0.00

a_{se} ((5.4d), TBDY) = $(a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$

$a_{se1} = 0.00$

$sh_1 = 100.00$

$bo_1 = 190.00$

$ho_1 = 540.00$

$bi2_1 = 655400.00$

$a_{se2} = 0.00$

$sh_2 = 100.00$

$bo_2 = 190.00$

$ho_2 = 540.00$

$bi2_2 = 655400.00$

$a_{se3} = 0$ (grid does not provide confinement)

$p_{sh,min} = \text{Min}(p_{sh,x}, p_{sh,y}) = 0.0010472$

$p_{sh,x} = p_{s1,x} + p_{s2,x} + p_{s3,x} = 0.00439823$

$p_{s1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirrups, $n_{s1} = 2.00$

$p_{s2,x}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirrups, $n_{s2} = 2.00$

$p_{s3,x}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$

$h_3 = 1800.00$

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirrups, $n_{s3} = 2.00$

$psh,y = ps1,y + ps2,y + ps3,y = 0.0010472$
 $ps1,y \text{ (column 1)} = (As1 \cdot h1 / s_1) / Ac = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 \cdot ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2,y \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 \cdot ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,y \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 \cdot ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

Asec = 750000.00

$s_1 = 100.00$

$s_2 = 100.00$

$s_3 = 200.00$

$fywe = 625.00$

$fce = 25.00$

From ((5.A5), TBDY), TBDY: $cc = 0.002$

$c =$ confinement factor = 1.00

$y1 = 0.00094258$

$sh1 = 0.00301626$

$ft1 = 282.7748$

$fy1 = 235.6456$

$su1 = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$lo/lou,min = lb/ld = 0.16565482$

$su1 = 0.4 \cdot esu1_nominal \text{ ((5.5), TBDY)} = 0.032$

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

For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered
characteristic value $fsy1 = fs1/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs1 = fs = 235.6456$

with $Es1 = Es = 200000.00$

$y2 = 0.00094258$

$sh2 = 0.00301626$

$ft2 = 282.7748$

$fy2 = 235.6456$

$su2 = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$lo/lou,min = lb/lb,min = 0.16565482$

$su2 = 0.4 \cdot esu2_nominal \text{ ((5.5), TBDY)} = 0.032$

From table 5A.1, TBDY: $esu2_nominal = 0.08$,

For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered
characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs2 = fs = 235.6456$

with $Es2 = Es = 200000.00$

$yv = 0.00094258$

$shv = 0.00301626$

$ftv = 282.7748$

$fyv = 235.6456$

$suv = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$lo/lou,min = lb/ld = 0.16565482$

$suv = 0.4 \cdot esuv_nominal \text{ ((5.5), TBDY)} = 0.032$

From table 5A.1, TBDY: $esuv_nominal = 0.08$,

considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
For calculation of $esuv_nominal$ and yv, shv, ftv, fyv , it is considered

characteristic value $f_{sv} = f_{sv}/1.2$, from table 5.1, TBDY.
 y_1, sh_1, ft_1, f_{y1} , are also multiplied by $\text{Min}(1, 1.25 \cdot (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $f_{sv} = f_s = 235.6456$
 with $E_{sv} = E_s = 200000.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.04275722$
 $2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.04275722$
 $v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.02429711$

and confined core properties:

$b = 2940.00$
 $d = 178.00$
 $d' = 12.00$
 $f_{cc} \text{ (5A.2, TBDY)} = 25.00$
 $cc \text{ (5A.5, TBDY)} = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.05098316$
 $2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.05098316$
 $v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.02897156$

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su \text{ (4.9)} = 0.23047746$
 $Mu = MR_c \text{ (4.14)} = 1.4440E+008$
 $u = su \text{ (4.1)} = 1.8844503E-005$

 Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$
 $l_b = 300.00$
 $l_d = 1810.995$
 Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 $l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 625.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

 Calculation of Mu_{2+}

 Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 $u = 1.8630672E-005$
 $Mu = 1.2341E+008$

with full section properties:

$b = 3000.00$
 $d = 208.00$
 $d' = 42.00$
 $v = 0.00176852$
 $N = 27588.841$
 $f_c = 25.00$
 $co \text{ (5A.5, TBDY)} = 0.002$
 Final value of cu : $cu^* = \text{shear_factor} \cdot \text{Max}(cu, cc) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)
 From (5.4b), TBDY: $cu = 0.0035$
 $we \text{ (5.4c)} = 0.00$
 $ase \text{ ((5.4d), TBDY)} = (ase_1 \cdot A_{col1} + ase_2 \cdot A_{col2} + ase_3 \cdot A_{web})/A_{sec} = 0.00$

```

ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
bi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
bi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472

```

```

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00

```

```

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

```

```

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 625.00
fce = 25.00
From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00094258
sh1 = 0.00301626
ft1 = 282.7748
fy1 = 235.6456
su1 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.16565482
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 235.6456
with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626

```

```

ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lo,min = lb/lb,min = 0.16565482
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 235.6456
    with Es2 = Es = 200000.00
    yv = 0.00094258
    shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lo,min = lb/lb = 0.16565482
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 235.6456
    with Esv = Es = 200000.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
    2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
    v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
    2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
    v = Asl,mid/(b*d)*(fsv/fc) = 0.00

```

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

```

---->
v < vs,y2 - LHS eq.(4.5) is satisfied
---->
su (4.9) = 0.22164534
Mu = MRc (4.14) = 1.2341E+008
u = su (4.1) = 1.8630672E-005

```

Calculation of ratio lb/lb

```

Lap Length: lb/lb = 0.16565482
lb = 300.00
lb = 1810.995
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
lb,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 625.00
t = 1.00
s = 0.80
e = 1.00

```

cb = 25.00
Ktr = 1.848
n = 34.00

Calculation of Mu2-

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

$\mu = 1.8844503E-005$
 $Mu = 1.4440E+008$

with full section properties:

b = 3000.00
d = 208.00
d' = 42.00
v = 0.00176852
N = 27588.841
fc = 25.00
co (5A.5, TBDY) = 0.002
Final value of μ : $\mu^* = \text{shear_factor} * \text{Max}(\mu, \mu_c) = 0.0035$
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: $\mu_c = 0.0035$
 μ_{we} (5.4c) = 0.00
 μ_{ase} ((5.4d), TBDY) = $(\mu_{ase1} * A_{col1} + \mu_{ase2} * A_{col2} + \mu_{ase3} * A_{web}) / A_{sec} = 0.00$
 $\mu_{ase1} = 0.00$
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
bi2_1 = 655400.00
 $\mu_{ase2} = 0.00$
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
bi2_2 = 655400.00
 $\mu_{ase3} = 0$ (grid does not provide confinement)
 $\mu_{psh,min} = \text{Min}(\mu_{psh,x}, \mu_{psh,y}) = 0.0010472$

$\mu_{psh,x} = \mu_{ps1,x} + \mu_{ps2,x} + \mu_{ps3,x} = 0.00439823$
 $\mu_{ps1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$
h1 = 600.00
 $A_{s1} = A_{stir1} * n_{s1} = 157.0796$
No stirups, $n_{s1} = 2.00$
 $\mu_{ps2,x}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$
h2 = 600.00
 $A_{s2} = A_{stir2} * n_{s2} = 157.0796$
No stirups, $n_{s2} = 2.00$
 $\mu_{ps3,x}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$
h3 = 1800.00
 $A_{s3} = A_{stir3} * n_{s3} = 0.00$
No stirups, $n_{s3} = 2.00$

$\mu_{psh,y} = \mu_{ps1,y} + \mu_{ps2,y} + \mu_{ps3,y} = 0.0010472$
 $\mu_{ps1,y}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.0005236$
h1 = 250.00
 $A_{s1} = A_{stir1} * n_{s1} = 157.0796$
No stirups, $n_{s1} = 2.00$
 $\mu_{ps2,y}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.0005236$
h2 = 250.00
 $A_{s2} = A_{stir2} * n_{s2} = 157.0796$
No stirups, $n_{s2} = 2.00$
 $\mu_{ps3,y}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00$
h3 = 250.00
 $A_{s3} = A_{stir3} * n_{s3} = 157.0796$
No stirups, $n_{s3} = 0.00$

```

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 625.00
fce = 25.00
From ((5.A.5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00094258
sh1 = 0.00301626
ft1 = 282.7748
fy1 = 235.6456
su1 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.16565482
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 235.6456
with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.16565482
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 235.6456
with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.16565482
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 235.6456
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.02429711
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002

```

$c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.05098316$
 $2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.05098316$
 $v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02897156$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

--->
 $su(4.9) = 0.23047746$
 $Mu = MRc(4.14) = 1.4440E+008$
 $u = su(4.1) = 1.8844503E-005$

Calculation of ratio l_b/d

Lap Length: $l_b/d = 0.16565482$
 $l_b = 300.00$
 $l_d = 1810.995$
 Calculation of l_b ,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 625.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Shear Strength $V_r = \text{Min}(V_{r1}, V_{r2}) = 1.1297E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 1.1297E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f_c'^{0.5}*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$
 $Mu/V_u - l_w/2 = 0.00 \leq 0$
 $= 1$ (normal-weight concrete)
 $f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 3000.00$
 $d = 200.00$
 $l_w = 250.00$
 $Mu = 2.5788780E-012$
 $V_u = 0.00$
 $N_u = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$
 $V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s3} = 0.00$ is calculated for web, with:
 $d = 200.00$

$$A_v = 0.00$$

$$s = 200.00$$

$$f_y = 500.00$$

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$$2(1-s/d) = 0.00$$

$$V_f ((11-3)-(11.4), \text{ACI 440}) = 0.00$$

$$\text{From (11-11), ACI 440: } V_s + V_f \leq 1.9929E+006$$

$$b_w = 3000.00$$

Calculation of Shear Strength at edge 2, $V_{r2} = 1.1297E+006$

$$\text{From (22.5.1.1) and 11.5.4.3, ACI 318-14: } V_{r2} = V_n < 0.83f_c'^{0.5}h*d$$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$

$$\mu_u/V_u - l_w/2 = 0.00 \leq 0$$

= 1 (normal-weight concrete)

$$f_c' = 25.00, \text{ but } f_c'^{0.5} \leq 8.3 \text{ MPa (22.5.3.1, ACI 318-14)}$$

$$h = 3000.00$$

$$d = 200.00$$

$$l_w = 250.00$$

$$\mu_u = 2.5788780E-012$$

$$V_u = 0.00$$

$$N_u = 27588.841$$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$

$V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s3} = 0.00$ is calculated for web, with:

$$d = 200.00$$

$$A_v = 0.00$$

$$s = 200.00$$

$$f_y = 500.00$$

V_{s3} has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$$2(1-s/d) = 0.00$$

$$V_f ((11-3)-(11.4), \text{ACI 440}) = 0.00$$

$$\text{From (11-11), ACI 440: } V_s + V_f \leq 1.9929E+006$$

$$b_w = 3000.00$$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1

At local axis: 3

Integration Section: (a)

Section Type: rcrws

Constant Properties

Knowledge Factor, $\gamma = 1.00$

According to 10.7.2.3, ASCE 41-17, shear walls with

transverse reinforcement percentage, $\gamma < 0.0015$

are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17

$$\gamma = 0.0010472$$

with $n = ps1 + ps2 + ps3$, being the shear reinf. ratio in a plane perpendicular to the shear axis 2

(pseudo-col.1 $ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236$

$h1 = 250.00$

$s1 = 100.00$

total area of hoops perpendicular to shear axis, $As1 = 157.0796$

(pseudo-col.2 $ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236$

$h2 = 250.00$

$s2 = 100.00$

total area of hoops perpendicular to shear axis, $As2 = 157.0796$

(grid $ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00$

$h3 = 250.00$

$s3 = 200.00$

total area of hoops perpendicular to shear axis, $As3 = 0.00$

total section area, $Ac = 750000.00$

Consequently:

New material of Secondary Member: Concrete Strength, $fc = fc_lower_bound = 25.00$

New material of Secondary Member: Steel Strength, $fs = fs_lower_bound = 500.00$

Concrete Elasticity, $Ec = 26999.444$

Steel Elasticity, $Es = 200000.00$

Total Height, $H_{tot} = 3000.00$

Edges Width, $Wedg = 250.00$

Edges Height, $Hedg = 600.00$

Web Width, $Wweb = 250.00$

Cover Thickness, $c = 25.00$

Element Length, $L = 3000.00$

Secondary 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

Lap Length $lb = 300.00$

No FRP Wrapping

Stepwise Properties

Bending Moment, $M = -1.8438483E-010$

Shear Force, $V2 = -9.9179258E-014$

Shear Force, $V3 = -44458.437$

Axial Force, $F = -27925.142$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $Asl_t = 0.00$

-Compression: $Asl_c = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $Asl_{ten} = 2830.575$

-Compression: $Asl_{com} = 2830.575$

-Middle: $Asl_{mid} = 1608.495$

Mean Diameter of Tension Reinforcement, $DbL = 16.46154$

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $u_R = 1.0^*$ $u = 0.0029294$

$u = y + p = 0.0029294$

- Calculation of y -

$y = (My*Ip)/(EI)_{Eff} = 0.0009294 ((10-5), ASCE 41-17))$

$My = 1.4295E+008$

$(EI)_{Eff} = 0.35*Ec*I$ (table 10-5)

$Ec*I = 1.0547E+014$

$Ip = 0.5*d = 0.5*(0.8*h) = 240.00$

Calculation of Yielding Moment M_y

Calculation of ρ_y and M_y according to Annex 7 -

$$y = \text{Min}(y_{\text{ten}}, y_{\text{com}})$$

$$y_{\text{ten}} = 7.0161634\text{E-}006$$

$$\text{with } ((10.1), \text{ASCE 41-17}) f_y = \text{Min}(f_y, 1.25 \cdot f_y \cdot (l_b/d)^{2/3}) = 218.754$$

$$d = 208.00$$

$$y = 0.25051483$$

$$A = 0.01185465$$

$$B = 0.00720582$$

$$\text{with } p_t = 0.00453618$$

$$p_c = 0.00453618$$

$$p_v = 0.00257772$$

$$N = 27925.142$$

$$b = 3000.00$$

$$s = 0.20192308$$

$$y_{\text{comp}} = 3.2328137\text{E-}005$$

$$\text{with } f_c = 25.00$$

$$E_c = 26999.444$$

$$y = 0.24786413$$

$$A = 0.01151582$$

$$B = 0.00700125$$

$$\text{with } E_s = 200000.00$$

Calculation of ratio l_b/d

$$\text{Lap Length: } l_d/d, \text{min} = 0.20706852$$

$$l_b = 300.00$$

$$l_d = 1448.796$$

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

l_d, min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)

$$= 1$$

$$d_b = 16.35294$$

$$\text{Mean strength value of all re-bars: } f_y = 500.00$$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

- Calculation of ρ_p -

Considering wall controlled by flexure (shear control ratio ≤ 1),
from table 10-19: $\rho_p = 0.002$

with:

- Condition i (shear wall and wall segments)

$$-(A_s - A_s') \cdot f_y + P / (t_w \cdot l_w \cdot f_c') = -0.19236787$$

$$A_s = 0.00$$

$$A_s' = 7269.645$$

$$f_y = 500.00$$

$$P = 27925.142$$

$$t_w = 3000.00$$

$$l_w = 250.00$$

$$f_c' = 25.00$$

$$-V / (t_w \cdot l_w \cdot f_c'^{0.5}) = 3.1850248\text{E-}019, \text{NOTE: units in lb \& in}$$

- Confined Boundary: No

Boundary hoops spacing does not exceed $8d_b$ ($s_1 < 8 \cdot d_b$ and $s_2 < 8 \cdot d_b$)

Boundary Trans. Reinf. does not exceed 50% of ACI 318 provision ($V_{w1} + V_{w2} > 0.50 \cdot (V - V_c - V_{w3})$)

With

Boundary Element 1:

$$V_{w1} = 157079.633$$

s1 = 100.00

Boundary Element 2:

Vw2 = 157079.633

s2 = 100.00

Grid Shear Force, Vw3 = 0.00

Concrete Shear Force, Vc = 193894.07

(The variables above have already been given in Shear control ratio calculation)

Mean diameter of all bars, db = 17.33333

Design Shear Force, V = 9.9179258E-014

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1

At local axis: 3

Integration Section: (a)

Calculation No. 5

wall W1, 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: wall W1 of floor 1

At local axis: 2

Integration Section: (b)

Section Type: rcrws

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:

New material of Secondary Member: Concrete Strength, $f_c = f_{c_lower_bound} = 25.00$
 New material of Secondary Member: Steel Strength, $f_s = f_{s_lower_bound} = 500.00$
 Concrete Elasticity, $E_c = 26999.444$
 Steel Elasticity, $E_s = 200000.00$
 Total Height, $H_{tot} = 3000.00$
 Edges Width, $W_{edg} = 250.00$
 Edges Height, $H_{edg} = 600.00$
 Web Width, $W_{web} = 250.00$
 Cover Thickness, $c = 25.00$
 Element Length, $L = 3000.00$
 Secondary 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
 Lap Length $l_o = l_b = 300.00$
 No FRP Wrapping

Stepwise Properties

EDGE -A-
 Bending Moment, $M_a = -1.8438483E-010$
 Shear Force, $V_a = -9.9179258E-014$
 EDGE -B-
 Bending Moment, $M_b = -1.1366247E-010$
 Shear Force, $V_b = 9.9179258E-014$
 BOTH EDGES
 Axial Force, $F = -27925.142$
 Longitudinal Reinforcement Area Distribution (in 2 divisions)
 -Tension: $A_{sl,t} = 0.00$
 -Compression: $A_{sl,c} = 7269.645$
 Longitudinal Reinforcement Area Distribution (in 3 divisions)
 -Tension: $A_{sl,ten} = 2830.575$
 -Compression: $A_{sl,com} = 2830.575$
 -Middle: $A_{sl,mid} = 1608.495$
 Mean Diameter of Tension Reinforcement, $Db_{L,ten} = 16.46154$

New component: From table 7-7, ASCE 41_17: Final Shear Capacity $V_R = 1.0 \cdot V_n = 538708.451$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_n < 0.83 \cdot f_c'^{0.5} \cdot h \cdot d = 538708.451$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
 where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 224549.186$
 $\mu_u / \nu_u - l_w / 2 = 1021.031 > 0$
 = 1 (normal-weight concrete)
 $f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 3000.00$
 $d = 200.00$
 $l_w = 250.00$
 $\mu_u = 1.1366247E-010$
 $\nu_u = 9.9179258E-014$
 $N_u = 27925.142$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$
 $V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)
 $V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:
 $d = 200.00$
 $A_v = 157079.633$

$$s = 100.00$$

$$f_y = 500.00$$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

$$d = 200.00$$

$$A_v = 0.00$$

$$s = 200.00$$

$$f_y = 500.00$$

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$$2(1-s/d) = 0.00$$

$$V_f ((11-3)-(11.4), \text{ACI 440}) = 0.00$$

$$\text{From (11-11), ACI 440: } V_s + V_f \leq 1.9929\text{E}+006$$

$$b_w = 3000.00$$

End Of Calculation of Shear Capacity for element: wall W1 of floor 1

At local axis: 2

Integration Section: (b)

Calculation No. 6

wall W1, Floor 1

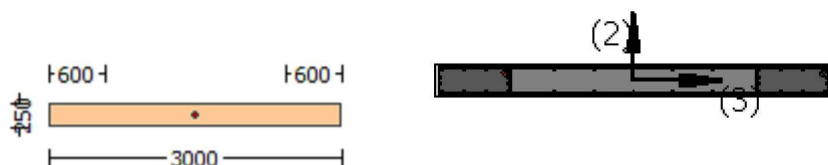
Limit State: Operational Level (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Chord rotation capacity (μ)

Edge: End

Local Axis: (2)



Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At Shear local axis: 3

(Bending local axis: 2)

Section Type: rcwbs

Constant Properties

Knowledge Factor, $\gamma = 1.00$

Mean strength values are used for both shear and moment calculations.

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 33.00$

```

New material of Secondary Member: Steel Strength,  $f_s = f_{sm} = 555.56$ 
Concrete Elasticity,  $E_c = 26999.444$ 
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
New material: Steel Strength,  $f_s = 1.25 \cdot f_{sm} = 694.45$ 
#####
Total Height,  $H_{tot} = 3000.00$ 
Edges Width,  $W_{edg} = 250.00$ 
Edges Height,  $H_{edg} = 600.00$ 
Web Width,  $W_{web} = 250.00$ 
Cover Thickness,  $c = 25.00$ 
Mean Confinement Factor overall section = 1.00
Element Length,  $L = 3000.00$ 
Secondary 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
Lap Length  $l_o = 300.00$ 
No FRP Wrapping
-----

Stepwise Properties
-----
At local axis: 3
EDGE -A-
Shear Force,  $V_a = 1.5016185E-058$ 
EDGE -B-
Shear Force,  $V_b = -1.5016185E-058$ 
BOTH EDGES
Axial Force,  $F = -27588.841$ 
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension:  $A_{slt} = 0.00$ 
-Compression:  $A_{slc} = 7269.645$ 
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension:  $A_{sl,ten} = 2865.133$ 
-Compression:  $A_{sl,com} = 2865.133$ 
-Middle:  $A_{sl,mid} = 0.00$ 
(According to 10.7.2.3  $A_{sl,mid}$  is setted equal to zero)
-----
-----

Calculation of Shear Capacity ratio ,  $V_e/V_r = 0.69050088$ 
Member Controlled by Flexure ( $V_e/V_r < 1$ )
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14  $V_e = (M_{pr1} + M_{pr2})/l_n = 1.6587E+006$ 
with
 $M_{pr1} = \text{Max}(\mu_{u1+}, \mu_{u1-}) = 2.4881E+009$ 
 $\mu_{u1+} = 2.1705E+009$ , 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
 $\mu_{u1-} = 2.4881E+009$ , 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
 $M_{pr2} = \text{Max}(\mu_{u2+}, \mu_{u2-}) = 2.4881E+009$ 
 $\mu_{u2+} = 2.1705E+009$ , 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
 $\mu_{u2-} = 2.4881E+009$ , is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
-----

Calculation of  $\mu_{u1+}$ 
-----
-----

Calculation of ultimate curvature  $\phi_u$  according to 4.1, Biskinis/Fardis 2013:
 $\phi_u = 1.2902105E-006$ 

```

Mu = 2.1705E+009

with full section properties:

b = 250.00

d = 2957.00

d' = 43.00

v = 0.00113091

N = 27588.841

fc = 33.00

co (5A.5, TBDY) = 0.002

Final value of cu: $cu^* = \text{shear_factor} * \text{Max}(cu, cc) = 0.0035$

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

From (5.4b), TBDY: $cu = 0.0035$

we (5.4c) = 0.00

ase ((5.4d), TBDY) = $(ase1 * Acol1 + ase2 * Acol2 + ase3 * Aweb) / Asec = 0.00$

ase1 = 0.00

sh_1 = 100.00

bo_1 = 190.00

ho_1 = 540.00

bi2_1 = 655400.00

ase2 = 0.00

sh_2 = 100.00

bo_2 = 190.00

ho_2 = 540.00

bi2_2 = 655400.00

ase3 = 0 (grid does not provide confinement)

psh,min = $\text{Min}(psh,x, psh,y) = 0.0010472$

psh,x = $ps1,x + ps2,x + ps3,x = 0.00439823$

ps1,x (column 1) = $(As1 * h1 / s_1) / Ac = 0.00125664$

h1 = 600.00

As1 = $Astir1 * ns1 = 157.0796$

No stirups, ns1 = 2.00

ps2,x (column 2) = $(As2 * h2 / s_2) / Ac = 0.00125664$

h2 = 600.00

As2 = $Astir2 * ns2 = 157.0796$

No stirups, ns2 = 2.00

ps3,x (web) = $(As3 * h3 / s_3) / Ac = 0.00188496$

h3 = 1800.00

As3 = $Astir3 * ns3 = 0.00$

No stirups, ns3 = 2.00

psh,y = $ps1,y + ps2,y + ps3,y = 0.0010472$

ps1,y (column 1) = $(As1 * h1 / s_1) / Ac = 0.0005236$

h1 = 250.00

As1 = $Astir1 * ns1 = 157.0796$

No stirups, ns1 = 2.00

ps2,y (column 2) = $(As2 * h2 / s_2) / Ac = 0.0005236$

h2 = 250.00

As2 = $Astir2 * ns2 = 157.0796$

No stirups, ns2 = 2.00

ps3,y (web) = $(As3 * h3 / s_3) / Ac = 0.00$

h3 = 250.00

As3 = $Astir3 * ns3 = 157.0796$

No stirups, ns3 = 0.00

Asec = 750000.00

s_1 = 100.00

s_2 = 100.00

s_3 = 200.00

fywe = 694.45

fce = 33.00

From ((5.A5), TBDY), TBDY: $cc = 0.002$

c = confinement factor = 1.00

y1 = 0.00096384

sh1 = 0.00308428

ft1 = 321.2814

```

fy1 = 267.7345
su1 = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb = 0.17128923
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 267.7345
    with Es1 = Es = 200000.00
y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.17128923
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 267.7345
    with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb = 0.17128923
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 267.7345
    with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.19157175
Mu = MRc (4.14) = 2.1705E+009
u = su (4.1) = 1.2902105E-006

```


Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$

$l_b = 300.00$

$l_d = 1751.424$

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

l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$= 1$

$db = 16.35294$

Mean strength value of all re-bars: $f_y = 694.45$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$cb = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_1 -

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

$\mu = 1.2974768E-006$

$\mu_u = 2.4881E+009$

with full section properties:

$b = 250.00$

$d = 2957.00$

$d' = 43.00$

$v = 0.00113091$

$N = 27588.841$

$f_c = 33.00$

ϕ_c (5A.5, TBDY) = 0.002

Final value of ϕ_c : $\phi_c^* = \text{shear_factor} * \text{Max}(\phi_c, \phi_c) = 0.0035$

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

From (5.4b), TBDY: $\phi_c = 0.0035$

ϕ_w (5.4c) = 0.00

ϕ_{ase} ((5.4d), TBDY) = $(\phi_{ase1} * A_{col1} + \phi_{ase2} * A_{col2} + \phi_{ase3} * A_{web}) / A_{sec} = 0.00$

$\phi_{ase1} = 0.00$

$\phi_{sh_1} = 100.00$

$\phi_{bo_1} = 190.00$

$\phi_{ho_1} = 540.00$

$\phi_{bi2_1} = 655400.00$

$\phi_{ase2} = 0.00$

$\phi_{sh_2} = 100.00$

$\phi_{bo_2} = 190.00$

$\phi_{ho_2} = 540.00$

$\phi_{bi2_2} = 655400.00$

$\phi_{ase3} = 0$ (grid does not provide confinement)

$\phi_{psh,min} = \text{Min}(\phi_{psh,x}, \phi_{psh,y}) = 0.0010472$

$\phi_{psh,x} = \phi_{ps1,x} + \phi_{ps2,x} + \phi_{ps3,x} = 0.00439823$

$\phi_{ps1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirrups, $n_{s1} = 2.00$

$\phi_{ps2,x}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirrups, $n_{s2} = 2.00$

$\phi_{ps3,x}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$

$h_3 = 1800.00$

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirups, ns3 = 2.00

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 694.45
fce = 33.00

From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00

y1 = 0.00096384
sh1 = 0.00308428
ft1 = 321.2814
fy1 = 267.7345
su1 = 0.00308428

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/d = 0.17128923
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/d)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs1 = fs = 267.7345
with Es1 = Es = 200000.00

y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb,min = 0.17128923
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/d)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs2 = fs = 267.7345
with Es2 = Es = 200000.00

yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/d = 0.17128923
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032

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

considering characteristic value $f_{sv} = f_{sv}/1.2$, from table 5.1, TBDY

For calculation of $e_{sv_nominal}$ and y_v , sh_v , ft_v , f_{yv} , it is considered characteristic value $f_{sv} = f_{sv}/1.2$, from table 5.1, TBDY.

y_1 , sh_1 , ft_1 , f_{y1} , are also multiplied by $\text{Min}(1, 1.25 \cdot (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.

with $f_{sv} = f_s = 267.7345$

with $E_{sv} = E_s = 200000.00$

$1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.03144444$

$2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.03144444$

$v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.01689449$

and confined core properties:

$b = 190.00$

$d = 2927.00$

$d' = 13.00$

f_{cc} (5A.2, TBDY) = 33.00

cc (5A.5, TBDY) = 0.002

c = confinement factor = 1.00

$1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.04179832$

$2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.04179832$

$v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.02245743$

Case/Assumption: Unconfined full section - Steel rupture

' satisfies Eq. (4.3)

--->

$v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

--->

su (4.9) = 0.19609924

$\mu_u = MR_c$ (4.14) = 2.4881E+009

$u = su$ (4.1) = 1.2974768E-006

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$

$l_b = 300.00$

$l_d = 1751.424$

Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

$l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

= 1

$db = 16.35294$

Mean strength value of all re-bars: $f_y = 694.45$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$cb = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_{u2+}

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

$u = 1.2902105E-006$

$\mu_u = 2.1705E+009$

with full section properties:

$b = 250.00$

$d = 2957.00$

$d' = 43.00$

$v = 0.00113091$

$N = 27588.841$

$f_c = 33.00$

co (5A.5, TBDY) = 0.002

Final value of cu : $cu^* = \text{shear_factor} \cdot \text{Max}(cu, cc) = 0.0035$

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

From (5.4b), TBDY: $cu = 0.0035$

```

we (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
bi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
bi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472

```

```

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00

```

```

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

```

```

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 694.45
fce = 33.00
From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00096384
sh1 = 0.00308428
ft1 = 321.2814
fy1 = 267.7345
su1 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/l_d = 0.17128923
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/l_d)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 267.7345
with Es1 = Es = 200000.00

```

```

y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.17128923
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
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 = 267.7345
with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.17128923
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
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 = 267.7345
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.19157175
Mu = MRc (4.14) = 2.1705E+009
u = su (4.1) = 1.2902105E-006

```

Calculation of ratio lb/ld

```

Lap Length: lb/ld = 0.17128923
lb = 300.00
ld = 1751.424
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 694.45
t = 1.00

```

s = 0.80
e = 1.00
cb = 25.00
Ktr = 1.848
n = 34.00

Calculation of Mu2-

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

$\phi_u = 1.2974768E-006$

$M_u = 2.4881E+009$

with full section properties:

b = 250.00

d = 2957.00

d' = 43.00

v = 0.00113091

N = 27588.841

fc = 33.00

ϕ_o (5A.5, TBDY) = 0.002

Final value of ϕ_u : $\phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_o) = 0.0035$

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

From (5.4b), TBDY: $\phi_u = 0.0035$

ϕ_{we} (5.4c) = 0.00

ϕ_{ase} ((5.4d), TBDY) = $(\phi_{ase1} * A_{col1} + \phi_{ase2} * A_{col2} + \phi_{ase3} * A_{web}) / A_{sec} = 0.00$

$\phi_{ase1} = 0.00$

sh_1 = 100.00

bo_1 = 190.00

ho_1 = 540.00

bi2_1 = 655400.00

$\phi_{ase2} = 0.00$

sh_2 = 100.00

bo_2 = 190.00

ho_2 = 540.00

bi2_2 = 655400.00

$\phi_{ase3} = 0$ (grid does not provide confinement)

$\phi_{psh,min} = \text{Min}(\phi_{psh,x}, \phi_{psh,y}) = 0.0010472$

$\phi_{psh,x} = \phi_{ps1,x} + \phi_{ps2,x} + \phi_{ps3,x} = 0.00439823$

$\phi_{ps1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

h1 = 600.00

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$\phi_{ps2,x}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$

h2 = 600.00

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$\phi_{ps3,x}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$

h3 = 1800.00

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

$\phi_{psh,y} = \phi_{ps1,y} + \phi_{ps2,y} + \phi_{ps3,y} = 0.0010472$

$\phi_{ps1,y}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.0005236$

h1 = 250.00

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$\phi_{ps2,y}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.0005236$

h2 = 250.00

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$\phi_{ps3,y}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00$

h3 = 250.00

$$As3 = Astir3 * ns3 = 157.0796$$

$$No stirups, ns3 = 0.00$$

$$Asec = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$fywe = 694.45$$

$$fce = 33.00$$

$$\text{From } ((5A5), \text{TBDY}), \text{TBDY: } cc = 0.002$$

$$c = \text{confinement factor} = 1.00$$

$$y1 = 0.00096384$$

$$sh1 = 0.00308428$$

$$ft1 = 321.2814$$

$$fy1 = 267.7345$$

$$su1 = 0.00308428$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/ld = 0.17128923$$

$$su1 = 0.4 * esu1_nominal ((5.5), \text{TBDY}) = 0.032$$

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 * (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

$$\text{with } fs1 = fs = 267.7345$$

$$\text{with } Es1 = Es = 200000.00$$

$$y2 = 0.00096384$$

$$sh2 = 0.00308428$$

$$ft2 = 321.2814$$

$$fy2 = 267.7345$$

$$su2 = 0.00308428$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/lb,min = 0.17128923$$

$$su2 = 0.4 * esu2_nominal ((5.5), \text{TBDY}) = 0.032$$

From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 * (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

$$\text{with } fs2 = fs = 267.7345$$

$$\text{with } Es2 = Es = 200000.00$$

$$yv = 0.00096384$$

$$shv = 0.00308428$$

$$ftv = 321.2814$$

$$fyv = 267.7345$$

$$suv = 0.00308428$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/ld = 0.17128923$$

$$suv = 0.4 * esuv_nominal ((5.5), \text{TBDY}) = 0.032$$

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

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

For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 * (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

$$\text{with } fsv = fs = 267.7345$$

$$\text{with } Esv = Es = 200000.00$$

$$1 = Asl,ten / (b * d) * (fs1 / fc) = 0.03144444$$

$$2 = Asl,com / (b * d) * (fs2 / fc) = 0.03144444$$

$$v = Asl,mid / (b * d) * (fsv / fc) = 0.01689449$$

and confined core properties:

$$b = 190.00$$

$$d = 2927.00$$

$$d' = 13.00$$

f_{cc} (5A.2, TBDY) = 33.00
 c_c (5A.5, TBDY) = 0.002
 c = confinement factor = 1.00
 $1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.04179832$
 $2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.04179832$
 $v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02245743$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)
 --->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 su (4.9) = 0.19609924
 $Mu = MRc$ (4.14) = 2.4881E+009
 $u = su$ (4.1) = 1.2974768E-006

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$
 $l_b = 300.00$
 $l_d = 1751.424$
 Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 $l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Shear Strength $V_r = \text{Min}(V_{r1}, V_{r2}) = 2.4022E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 2.4022E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f'_c*0.5*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$
 $Mu/V_u - l_w/2 = 0.00 < = 0$
 $= 1$ (normal-weight concrete)
 $f'_c = 33.00$, but $f'_c*0.5 < = 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $l_w = 3000.00$
 $Mu = 1.2001755E-010$
 $V_u = 1.5016185E-058$
 $Nu = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$
 $V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s2} = 418882.372$ is calculated for pseudo-Column 2, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 628323.557 is calculated for web, with:

$$d = 1440.00$$

$$A_v = 157079.633$$

$$s = 200.00$$

$$f_y = 555.56$$

Vs3 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$$V_f ((11-3)-(11.4), \text{ACI 440}) = 0.00$$

From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$

$$b_w = 250.00$$

Calculation of Shear Strength at edge 2, $V_{r2} = 2.4022E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c' \cdot h \cdot d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$

$$\mu_u / \mu_u - l_w / 2 = 0.00 \leq 0$$

= 1 (normal-weight concrete)

$$f_c' = 33.00, \text{ but } f_c'^{0.5} \leq 8.3 \text{ MPa (22.5.3.1, ACI 318-14)}$$

$$h = 250.00$$

$$d = 2400.00$$

$$l_w = 3000.00$$

$$\mu_u = 1.2001755E-010$$

$$V_u = 1.5016185E-058$$

$$N_u = 27588.841$$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$

$V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:

$$d = 480.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 555.56$$

V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s2} = 418882.372$ is calculated for pseudo-Column 2, with:

$$d = 480.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 555.56$$

V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s3} = 628323.557$ is calculated for web, with:

$$d = 1440.00$$

$$A_v = 157079.633$$

$$s = 200.00$$

$$f_y = 555.56$$

V_{s3} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$$V_f ((11-3)-(11.4), \text{ACI 440}) = 0.00$$

From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$

$$b_w = 250.00$$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At Shear local axis: 2

(Bending local axis: 3)

Section Type: rcwbs

Constant Properties

Knowledge Factor, $\phi = 1.00$

Mean strength values are used for both shear and moment calculations.

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 25.00$

New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 500.00$

Concrete Elasticity, $E_c = 26999.444$
 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
 New material: Steel Strength, $f_s = 1.25 \cdot f_{sm} = 625.00$
 #####
 Total Height, $H_{tot} = 3000.00$
 Edges Width, $W_{edg} = 250.00$
 Edges Height, $H_{edg} = 600.00$
 Web Width, $W_{web} = 250.00$
 Cover Thickness, $c = 25.00$
 Mean Confinement Factor overall section = 1.00
 Element Length, $L = 3000.00$
 Secondary 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
 Lap Length $l_o = 300.00$
 No FRP Wrapping

Stepwise Properties

At local axis: 2
 EDGE -A-
 Shear Force, $V_a = 0.00$
 EDGE -B-
 Shear Force, $V_b = 0.00$
 BOTH EDGES
 Axial Force, $F = -27588.841$
 Longitudinal Reinforcement Area Distribution (in 2 divisions)
 -Tension: $A_{sl,t} = 0.00$
 -Compression: $A_{sl,c} = 7269.645$
 Longitudinal Reinforcement Area Distribution (in 3 divisions)
 -Tension: $A_{sl,ten} = 2830.575$
 -Compression: $A_{sl,com} = 2830.575$
 -Middle: $A_{sl,mid} = 0.00$
 (According to 10.7.2.3 $A_{sl,mid}$ is setted equal to zero)

Calculation of Shear Capacity ratio, $V_e/V_r = 0.08521711$
 Member Controlled by Flexure ($V_e/V_r < 1$)
 Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 $V_e = (M_{pr1} + M_{pr2})/l_n = 96267.817$
 with
 $M_{pr1} = \max(\mu_{u1+}, \mu_{u1-}) = 1.4440E+008$
 $\mu_{u1+} = 1.2341E+008$, 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
 $\mu_{u1-} = 1.4440E+008$, 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
 $M_{pr2} = \max(\mu_{u2+}, \mu_{u2-}) = 1.4440E+008$
 $\mu_{u2+} = 1.2341E+008$, 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
 $\mu_{u2-} = 1.4440E+008$, is the ultimate moment strength at the edge 2 of the member in the opposite moment
 direction which is defined for the the static loading combination

Calculation of μ_{u1+}

Calculation of ultimate curvature ϕ_u according to 4.1, Biskinis/Fardis 2013:
 $\phi_u = 1.8630672E-005$
 $\mu_u = 1.2341E+008$

with full section properties:

$$b = 3000.00$$

$$d = 208.00$$

$$d' = 42.00$$

$$v = 0.00176852$$

$$N = 27588.841$$

$$f_c = 25.00$$

$$\phi (5A.5, \text{TB DY}) = 0.002$$

$$\text{Final value of } \phi: \phi^* = \text{shear_factor} * \text{Max}(\phi, \phi_c) = 0.0035$$

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

$$\text{From (5.4b), TB DY: } \phi = 0.0035$$

$$\phi_w (5.4c) = 0.00$$

$$\phi_{se} ((5.4d), \text{TB DY}) = (\phi_{se1} * A_{col1} + \phi_{se2} * A_{col2} + \phi_{se3} * A_{web}) / A_{sec} = 0.00$$

$$\phi_{se1} = 0.00$$

$$s_{h1} = 100.00$$

$$b_{o1} = 190.00$$

$$h_{o1} = 540.00$$

$$b_{i2,1} = 655400.00$$

$$\phi_{se2} = 0.00$$

$$s_{h2} = 100.00$$

$$b_{o2} = 190.00$$

$$h_{o2} = 540.00$$

$$b_{i2,2} = 655400.00$$

$$\phi_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$\phi_{sh,min} = \text{Min}(\phi_{sh,x}, \phi_{sh,y}) = 0.0010472$$

$$\phi_{sh,x} = \phi_{s1,x} + \phi_{s2,x} + \phi_{s3,x} = 0.00439823$$

$$\phi_{s1,x} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{s2,x} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{s3,x} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$\phi_{sh,y} = \phi_{s1,y} + \phi_{s2,y} + \phi_{s3,y} = 0.0010472$$

$$\phi_{s1,y} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{s2,y} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$$

$$h_2 = 250.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{s3,y} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00$$

$$h_3 = 250.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 157.0796$$

$$\text{No stirups, } n_{s3} = 0.00$$

$$A_{sec} = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$f_{ywe} = 625.00$$

$$f_{ce} = 25.00$$

$$\text{From ((5.A5), TB DY), TB DY: } \phi_c = 0.002$$

$$\phi_c = \text{confinement factor} = 1.00$$

$$y_1 = 0.00094258$$

$$s_{h1} = 0.00301626$$

$$f_{t1} = 282.7748$$

$$f_{y1} = 235.6456$$

```

su1 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.16565482
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 235.6456
with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.16565482
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 235.6456
with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.16565482
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 235.6456
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.22164534
Mu = MRc (4.14) = 1.2341E+008
u = su (4.1) = 1.8630672E-005

```

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$

$l_b = 300.00$

$l_d = 1810.995$

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

l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$= 1$

$db = 16.35294$

Mean strength value of all re-bars: $f_y = 625.00$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$cb = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_1 -

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

$\mu = 1.8844503E-005$

$\mu_u = 1.4440E+008$

with full section properties:

$b = 3000.00$

$d = 208.00$

$d' = 42.00$

$v = 0.00176852$

$N = 27588.841$

$f_c = 25.00$

α_0 (5A.5, TBDY) = 0.002

Final value of μ_u : $\mu_u^* = \text{shear_factor} * \text{Max}(\mu_u, \mu_c) = 0.0035$

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

From (5.4b), TBDY: $\mu_u = 0.0035$

μ_{ue} (5.4c) = 0.00

μ_{ue} ((5.4d), TBDY) = $(\mu_{ue1} * A_{col1} + \mu_{ue2} * A_{col2} + \mu_{ue3} * A_{web}) / A_{sec} = 0.00$

$\mu_{ue1} = 0.00$

$sh_1 = 100.00$

$bo_1 = 190.00$

$ho_1 = 540.00$

$bi2_1 = 655400.00$

$\mu_{ue2} = 0.00$

$sh_2 = 100.00$

$bo_2 = 190.00$

$ho_2 = 540.00$

$bi2_2 = 655400.00$

$\mu_{ue3} = 0$ (grid does not provide confinement)

$\mu_{psh,min} = \text{Min}(\mu_{psh,x}, \mu_{psh,y}) = 0.0010472$

$\mu_{psh,x} = \mu_{psh1,x} + \mu_{psh2,x} + \mu_{psh3,x} = 0.00439823$

$\mu_{psh1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$\mu_{psh2,x}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$\mu_{psh3,x}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$

$h_3 = 1800.00$

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

```

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

```

```

Asec = 750000.00

```

```

s_1 = 100.00

```

```

s_2 = 100.00

```

```

s_3 = 200.00

```

```

fywe = 625.00

```

```

fce = 25.00

```

```

From ((5.A5), TBDY), TBDY: cc = 0.002

```

```

c = confinement factor = 1.00

```

```

y1 = 0.00094258

```

```

sh1 = 0.00301626

```

```

ft1 = 282.7748

```

```

fy1 = 235.6456

```

```

su1 = 0.00301626

```

```

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

```

```

lo/lou,min = lb/ld = 0.16565482

```

```

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

```

```

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

```

```

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

```

```

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 = 235.6456

```

```

with Es1 = Es = 200000.00

```

```

y2 = 0.00094258

```

```

sh2 = 0.00301626

```

```

ft2 = 282.7748

```

```

fy2 = 235.6456

```

```

su2 = 0.00301626

```

```

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

```

```

lo/lou,min = lb/lb,min = 0.16565482

```

```

su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

```

```

From table 5A.1, TBDY: esu2_nominal = 0.08,

```

```

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

```

```

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 = 235.6456

```

```

with Es2 = Es = 200000.00

```

```

yv = 0.00094258

```

```

shv = 0.00301626

```

```

ftv = 282.7748

```

```

fyv = 235.6456

```

```

suv = 0.00301626

```

```

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

```

```

lo/lou,min = lb/ld = 0.16565482

```

```

suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032

```

```

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

```

```

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

```

For calculation of $\epsilon_{sv_nominal}$ and γ_v , Δv , Δf_v , f_{yv} , it is considered characteristic value $f_{sv} = f_{sv}/1.2$, from table 5.1, TBDY.

γ_1 , Δf_1 , f_{y1} , are also multiplied by $\text{Min}(1, 1.25 \cdot (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.

with $f_{sv} = f_s = 235.6456$

with $E_{sv} = E_s = 200000.00$

$1 = A_{s1,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.04275722$

$2 = A_{s1,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.04275722$

$v = A_{s1,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.02429711$

and confined core properties:

$b = 2940.00$

$d = 178.00$

$d' = 12.00$

$f_{cc} \text{ (5A.2, TBDY)} = 25.00$

$cc \text{ (5A.5, TBDY)} = 0.002$

$c = \text{confinement factor} = 1.00$

$1 = A_{s1,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.05098316$

$2 = A_{s1,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.05098316$

$v = A_{s1,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.02897156$

Case/Assumption: Unconfined full section - Steel rupture

' satisfies Eq. (4.3)

--->

$v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

--->

$\mu_u \text{ (4.9)} = 0.23047746$

$\mu_u = M_{Rc} \text{ (4.14)} = 1.4440E+008$

$u = \mu_u \text{ (4.1)} = 1.8844503E-005$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$

$l_b = 300.00$

$l_d = 1810.995$

Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

$l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$= 1$

$d_b = 16.35294$

Mean strength value of all re-bars: $f_y = 625.00$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$c_b = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_{u2+}

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

$u = 1.8630672E-005$

$\mu_u = 1.2341E+008$

with full section properties:

$b = 3000.00$

$d = 208.00$

$d' = 42.00$

$v = 0.00176852$

$N = 27588.841$

$f_c = 25.00$

$cc \text{ (5A.5, TBDY)} = 0.002$

Final value of μ_u : $\mu_u^* = \text{shear_factor} \cdot \text{Max}(\mu_u, cc) = 0.0035$

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

From (5.4b), TBDY: $\mu_u = 0.0035$

$\mu_u \text{ (5.4c)} = 0.00$

$$ase((5.4d), TBDY) = (ase1 \cdot Acol1 + ase2 \cdot Acol2 + ase3 \cdot Aweb) / Asec = 0.00$$

$$ase1 = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$ase2 = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$ase3 = 0 \text{ (grid does not provide confinement)}$$

$$psh, min = \min(psh, x, psh, y) = 0.0010472$$

$$psh, x = ps1, x + ps2, x + ps3, x = 0.00439823$$

$$ps1, x \text{ (column 1)} = (As1 \cdot h1 / s_1) / Ac = 0.00125664$$

$$h1 = 600.00$$

$$As1 = Astir1 \cdot ns1 = 157.0796$$

$$\text{No stirups, } ns1 = 2.00$$

$$ps2, x \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.00125664$$

$$h2 = 600.00$$

$$As2 = Astir2 \cdot ns2 = 157.0796$$

$$\text{No stirups, } ns2 = 2.00$$

$$ps3, x \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00188496$$

$$h3 = 1800.00$$

$$As3 = Astir3 \cdot ns3 = 0.00$$

$$\text{No stirups, } ns3 = 2.00$$

$$psh, y = ps1, y + ps2, y + ps3, y = 0.0010472$$

$$ps1, y \text{ (column 1)} = (As1 \cdot h1 / s_1) / Ac = 0.0005236$$

$$h1 = 250.00$$

$$As1 = Astir1 \cdot ns1 = 157.0796$$

$$\text{No stirups, } ns1 = 2.00$$

$$ps2, y \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.0005236$$

$$h2 = 250.00$$

$$As2 = Astir2 \cdot ns2 = 157.0796$$

$$\text{No stirups, } ns2 = 2.00$$

$$ps3, y \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00$$

$$h3 = 250.00$$

$$As3 = Astir3 \cdot ns3 = 157.0796$$

$$\text{No stirups, } ns3 = 0.00$$

$$Asec = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$fywe = 625.00$$

$$fce = 25.00$$

$$\text{From ((5.A5), TBDY), TBDY: } cc = 0.002$$

$$c = \text{confinement factor} = 1.00$$

$$y1 = 0.00094258$$

$$sh1 = 0.00301626$$

$$ft1 = 282.7748$$

$$fy1 = 235.6456$$

$$su1 = 0.00301626$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lo, min = lb/ld = 0.16565482$$

$$su1 = 0.4 \cdot esu1_{nominal}((5.5), TBDY) = 0.032$$

$$\text{From table 5A.1, TBDY: } esu1_{nominal} = 0.08,$$

For calculation of esu1_nominal and y1, sh1, ft1, fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

$$y1, sh1, ft1, fy1, \text{ are also multiplied by } \min(1, 1.25 \cdot (lb/ld)^{2/3}), \text{ from 10.3.5, ASCE 41-17.}$$

$$\text{with } fs1 = fs = 235.6456$$

$$\text{with } Es1 = Es = 200000.00$$

$$y2 = 0.00094258$$


```

sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lo,min = lb/lb,min = 0.16565482
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 235.6456
    with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lo,min = lb/lb = 0.16565482
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 235.6456
    with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.22164534
Mu = MRc (4.14) = 1.2341E+008
u = su (4.1) = 1.8630672E-005

```

Calculation of ratio lb/lb

```

Lap Length: lb/lb = 0.16565482
lb = 300.00
lb = 1810.995
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
lb,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 625.00
t = 1.00
s = 0.80

```

e = 1.00
cb = 25.00
Ktr = 1.848
n = 34.00

Calculation of Mu2-

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

$\phi_u = 1.8844503E-005$
 $M_u = 1.4440E+008$

with full section properties:

b = 3000.00
d = 208.00
d' = 42.00
v = 0.00176852
N = 27588.841

fc = 25.00
co (5A.5, TBDY) = 0.002

Final value of ϕ_u : $\phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$

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

From (5.4b), TBDY: $\phi_u = 0.0035$

we (5.4c) = 0.00

ase ((5.4d), TBDY) = $(\text{ase1} * A_{col1} + \text{ase2} * A_{col2} + \text{ase3} * A_{web}) / A_{sec} = 0.00$

ase1 = 0.00

sh_1 = 100.00

bo_1 = 190.00

ho_1 = 540.00

bi2_1 = 655400.00

ase2 = 0.00

sh_2 = 100.00

bo_2 = 190.00

ho_2 = 540.00

bi2_2 = 655400.00

ase3 = 0 (grid does not provide confinement)

psh,min = $\text{Min}(psh,x, psh,y) = 0.0010472$

psh,x = $ps1,x + ps2,x + ps3,x = 0.00439823$

ps1,x (column 1) = $(As1 * h1 / s_1) / A_c = 0.00125664$

h1 = 600.00

As1 = $A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

ps2,x (column 2) = $(As2 * h2 / s_2) / A_c = 0.00125664$

h2 = 600.00

As2 = $A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

ps3,x (web) = $(As3 * h3 / s_3) / A_c = 0.00188496$

h3 = 1800.00

As3 = $A_{stir3} * n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

psh,y = $ps1,y + ps2,y + ps3,y = 0.0010472$

ps1,y (column 1) = $(As1 * h1 / s_1) / A_c = 0.0005236$

h1 = 250.00

As1 = $A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

ps2,y (column 2) = $(As2 * h2 / s_2) / A_c = 0.0005236$

h2 = 250.00

As2 = $A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

ps3,y (web) = $(As3 * h3 / s_3) / A_c = 0.00$

h3 = 250.00

As3 = $A_{stir3} * n_{s3} = 157.0796$

No stirrups, ns3 = 0.00

Asec = 750000.00

s_1 = 100.00

s_2 = 100.00

s_3 = 200.00

fywe = 625.00

fce = 25.00

From ((5.A.5), TBDY), TBDY: cc = 0.002

c = confinement factor = 1.00

y1 = 0.00094258

sh1 = 0.00301626

ft1 = 282.7748

fy1 = 235.6456

su1 = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb = 0.16565482

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

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs1 = fs = 235.6456

with Es1 = Es = 200000.00

y2 = 0.00094258

sh2 = 0.00301626

ft2 = 282.7748

fy2 = 235.6456

su2 = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb,min = 0.16565482

su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs2 = fs = 235.6456

with Es2 = Es = 200000.00

yv = 0.00094258

shv = 0.00301626

ftv = 282.7748

fyv = 235.6456

suv = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb = 0.16565482

suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032

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

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

For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fsv = fs = 235.6456

with Esv = Es = 200000.00

1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722

2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722

v = Asl,mid/(b*d)*(fsv/fc) = 0.02429711

and confined core properties:

b = 2940.00

d = 178.00

d' = 12.00

fcc (5A.2, TBDY) = 25.00

$cc(5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.05098316$
 $2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.05098316$
 $v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02897156$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)
 --->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su(4.9) = 0.23047746$
 $Mu = MRc(4.14) = 1.4440E+008$
 $u = su(4.1) = 1.8844503E-005$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$
 $l_b = 300.00$
 $l_d = 1810.995$
 Calculation of l_b ,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 625.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Shear Strength $V_r = \text{Min}(V_{r1}, V_{r2}) = 1.1297E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 1.1297E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f'_c^{0.5}*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$
 $Mu/V_u - l_w/2 = 0.00 \leq 0$
 $= 1$ (normal-weight concrete)
 $f'_c = 25.00$, but $f_c^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 3000.00$
 $d = 200.00$
 $l_w = 250.00$
 $Mu = 2.5788780E-012$
 $V_u = 0.00$
 $N_u = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$
 $V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s3} = 0.00$ is calculated for web, with:

d = 200.00

Av = 0.00

s = 200.00

fy = 500.00

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$2(1-s/d) = 0.00$

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

From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$

bw = 3000.00

Calculation of Shear Strength at edge 2, $V_{r2} = 1.1297E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c' \cdot h \cdot d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$

$\mu_u / \mu_u - l_w / 2 = 0.00 \leq 0$

= 1 (normal-weight concrete)

$f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)

h = 3000.00

d = 200.00

$l_w = 250.00$

$\mu_u = 2.5788780E-012$

$V_u = 0.00$

$N_u = 27588.841$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$

$V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:

d = 200.00

Av = 157079.633

s = 100.00

fy = 500.00

V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:

d = 200.00

Av = 157079.633

s = 100.00

fy = 500.00

V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s3} = 0.00$ is calculated for web, with:

d = 200.00

Av = 0.00

s = 200.00

fy = 500.00

V_{s3} has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$2(1-s/d) = 0.00$

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

From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$

bw = 3000.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1

At local axis: 2

Integration Section: (b)

Section Type: rcwrs

Constant Properties

Knowledge Factor, = 1.00

According to 10.7.2.3, ASCE 41-17, shear walls with
transverse reinforcement percentage, $n < 0.0015$

are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17

$$n = 0.0010472$$

with $n = ps1 + ps2 + ps3$, being the shear reinf. ratio in a plane perpendicular to the shear axis 3

(pseudo-col.1 $ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236$

$$h1 = 250.00$$

$$s1 = 100.00$$

$$\text{total area of hoops perpendicular to shear axis, } As1 = 157.0796$$

(pseudo-col.2 $ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236$

$$h2 = 250.00$$

$$s2 = 100.00$$

$$\text{total area of hoops perpendicular to shear axis, } As2 = 157.0796$$

(grid $ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00$

$$h3 = 250.00$$

$$s3 = 200.00$$

$$\text{total area of hoops perpendicular to shear axis, } As3 = 0.00$$

$$\text{total section area, } Ac = 750000.00$$

Consequently:

New material of Secondary Member: Concrete Strength, $fc = fc_lower_bound = 25.00$

New material of Secondary Member: Steel Strength, $fs = fs_lower_bound = 500.00$

Concrete Elasticity, $Ec = 26999.444$

Steel Elasticity, $Es = 200000.00$

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_b = 300.00$

No FRP Wrapping

Stepwise Properties

Bending Moment, $M = 49279.25$

Shear Force, $V2 = 9.9179258E-014$

Shear Force, $V3 = 44458.437$

Axial Force, $F = -27925.142$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $As_{lt} = 0.00$

-Compression: $As_{lc} = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $As_{l,ten} = 2865.133$

-Compression: $As_{l,com} = 2865.133$

-Middle: $As_{l,mid} = 1539.38$

Mean Diameter of Tension Reinforcement, $Db_L = 17.33333$

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $u_R = 1.0^*$ $u = 0.00446269$

$$u = y + p = 0.00446269$$

- Calculation of y -

$$y = (My*Ip)/(EI)_{Eff} = 0.00046269 \text{ ((10-5), ASCE 41-17))}$$

$$My = 2.0495E+009$$

$$(EI)_{Eff} = 0.35*Ec*I \text{ (table 10-5)}$$

$$Ec*I = 1.5187E+016$$

$$Ip = 0.5*d = 0.5*(0.8*h) = 1200.00$$

Calculation of Yielding Moment M_y

Calculation of ρ_y and M_y according to Annex 7 -

```
y = Min( y_ten, y_com)
y_ten = 4.6949925E-007
with ((10.1), ASCE 41-17) fy = Min(fy, 1.25*fy*(lb/ld)^2/3) = 218.754
d = 2957.00
y = 0.2121567
A = 0.01000649
B = 0.00516109
with pt = 0.00387573
pc = 0.00387573
pv = 0.00208235
N = 27925.142
b = 250.00
" = 0.01454177
y_comp = 2.6940114E-006
with fc = 25.00
Ec = 26999.444
y = 0.2092218
A = 0.00972049
B = 0.00498841
with Es = 200000.00
```

Calculation of ratio l_b/l_d

```
Lap Length: ld/ld,min = 0.20706852
lb = 300.00
ld = 1448.796
Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 500.00
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 1.848
n = 34.00
```

- Calculation of ρ_p -

Considering wall controlled by flexure (shear control ratio ≤ 1),
from table 10-19: $\rho_p = 0.004$

with:

- Condition i (shear wall and wall segments)
- $(A_s - A_s') \cdot f_y + P) / (t_w \cdot l_w \cdot f_c') = -0.19236787$
 $A_s = 0.00$
 $A_s' = 7269.645$
 $f_y = 500.00$
 $P = 27925.142$
 $t_w = 250.00$
 $l_w = 3000.00$
 $f_c = 25.00$
- $V / (t_w \cdot l_w \cdot f_c^{0.5}) = 0.14277302$, NOTE: units in lb & in
- Confined Boundary: Yes
Table values have been multiplied by 0.8 according to subnote b
Boundary Trans. Reinf. exceeds 75% of ACI 318 provision ($V_{w1} + V_{w2} > 0.50 \cdot (V - V_c - V_{w3})$)
Boundary hoops spacing does not exceed $8d_b$ ($s_1 < 8 \cdot d_b$ and $s_2 < 8 \cdot d_b$)
With

Boundary Element 1:

$V_{w1} = 376991.118$

$s1 = 100.00$

Boundary Element 2:

$V_{w2} = 376991.118$

$s2 = 100.00$

Grid Shear Force, $V_{w3} = 0.00$

Concrete Shear Force, $V_c = 815585.028$

(The variables above have already been given in Shear control ratio calculation)

Mean diameter of all bars, $d_b = 17.33333$

Design Shear Force, $V = 44458.437$

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1

At local axis: 2

Integration Section: (b)

Calculation No. 7

wall W1, Floor 1

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

Analysis: Uniform +X

Check: Shear capacity V_{Rd}

Edge: End

Local Axis: (3)



Start Of Calculation of Shear Capacity for element: wall W1 of floor 1

At local axis: 3

Integration Section: (b)

Section Type: rcrws

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:
 New material of Secondary Member: Concrete Strength, $f_c = f_{c_lower_bound} = 25.00$
 New material of Secondary Member: Steel Strength, $f_s = f_{s_lower_bound} = 500.00$
 Concrete Elasticity, $E_c = 26999.444$
 Steel Elasticity, $E_s = 200000.00$
 Total Height, $H_{tot} = 3000.00$
 Edges Width, $W_{edg} = 250.00$
 Edges Height, $H_{edg} = 600.00$
 Web Width, $W_{web} = 250.00$
 Cover Thickness, $c = 25.00$
 Element Length, $L = 3000.00$
 Secondary 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
 Lap Length $l_o = l_b = 300.00$
 No FRP Wrapping

Stepwise Properties

EDGE -A-
 Bending Moment, $M_a = 1.3334E+008$
 Shear Force, $V_a = -44458.437$
 EDGE -B-
 Bending Moment, $M_b = 49279.25$
 Shear Force, $V_b = 44458.437$
 BOTH EDGES
 Axial Force, $F = -27925.142$
 Longitudinal Reinforcement Area Distribution (in 2 divisions)
 -Tension: $As_t = 0.00$
 -Compression: $As_c = 7269.645$
 Longitudinal Reinforcement Area Distribution (in 3 divisions)
 -Tension: $As_{t,ten} = 2865.133$
 -Compression: $As_{c,com} = 2865.133$
 -Middle: $As_{mid} = 1539.38$
 Mean Diameter of Tension Reinforcement, $Db_{L,ten} = 17.33333$

New component: From table 7-7, ASCE 41_17: Final Shear Capacity $V_R = 1.0 \cdot V_n = 2.1351E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_n < 0.83 \cdot f_c'^{0.5} \cdot h \cdot d = 2.1351E+006$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
 where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815585.028$
 $M_u/V_u - l_w/2 = -1498.892 \leq 0$
 = 1 (normal-weight concrete)
 $f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $l_w = 3000.00$
 $M_u = 49279.25$
 $V_u = 44458.437$
 $N_u = 27925.142$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.3195E+006$
 $V_{s1} = 376991.118$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)
 $V_{s2} = 376991.118$ is calculated for pseudo-Column 2, with:

d = 480.00

Av = 157079.633

s = 100.00

fy = 500.00

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 565486.678 is calculated for web, with:

d = 1440.00

Av = 157079.633

s = 200.00

fy = 500.00

Vs3 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

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

From (11-11), ACI 440: Vs + Vf <= 1.9929E+006

bw = 250.00

End Of Calculation of Shear Capacity for element: wall W1 of floor 1

At local axis: 3

Integration Section: (b)

Calculation No. 8

wall W1, 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: wall W1 of floor 1

At Shear local axis: 3

(Bending local axis: 2)

Section Type: rcwrs

Constant Properties

Knowledge Factor, = 1.00

Mean strength values are used for both shear and moment calculations.

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 33.00$

New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 555.56$

Concrete Elasticity, $E_c = 26999.444$

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

New material: Steel Strength, $f_s = 1.25 \cdot f_{sm} = 694.45$

#####

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Mean Confinement Factor overall section = 1.00

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_o = 300.00$

No FRP Wrapping

Stepwise Properties

At local axis: 3

EDGE -A-

Shear Force, $V_a = 1.5016185E-058$

EDGE -B-

Shear Force, $V_b = -1.5016185E-058$

BOTH EDGES

Axial Force, $F = -27588.841$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $As_t = 0.00$

-Compression: $As_c = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $As_{t,ten} = 2865.133$

-Compression: $As_{c,com} = 2865.133$

-Middle: $As_{mid} = 0.00$

(According to 10.7.2.3 As_{mid} is setted equal to zero)

Calculation of Shear Capacity ratio, $V_e/V_r = 0.69050088$

Member Controlled by Flexure ($V_e/V_r < 1$)

Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 $V_e = (M_{pr1} + M_{pr2})/l_n = 1.6587E+006$ with

$M_{pr1} = \text{Max}(Mu_{1+}, Mu_{1-}) = 2.4881E+009$

$Mu_{1+} = 2.1705E+009$, 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

$Mu_{1-} = 2.4881E+009$, 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

$M_{pr2} = \text{Max}(Mu_{2+}, Mu_{2-}) = 2.4881E+009$

$Mu_{2+} = 2.1705E+009$, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the static loading combination

$Mu_{2-} = 2.4881E+009$, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the static loading combination

Calculation of Mu_{1+}

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

$$u = 1.2902105E-006$$

$$\mu = 2.1705E+009$$

with full section properties:

$$b = 250.00$$

$$d = 2957.00$$

$$d' = 43.00$$

$$v = 0.00113091$$

$$N = 27588.841$$

$$f_c = 33.00$$

$$\omega (5A.5, \text{TB DY}) = 0.002$$

$$\text{Final value of } \phi_u: \phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$$

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

$$\text{From (5.4b), TB DY: } \phi_u = 0.0035$$

$$w_e (5.4c) = 0.00$$

$$a_{se} ((5.4d), \text{TB DY}) = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$$

$$a_{se1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$a_{se2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$a_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$\phi_{sh,min} = \text{Min}(\phi_{sh,x}, \phi_{sh,y}) = 0.0010472$$

$$\phi_{sh,x} = \phi_{s1,x} + \phi_{s2,x} + \phi_{s3,x} = 0.00439823$$

$$\phi_{s1,x} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{s2,x} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{s3,x} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$\phi_{sh,y} = \phi_{s1,y} + \phi_{s2,y} + \phi_{s3,y} = 0.0010472$$

$$\phi_{s1,y} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{s2,y} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$$

$$h_2 = 250.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{s3,y} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00$$

$$h_3 = 250.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 157.0796$$

$$\text{No stirups, } n_{s3} = 0.00$$

$$A_{sec} = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$f_{ywe} = 694.45$$

$$f_{ce} = 33.00$$

$$\text{From ((5.A5), TB DY), TB DY: } \phi_c = 0.002$$

$$c = \text{confinement factor} = 1.00$$

$$y_1 = 0.00096384$$

```

sh1 = 0.00308428
ft1 = 321.2814
fy1 = 267.7345
su1 = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb = 0.17128923
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 267.7345
    with Es1 = Es = 200000.00
y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.17128923
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 267.7345
    with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb = 0.17128923
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 267.7345
    with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
    1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
    2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
    v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.19157175

```

$$\begin{aligned} \mu &= M/R_c (4.14) = 2.1705E+009 \\ u &= s_u (4.1) = 1.2902105E-006 \end{aligned}$$

Calculation of ratio l_b/l_d

$$\text{Lap Length: } l_b/l_d = 0.17128923$$

$$l_b = 300.00$$

$$l_d = 1751.424$$

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

l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$$= 1$$

$$d_b = 16.35294$$

Mean strength value of all re-bars: $f_y = 694.45$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

Calculation of μ_1 -

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

$$u = 1.2974768E-006$$

$$\mu = 2.4881E+009$$

with full section properties:

$$b = 250.00$$

$$d = 2957.00$$

$$d' = 43.00$$

$$v = 0.00113091$$

$$N = 27588.841$$

$$f_c = 33.00$$

$$c_o (5A.5, \text{TB DY}) = 0.002$$

$$\text{Final value of } c_u: c_u = \text{shear_factor} * \text{Max}(c_u, c_c) = 0.0035$$

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

$$\text{From (5.4b), TB DY: } c_u = 0.0035$$

$$w_e (5.4c) = 0.00$$

$$a_{se} ((5.4d), \text{TB DY}) = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$$

$$a_{se1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$a_{se2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$a_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$psh_{min} = \text{Min}(psh_x, psh_y) = 0.0010472$$

$$psh_x = ps1_x + ps2_x + ps3_x = 0.00439823$$

$$ps1_x (\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

No stirups, $n_{s1} = 2.00$

$$ps2_x (\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

No stirups, $n_{s2} = 2.00$

$$ps3_x (\text{web}) = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

h3 = 1800.00
 As3 = Astir3*ns3 = 0.00
 No stirups, ns3 = 2.00

 psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
 ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
 h1 = 250.00
 As1 = Astir1*ns1 = 157.0796
 No stirups, ns1 = 2.00
 ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
 h2 = 250.00
 As2 = Astir2*ns2 = 157.0796
 No stirups, ns2 = 2.00
 ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
 h3 = 250.00
 As3 = Astir3*ns3 = 157.0796
 No stirups, ns3 = 0.00

 Asec = 750000.00
 s_1 = 100.00
 s_2 = 100.00
 s_3 = 200.00

fywe = 694.45
 fce = 33.00

From ((5.A5), TBDY), TBDY: cc = 0.002
 c = confinement factor = 1.00

y1 = 0.00096384
 sh1 = 0.00308428
 ft1 = 321.2814
 fy1 = 267.7345
 su1 = 0.00308428

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

lo/lou,min = lb/lb = 0.17128923

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

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
 characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs1 = fs = 267.7345

with Es1 = Es = 200000.00

y2 = 0.00096384
 sh2 = 0.00308428
 ft2 = 321.2814
 fy2 = 267.7345
 su2 = 0.00308428

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

lo/lou,min = lb/lb,min = 0.17128923

su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
 characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs2 = fs = 267.7345

with Es2 = Es = 200000.00

yv = 0.00096384
 shv = 0.00308428
 ftv = 321.2814
 fyv = 267.7345
 suv = 0.00308428

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

lo/lou,min = lb/lb = 0.17128923

$suv = 0.4 * esuv_nominal ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esuv_nominal = 0.08$,
 considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
 For calculation of $esuv_nominal$ and yv, shv, ftv, fyv , it is considered
 characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 * (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fsv = fs = 267.7345$
 with $Esv = Es = 200000.00$
 $1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444$
 $2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444$
 $v = Asl,mid/(b*d)*(fsv/fc) = 0.01689449$

and confined core properties:

$b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $fcc (5A.2, TBDY) = 33.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832$
 $2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832$
 $v = Asl,mid/(b*d)*(fsv/fc) = 0.02245743$

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < vs,y2$ - LHS eq.(4.5) is satisfied
 ---->
 $su (4.9) = 0.19609924$
 $Mu = MRc (4.14) = 2.4881E+009$
 $u = su (4.1) = 1.2974768E-006$

Calculation of ratio lb/ld

Lap Length: $lb/ld = 0.17128923$
 $lb = 300.00$
 $ld = 1751.424$
 Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $fy = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $Ktr = 1.848$
 $n = 34.00$

Calculation of $Mu2+$

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 $u = 1.2902105E-006$
 $Mu = 2.1705E+009$

with full section properties:

$b = 250.00$
 $d = 2957.00$
 $d' = 43.00$
 $v = 0.00113091$
 $N = 27588.841$
 $fc = 33.00$
 $co (5A.5, TBDY) = 0.002$
 Final value of cu : $cu^* = \text{shear_factor} * \text{Max}(cu, cc) = 0.0035$

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

From (5.4b), TBDY: $c_u = 0.0035$

w_e (5.4c) = 0.00

a_{se} ((5.4d), TBDY) = $(a_{se1} \cdot A_{col1} + a_{se2} \cdot A_{col2} + a_{se3} \cdot A_{web}) / A_{sec} = 0.00$

$a_{se1} = 0.00$

$sh_1 = 100.00$

$bo_1 = 190.00$

$ho_1 = 540.00$

$bi2_1 = 655400.00$

$a_{se2} = 0.00$

$sh_2 = 100.00$

$bo_2 = 190.00$

$ho_2 = 540.00$

$bi2_2 = 655400.00$

$a_{se3} = 0$ (grid does not provide confinement)

$p_{sh,min} = \text{Min}(p_{sh,x}, p_{sh,y}) = 0.0010472$

$p_{sh,x} = p_{s1,x} + p_{s2,x} + p_{s3,x} = 0.00439823$

$p_{s1,x}$ (column 1) = $(A_{s1} \cdot h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} \cdot n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$p_{s2,x}$ (column 2) = $(A_{s2} \cdot h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} \cdot n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$p_{s3,x}$ (web) = $(A_{s3} \cdot h_3 / s_3) / A_c = 0.00188496$

$h_3 = 1800.00$

$A_{s3} = A_{stir3} \cdot n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

$p_{sh,y} = p_{s1,y} + p_{s2,y} + p_{s3,y} = 0.0010472$

$p_{s1,y}$ (column 1) = $(A_{s1} \cdot h_1 / s_1) / A_c = 0.0005236$

$h_1 = 250.00$

$A_{s1} = A_{stir1} \cdot n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$p_{s2,y}$ (column 2) = $(A_{s2} \cdot h_2 / s_2) / A_c = 0.0005236$

$h_2 = 250.00$

$A_{s2} = A_{stir2} \cdot n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$p_{s3,y}$ (web) = $(A_{s3} \cdot h_3 / s_3) / A_c = 0.00$

$h_3 = 250.00$

$A_{s3} = A_{stir3} \cdot n_{s3} = 157.0796$

No stirups, $n_{s3} = 0.00$

$A_{sec} = 750000.00$

$s_1 = 100.00$

$s_2 = 100.00$

$s_3 = 200.00$

$f_{ywe} = 694.45$

$f_{ce} = 33.00$

From ((5.A5), TBDY), TBDY: $c_c = 0.002$

c = confinement factor = 1.00

$y_1 = 0.00096384$

$sh_1 = 0.00308428$

$ft_1 = 321.2814$

$fy_1 = 267.7345$

$su_1 = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$lo/lo_{u,min} = lb/ld = 0.17128923$

$su_1 = 0.4 \cdot esu_{1,nominal}$ ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: $esu_{1,nominal} = 0.08$,

For calculation of $esu_{1,nominal}$ and y_1 , sh_1 , ft_1 , fy_1 , it is considered
characteristic value $fsy_1 = fs_1/1.2$, from table 5.1, TBDY.

y_1 , sh_1 , ft_1 , fy_1 , are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

```

with fs1 = fs = 267.7345
with Es1 = Es = 200000.00
y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.17128923
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 267.7345
with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.17128923
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 267.7345
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.19157175
Mu = MRc (4.14) = 2.1705E+009
u = su (4.1) = 1.2902105E-006

```

Calculation of ratio lb/lb

```

Lap Length: lb/lb = 0.17128923
lb = 300.00
lb = 1751.424
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
lb,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294

```

Mean strength value of all re-bars: $f_y = 694.45$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$cb = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_2 -

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

$\mu = 1.2974768E-006$

$\mu = 2.4881E+009$

with full section properties:

$b = 250.00$

$d = 2957.00$

$d' = 43.00$

$v = 0.00113091$

$N = 27588.841$

$f_c = 33.00$

$\alpha (5A.5, TBDY) = 0.002$

Final value of μ : $\mu^* = \text{shear_factor} * \text{Max}(\mu, \mu_c) = 0.0035$

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

From (5.4b), TBDY: $\mu = 0.0035$

$\mu_e (5.4c) = 0.00$

$\alpha_e ((5.4d), TBDY) = (\alpha_e1 * A_{col1} + \alpha_e2 * A_{col2} + \alpha_e3 * A_{web}) / A_{sec} = 0.00$

$\alpha_e1 = 0.00$

$sh_1 = 100.00$

$bo_1 = 190.00$

$ho_1 = 540.00$

$bi2_1 = 655400.00$

$\alpha_e2 = 0.00$

$sh_2 = 100.00$

$bo_2 = 190.00$

$ho_2 = 540.00$

$bi2_2 = 655400.00$

$\alpha_e3 = 0$ (grid does not provide confinement)

$\mu_{sh,min} = \text{Min}(\mu_{sh,x}, \mu_{sh,y}) = 0.0010472$

$\mu_{sh,x} = \mu_{s1,x} + \mu_{s2,x} + \mu_{s3,x} = 0.00439823$

$\mu_{s1,x} (\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$\mu_{s2,x} (\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$\mu_{s3,x} (\text{web}) = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$

$h_3 = 1800.00$

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

$\mu_{sh,y} = \mu_{s1,y} + \mu_{s2,y} + \mu_{s3,y} = 0.0010472$

$\mu_{s1,y} (\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$

$h_1 = 250.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$\mu_{s2,y} (\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$

$h_2 = 250.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$$ps3,y \text{ (web)} = (As3 \cdot h3/s_3)/Ac = 0.00$$

$$h3 = 250.00$$

$$As3 = Astir3 \cdot ns3 = 157.0796$$

$$\text{No stirups, } ns3 = 0.00$$

$$Asec = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$fywe = 694.45$$

$$fce = 33.00$$

$$\text{From ((5.A5), TBDY), TBDY: } cc = 0.002$$

$$c = \text{confinement factor} = 1.00$$

$$y1 = 0.00096384$$

$$sh1 = 0.00308428$$

$$ft1 = 321.2814$$

$$fy1 = 267.7345$$

$$su1 = 0.00308428$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/d = 0.17128923$$

$$su1 = 0.4 \cdot esu1_nominal \text{ ((5.5), TBDY)} = 0.032$$

$$\text{From table 5A.1, TBDY: } esu1_nominal = 0.08,$$

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

$$y1, sh1,ft1,fy1, \text{ are also multiplied by } \text{Min}(1, 1.25 \cdot (lb/d)^{2/3}), \text{ from 10.3.5, ASCE 41-17.}$$

$$\text{with } fs1 = fs = 267.7345$$

$$\text{with } Es1 = Es = 200000.00$$

$$y2 = 0.00096384$$

$$sh2 = 0.00308428$$

$$ft2 = 321.2814$$

$$fy2 = 267.7345$$

$$su2 = 0.00308428$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/lb,min = 0.17128923$$

$$su2 = 0.4 \cdot esu2_nominal \text{ ((5.5), TBDY)} = 0.032$$

$$\text{From table 5A.1, TBDY: } esu2_nominal = 0.08,$$

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

$$y1, sh1,ft1,fy1, \text{ are also multiplied by } \text{Min}(1, 1.25 \cdot (lb/d)^{2/3}), \text{ from 10.3.5, ASCE 41-17.}$$

$$\text{with } fs2 = fs = 267.7345$$

$$\text{with } Es2 = Es = 200000.00$$

$$yv = 0.00096384$$

$$shv = 0.00308428$$

$$ftv = 321.2814$$

$$fyv = 267.7345$$

$$suv = 0.00308428$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/d = 0.17128923$$

$$suv = 0.4 \cdot esuv_nominal \text{ ((5.5), TBDY)} = 0.032$$

$$\text{From table 5A.1, TBDY: } esuv_nominal = 0.08,$$

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

For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

$$y1, sh1,ft1,fy1, \text{ are also multiplied by } \text{Min}(1, 1.25 \cdot (lb/d)^{2/3}), \text{ from 10.3.5, ASCE 41-17.}$$

$$\text{with } fsv = fs = 267.7345$$

$$\text{with } Esv = Es = 200000.00$$

$$1 = Asl,ten/(b \cdot d) \cdot (fs1/fc) = 0.03144444$$

$$2 = Asl,com/(b \cdot d) \cdot (fs2/fc) = 0.03144444$$

$$v = Asl,mid/(b \cdot d) \cdot (fsv/fc) = 0.01689449$$

and confined core properties:

$$b = 190.00$$

$d = 2927.00$
 $d' = 13.00$
 $f_{cc} (5A.2, TBDY) = 33.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.04179832$
 $2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.04179832$
 $v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02245743$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.19609924$
 $Mu = MRc (4.14) = 2.4881E+009$
 $u = su (4.1) = 1.2974768E-006$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$
 $l_b = 300.00$
 $l_d = 1751.424$
 Calculation of l_b, \min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d, \min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Shear Strength $V_r = \min(V_{r1}, V_{r2}) = 2.4022E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 2.4022E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f_c'^{0.5}*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$
 $Mu/V_u - l_w/2 = 0.00 \leq 0$
 $= 1$ (normal-weight concrete)
 $f_c' = 33.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $l_w = 3000.00$
 $Mu = 1.2001755E-010$
 $V_u = 1.5016185E-058$
 $Nu = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$
 $V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)
 $V_{s2} = 418882.372$ is calculated for pseudo-Column 2, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$

$f_y = 555.56$

V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s3} = 628323.557$ is calculated for web, with:

$d = 1440.00$

$A_v = 157079.633$

$s = 200.00$

$f_y = 555.56$

V_{s3} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$

From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$

$b_w = 250.00$

Calculation of Shear Strength at edge 2, $V_{r2} = 2.4022E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c'^{0.5} \cdot h \cdot d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$

$M_u/V_u - l_w/2 = 0.00 \leq 0$

= 1 (normal-weight concrete)

$f_c' = 33.00$, but $f_c'^{0.5} \leq 8.3 \text{ MPa}$ (22.5.3.1, ACI 318-14)

$h = 250.00$

$d = 2400.00$

$l_w = 3000.00$

$M_u = 1.2001755E-010$

$V_u = 1.5016185E-058$

$N_u = 27588.841$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$

$V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:

$d = 480.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 555.56$

V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s2} = 418882.372$ is calculated for pseudo-Column 2, with:

$d = 480.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 555.56$

V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s3} = 628323.557$ is calculated for web, with:

$d = 1440.00$

$A_v = 157079.633$

$s = 200.00$

$f_y = 555.56$

V_{s3} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$

From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$

$b_w = 250.00$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcwrs

Constant Properties

Knowledge Factor, = 1.00

Mean strength values are used for both shear and moment calculations.
Consequently:

```

New material of Secondary Member: Concrete Strength,  $f_c = f_{cm} = 25.00$ 
New material of Secondary Member: Steel Strength,  $f_s = f_{sm} = 500.00$ 
Concrete Elasticity,  $E_c = 26999.444$ 
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
New material: Steel Strength,  $f_s = 1.25 \cdot f_{sm} = 625.00$ 
#####
Total Height,  $H_{tot} = 3000.00$ 
Edges Width,  $W_{edg} = 250.00$ 
Edges Height,  $H_{edg} = 600.00$ 
Web Width,  $W_{web} = 250.00$ 
Cover Thickness,  $c = 25.00$ 
Mean Confinement Factor overall section = 1.00
Element Length,  $L = 3000.00$ 
Secondary 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
Lap Length  $l_o = 300.00$ 
No FRP Wrapping
-----

Stepwise Properties
-----
At local axis: 2
EDGE -A-
Shear Force,  $V_a = 0.00$ 
EDGE -B-
Shear Force,  $V_b = 0.00$ 
BOTH EDGES
Axial Force,  $F = -27588.841$ 
Longitudinal Reinforcement Area Distribution (in 2 divisions)
  -Tension:  $A_{slt} = 0.00$ 
  -Compression:  $A_{slc} = 7269.645$ 
Longitudinal Reinforcement Area Distribution (in 3 divisions)
  -Tension:  $A_{sl,ten} = 2830.575$ 
  -Compression:  $A_{sl,com} = 2830.575$ 
  -Middle:  $A_{sl,mid} = 0.00$ 
  (According to 10.7.2.3  $A_{sl,mid}$  is setted equal to zero)
-----
-----

Calculation of Shear Capacity ratio ,  $V_e/V_r = 0.08521711$ 
Member Controlled by Flexure ( $V_e/V_r < 1$ )
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14  $V_e = (M_{pr1} + M_{pr2})/l_n = 96267.817$ 
with
 $M_{pr1} = \text{Max}(\mu_{u1+} , \mu_{u1-}) = 1.4440\text{E}+008$ 
 $\mu_{u1+} = 1.2341\text{E}+008$ , 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
 $\mu_{u1-} = 1.4440\text{E}+008$ , 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
 $M_{pr2} = \text{Max}(\mu_{u2+} , \mu_{u2-}) = 1.4440\text{E}+008$ 
 $\mu_{u2+} = 1.2341\text{E}+008$ , 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
 $\mu_{u2-} = 1.4440\text{E}+008$ , is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
-----

Calculation of  $\mu_{u1+}$ 
-----
-----

Calculation of ultimate curvature  $\mu_u$  according to 4.1, Biskinis/Fardis 2013:

```

u = 1.8630672E-005
Mu = 1.2341E+008

with full section properties:

b = 3000.00
d = 208.00
d' = 42.00
v = 0.00176852
N = 27588.841
fc = 25.00
co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: cu = 0.0035
we (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
bi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
bi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664
h2 = 600.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496
h3 = 1800.00
As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 625.00
fce = 25.00
From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00094258
sh1 = 0.00301626


```

ft1 = 282.7748
fy1 = 235.6456
su1 = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.16565482
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 235.6456
    with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.16565482
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 235.6456
    with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.16565482
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 235.6456
    with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
    c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.22164534
Mu = MRc (4.14) = 1.2341E+008

```

$$u = su(4.1) = 1.8630672E-005$$

Calculation of ratio lb/d

Lap Length: lb/d = 0.16565482

$$lb = 300.00$$

$$ld = 1810.995$$

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

ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$$= 1$$

$$db = 16.35294$$

Mean strength value of all re-bars: fy = 625.00

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$cb = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

Calculation of Mu1-

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

$$u = 1.8844503E-005$$

$$Mu = 1.4440E+008$$

with full section properties:

$$b = 3000.00$$

$$d = 208.00$$

$$d' = 42.00$$

$$v = 0.00176852$$

$$N = 27588.841$$

$$f_c = 25.00$$

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

$$\text{Final value of } cu: cu^* = \text{shear_factor} * \text{Max}(cu, cc) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } cu = 0.0035$$

$$we(5.4c) = 0.00$$

$$ase((5.4d), TBDY) = (ase1 * A_{col1} + ase2 * A_{col2} + ase3 * A_{web}) / A_{sec} = 0.00$$

$$ase1 = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$ase2 = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$ase3 = 0 \text{ (grid does not provide confinement)}$$

$$psh, min = \text{Min}(psh, x, psh, y) = 0.0010472$$

$$psh, x = ps1, x + ps2, x + ps3, x = 0.00439823$$

$$ps1, x \text{ (column 1)} = (As1 * h1 / s_1) / A_c = 0.00125664$$

$$h1 = 600.00$$

$$As1 = Astir1 * ns1 = 157.0796$$

No stirups, ns1 = 2.00

$$ps2, x \text{ (column 2)} = (As2 * h2 / s_2) / A_c = 0.00125664$$

$$h2 = 600.00$$

$$As2 = Astir2 * ns2 = 157.0796$$

No stirups, ns2 = 2.00

$$ps3, x \text{ (web)} = (As3 * h3 / s_3) / A_c = 0.00188496$$

$$h3 = 1800.00$$

As3 = Astir3*ns3 = 0.00
No stirups, ns3 = 2.00

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
h1 = 250.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
h2 = 250.00
As2 = Astir2*ns2 = 157.0796
No stirups, ns2 = 2.00
ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00
s_1 = 100.00
s_2 = 100.00
s_3 = 200.00
fywe = 625.00
fce = 25.00

From ((5.A5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00

y1 = 0.00094258
sh1 = 0.00301626
ft1 = 282.7748
fy1 = 235.6456
su1 = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb = 0.16565482

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

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs1 = fs = 235.6456

with Es1 = Es = 200000.00

y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb,min = 0.16565482

su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs2 = fs = 235.6456

with Es2 = Es = 200000.00

yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb = 0.16565482

suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: $e_{suv_nominal} = 0.08$,
 considering characteristic value $f_{syv} = f_{sv}/1.2$, from table 5.1, TBDY
 For calculation of $e_{suv_nominal}$ 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.
 y_1, sh_1, ft_1, fy_1 , are also multiplied by $\text{Min}(1, 1.25 \cdot (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $f_{sv} = f_s = 235.6456$
 with $E_{sv} = E_s = 200000.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.04275722$
 $2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.04275722$
 $v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.02429711$

and confined core properties:

$b = 2940.00$
 $d = 178.00$
 $d' = 12.00$
 $f_{cc} \text{ (5A.2, TBDY)} = 25.00$
 $cc \text{ (5A.5, TBDY)} = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.05098316$
 $2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.05098316$
 $v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.02897156$

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

---->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

---->
 $su \text{ (4.9)} = 0.23047746$
 $Mu = MR_c \text{ (4.14)} = 1.4440E+008$
 $u = su \text{ (4.1)} = 1.8844503E-005$

 Calculation of ratio l_b/l_d

 Lap Length: $l_b/l_d = 0.16565482$

$l_b = 300.00$
 $l_d = 1810.995$

Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 $l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 625.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

 Calculation of Mu_{2+}

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

$u = 1.8630672E-005$
 $Mu = 1.2341E+008$

 with full section properties:

$b = 3000.00$
 $d = 208.00$
 $d' = 42.00$
 $v = 0.00176852$
 $N = 27588.841$
 $f_c = 25.00$
 $co \text{ (5A.5, TBDY)} = 0.002$
 Final value of cu : $cu^* = \text{shear_factor} \cdot \text{Max}(cu, cc) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)

From (5.4b), TBDY: $c_u = 0.0035$
 w_e (5.4c) = 0.00
 a_{se} ((5.4d), TBDY) = $(a_{se1} \cdot A_{col1} + a_{se2} \cdot A_{col2} + a_{se3} \cdot A_{web}) / A_{sec} = 0.00$
 $a_{se1} = 0.00$
 $sh_1 = 100.00$
 $bo_1 = 190.00$
 $ho_1 = 540.00$
 $bi2_1 = 655400.00$
 $a_{se2} = 0.00$
 $sh_2 = 100.00$
 $bo_2 = 190.00$
 $ho_2 = 540.00$
 $bi2_2 = 655400.00$
 $a_{se3} = 0$ (grid does not provide confinement)
 $psh, min = \min(psh, x, psh, y) = 0.0010472$

$psh, x = ps1, x + ps2, x + ps3, x = 0.00439823$
 $ps1, x$ (column 1) = $(As1 \cdot h1 / s_1) / A_c = 0.00125664$
 $h1 = 600.00$
 $As1 = Astir1 \cdot ns1 = 157.0796$
No stirups, $ns1 = 2.00$
 $ps2, x$ (column 2) = $(As2 \cdot h2 / s_2) / A_c = 0.00125664$
 $h2 = 600.00$
 $As2 = Astir2 \cdot ns2 = 157.0796$
No stirups, $ns2 = 2.00$
 $ps3, x$ (web) = $(As3 \cdot h3 / s_3) / A_c = 0.00188496$
 $h3 = 1800.00$
 $As3 = Astir3 \cdot ns3 = 0.00$
No stirups, $ns3 = 2.00$

$psh, y = ps1, y + ps2, y + ps3, y = 0.0010472$
 $ps1, y$ (column 1) = $(As1 \cdot h1 / s_1) / A_c = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 \cdot ns1 = 157.0796$
No stirups, $ns1 = 2.00$
 $ps2, y$ (column 2) = $(As2 \cdot h2 / s_2) / A_c = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 \cdot ns2 = 157.0796$
No stirups, $ns2 = 2.00$
 $ps3, y$ (web) = $(As3 \cdot h3 / s_3) / A_c = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 \cdot ns3 = 157.0796$
No stirups, $ns3 = 0.00$

$A_{sec} = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$

$fy_{we} = 625.00$
 $f_{ce} = 25.00$

From ((5.A5), TBDY), TBDY: $c_c = 0.002$
 c = confinement factor = 1.00

$y1 = 0.00094258$
 $sh1 = 0.00301626$
 $ft1 = 282.7748$
 $fy1 = 235.6456$
 $su1 = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$lo/lo_{u, min} = lb/ld = 0.16565482$

$su1 = 0.4 \cdot esu1_{nominal}$ ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: $esu1_{nominal} = 0.08$,

For calculation of $esu1_{nominal}$ and $y1$, $sh1$, $ft1$, $fy1$, it is considered
characteristic value $fsy1 = fs1 / 1.2$, from table 5.1, TBDY.

$y1$, $sh1$, $ft1$, $fy1$, are also multiplied by $\min(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs1 = fs = 235.6456$

```

with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.16565482
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 235.6456
with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.16565482
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 235.6456
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.22164534
Mu = MRc (4.14) = 1.2341E+008
u = su (4.1) = 1.8630672E-005

```

Calculation of ratio lb/lb

```

Lap Length: lb/lb = 0.16565482
lb = 300.00
lb = 1810.995
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
lb,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 625.00

```

$t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of μ_2 -

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

$\mu = 1.8844503E-005$
 $\mu_u = 1.4440E+008$

with full section properties:

$b = 3000.00$
 $d = 208.00$
 $d' = 42.00$
 $v = 0.00176852$
 $N = 27588.841$

$f_c = 25.00$
 $\alpha (5A.5, TBDY) = 0.002$

Final value of μ_u : $\mu_u^* = \text{shear_factor} * \text{Max}(\mu_u, \mu_c) = 0.0035$

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

From (5.4b), TBDY: $\mu_u = 0.0035$

$\mu_w (5.4c) = 0.00$

$\alpha_e ((5.4d), TBDY) = (\alpha_e1 * A_{col1} + \alpha_e2 * A_{col2} + \alpha_e3 * A_{web}) / A_{sec} = 0.00$

$\alpha_e1 = 0.00$

$sh_1 = 100.00$

$bo_1 = 190.00$

$ho_1 = 540.00$

$bi2_1 = 655400.00$

$\alpha_e2 = 0.00$

$sh_2 = 100.00$

$bo_2 = 190.00$

$ho_2 = 540.00$

$bi2_2 = 655400.00$

$\alpha_e3 = 0$ (grid does not provide confinement)

$p_{sh,min} = \text{Min}(p_{sh,x}, p_{sh,y}) = 0.0010472$

$p_{sh,x} = p_{s1,x} + p_{s2,x} + p_{s3,x} = 0.00439823$

$p_{s1,x} (\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$p_{s2,x} (\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$p_{s3,x} (\text{web}) = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$

$h_3 = 1800.00$

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

$p_{sh,y} = p_{s1,y} + p_{s2,y} + p_{s3,y} = 0.0010472$

$p_{s1,y} (\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$

$h_1 = 250.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$p_{s2,y} (\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$

$h_2 = 250.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$p_{s3,y} (\text{web}) = (A_{s3} * h_3 / s_3) / A_c = 0.00$

h3 = 250.00
As3 = Astir3*ns3 = 157.0796
No stirups, ns3 = 0.00

Asec = 750000.00

s_1 = 100.00

s_2 = 100.00

s_3 = 200.00

fywe = 625.00

fce = 25.00

From ((5.A5), TBDY), TBDY: cc = 0.002

c = confinement factor = 1.00

y1 = 0.00094258

sh1 = 0.00301626

ft1 = 282.7748

fy1 = 235.6456

su1 = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb = 0.16565482

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

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs1 = fs = 235.6456

with Es1 = Es = 200000.00

y2 = 0.00094258

sh2 = 0.00301626

ft2 = 282.7748

fy2 = 235.6456

su2 = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb,min = 0.16565482

su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs2 = fs = 235.6456

with Es2 = Es = 200000.00

yv = 0.00094258

shv = 0.00301626

ftv = 282.7748

fyv = 235.6456

suv = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

lo/lou,min = lb/lb = 0.16565482

suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032

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

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

For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fsv = fs = 235.6456

with Esv = Es = 200000.00

1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722

2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722

v = Asl,mid/(b*d)*(fsv/fc) = 0.02429711

and confined core properties:

b = 2940.00

d = 178.00

$d' = 12.00$
 $f_{cc} (5A.2, TBDY) = 25.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.05098316$
 $2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.05098316$
 $v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02897156$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)
 --->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.23047746$
 $Mu = MRc (4.14) = 1.4440E+008$
 $u = su (4.1) = 1.8844503E-005$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$
 $l_b = 300.00$
 $l_d = 1810.995$
 Calculation of l_b, \min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d, \min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 625.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Shear Strength $V_r = \min(V_{r1}, V_{r2}) = 1.1297E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 1.1297E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f'_c^{0.5}*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$
 $Mu/V_u - l_w/2 = 0.00 \leq 0$
 $= 1$ (normal-weight concrete)
 $f'_c = 25.00$, but $f'_c^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 3000.00$
 $d = 200.00$
 $l_w = 250.00$
 $Mu = 2.5788780E-012$
 $V_u = 0.00$
 $Nu = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$
 $V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)
 $V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
Vs3 = 0.00 is calculated for web, with:
 $d = 200.00$
 $A_v = 0.00$
 $s = 200.00$
 $f_y = 500.00$
Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)
 $2(1-s/d) = 0.00$
 $V_f((11-3)-(11.4), \text{ACI } 440) = 0.00$
From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$
 $bw = 3000.00$

Calculation of Shear Strength at edge 2, $V_{r2} = 1.1297E+006$
From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c' \cdot h \cdot d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$
 $\mu_u/\mu_u - l_w/2 = 0.00 \leq 0$
= 1 (normal-weight concrete)
 $f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3 \text{ MPa}$ (22.5.3.1, ACI 318-14)
 $h = 3000.00$
 $d = 200.00$
 $l_w = 250.00$
 $\mu_u = 2.5788780E-012$
 $V_u = 0.00$
 $N_u = 27588.841$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$

$V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:

$d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$

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

Vs2 = 157079.633 is calculated for pseudo-Column 2, with:

$d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

$d = 200.00$
 $A_v = 0.00$
 $s = 200.00$
 $f_y = 500.00$

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$2(1-s/d) = 0.00$

$V_f((11-3)-(11.4), \text{ACI } 440) = 0.00$

From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$

$bw = 3000.00$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (b)
Section Type: rcrws

Constant Properties

Knowledge Factor, = 1.00
According to 10.7.2.3, ASCE 41-17, shear walls with

transverse reinforcement percentage, $n < 0.0015$
are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
 $n = 0.0010472$

with $n = ps1 + ps2 + ps3$, being the shear reinf. ratio in a plane perpendicular to the shear axis 2
(pseudo-col.1 $ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236$
 $h1 = 250.00$
 $s1 = 100.00$
total area of hoops perpendicular to shear axis, $As1 = 157.0796$
(pseudo-col.2 $ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236$
 $h2 = 250.00$
 $s2 = 100.00$
total area of hoops perpendicular to shear axis, $As2 = 157.0796$
(grid $ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00$
 $h3 = 250.00$
 $s3 = 200.00$
total area of hoops perpendicular to shear axis, $As3 = 0.00$
total section area, $Ac = 750000.00$

Consequently:

New material of Secondary Member: Concrete Strength, $fc = fc_lower_bound = 25.00$

New material of Secondary Member: Steel Strength, $fs = fs_lower_bound = 500.00$

Concrete Elasticity, $Ec = 26999.444$

Steel Elasticity, $Es = 200000.00$

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_b = 300.00$

No FRP Wrapping

Stepwise Properties

Bending Moment, $M = -1.1366247E-010$

Shear Force, $V2 = 9.9179258E-014$

Shear Force, $V3 = 44458.437$

Axial Force, $F = -27925.142$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $Asl_t = 0.00$

-Compression: $Asl_c = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $Asl_{ten} = 2830.575$

-Compression: $Asl_{com} = 2830.575$

-Middle: $Asl_{mid} = 1608.495$

Mean Diameter of Tension Reinforcement, $DbL = 16.46154$

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $u_R = 1.0^*$ $u = 0.0029294$

$u = y + p = 0.0029294$

- Calculation of y -

$y = (My*Ip)/(EI)_{Eff} = 0.0009294 ((10-5), ASCE 41-17))$

$My = 1.4295E+008$

$(EI)_{Eff} = 0.35*Ec*I$ (table 10-5)

$Ec*I = 1.0547E+014$

$$l_p = 0.5 \cdot d = 0.5 \cdot (0.8 \cdot h) = 240.00$$

Calculation of Yielding Moment M_y

Calculation of y and M_y according to Annex 7 -

$$y = \text{Min}(y_{\text{ten}}, y_{\text{com}})$$

$$y_{\text{ten}} = 7.0161634\text{E-}006$$

$$\text{with } ((10.1), \text{ASCE 41-17}) f_y = \text{Min}(f_y, 1.25 \cdot f_y \cdot (l_b/l_d)^{2/3}) = 218.754$$

$$d = 208.00$$

$$y = 0.25051483$$

$$A = 0.01185465$$

$$B = 0.00720582$$

$$\text{with } p_t = 0.00453618$$

$$p_c = 0.00453618$$

$$p_v = 0.00257772$$

$$N = 27925.142$$

$$b = 3000.00$$

$$" = 0.20192308$$

$$y_{\text{comp}} = 3.2328137\text{E-}005$$

$$\text{with } f_c = 25.00$$

$$E_c = 26999.444$$

$$y = 0.24786413$$

$$A = 0.01151582$$

$$B = 0.00700125$$

$$\text{with } E_s = 200000.00$$

Calculation of ratio l_b/l_d

$$\text{Lap Length: } l_d/l_{d,\text{min}} = 0.20706852$$

$$l_b = 300.00$$

$$l_d = 1448.796$$

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

$l_{d,\text{min}}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)

$$= 1$$

$$d_b = 16.35294$$

$$\text{Mean strength value of all re-bars: } f_y = 500.00$$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

- Calculation of p -

Considering wall controlled by flexure (shear control ratio ≤ 1),

from table 10-19: $p = 0.002$

with:

- Condition i (shear wall and wall segments)

$$-(A_s - A_s') \cdot f_y + P / (t_w \cdot l_w \cdot f_c') = -0.19236787$$

$$A_s = 0.00$$

$$A_s' = 7269.645$$

$$f_y = 500.00$$

$$P = 27925.142$$

$$t_w = 3000.00$$

$$l_w = 250.00$$

$$f_c = 25.00$$

$$- V / (t_w \cdot l_w \cdot f_c'^{0.5}) = 3.1850248\text{E-}019, \text{ NOTE: units in lb \& in}$$

- Confined Boundary: No

Boundary hoops spacing does not exceed $8d_b$ ($s_1 < 8 \cdot d_b$ and $s_2 < 8 \cdot d_b$)

Boundary Trans. Reinf. does not exceed 50% of ACI 318 provision ($V_{w1} + V_{w2} > 0.50 \cdot (V - V_c - V_{w3})$)

With
Boundary Element 1:
Vw1 = 157079.633
s1 = 100.00
Boundary Element 2:
Vw2 = 157079.633
s2 = 100.00
Grid Shear Force, Vw3 = 0.00
Concrete Shear Force, Vc = 224549.186
(The variables above have already been given in Shear control ratio calculation)
Mean diameter of all bars, db = 17.33333
Design Shear Force, V = 9.9179258E-014

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (b)

Calculation No. 9

wall W1, 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: wall W1 of floor 1
At local axis: 2
Integration Section: (a)
Section Type: rcwrs

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:
 New material of Secondary Member: Concrete Strength, $f_c = f_{c_lower_bound} = 25.00$
 New material of Secondary Member: Steel Strength, $f_s = f_{s_lower_bound} = 500.00$
 Concrete Elasticity, $E_c = 26999.444$
 Steel Elasticity, $E_s = 200000.00$
 Total Height, $H_{tot} = 3000.00$
 Edges Width, $W_{edg} = 250.00$
 Edges Height, $H_{edg} = 600.00$
 Web Width, $W_{web} = 250.00$
 Cover Thickness, $c = 25.00$
 Element Length, $L = 3000.00$
 Secondary 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
 Lap Length $l_o = l_b = 300.00$
 No FRP Wrapping

Stepwise Properties

EDGE -A-
 Bending Moment, $M_a = -2.2306748E-010$
 Shear Force, $V_a = -1.1969937E-013$
 EDGE -B-
 Bending Moment, $M_b = -1.3664558E-010$
 Shear Force, $V_b = 1.1969937E-013$
 BOTH EDGES
 Axial Force, $F = -27994.722$
 Longitudinal Reinforcement Area Distribution (in 2 divisions)
 -Tension: $A_{sl,t} = 0.00$
 -Compression: $A_{sl,c} = 7269.645$
 Longitudinal Reinforcement Area Distribution (in 3 divisions)
 -Tension: $A_{sl,ten} = 2830.575$
 -Compression: $A_{sl,com} = 2830.575$
 -Middle: $A_{sl,mid} = 1608.495$
 Mean Diameter of Tension Reinforcement, $Db_{L,ten} = 16.46154$

New component: From table 7-7, ASCE 41_17: Final Shear Capacity $V_R = 1.0 \cdot V_n = 507942.395$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_n < 0.83 \cdot f_c'^{0.5} \cdot h \cdot d = 507942.395$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
 where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 193783.13$
 $\mu_u / \mu - l_w / 2 = 1738.564 > 0$
 $= 1$ (normal-weight concrete)
 $f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 3000.00$
 $d = 200.00$
 $l_w = 250.00$
 $\mu_u = 2.2306748E-010$
 $V_u = 1.1969937E-013$
 $N_u = 27994.722$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$
 $V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)

Vs2 = 157079.633 is calculated for pseudo-Column 2, with:

d = 200.00

Av = 157079.633

s = 100.00

fy = 500.00

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

d = 200.00

Av = 0.00

s = 200.00

fy = 500.00

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$2(1-s/d) = 0.00$

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

From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$

bw = 3000.00

End Of Calculation of Shear Capacity for element: wall W1 of floor 1

At local axis: 2

Integration Section: (a)

Calculation No. 10

wall W1, 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: wall W1 of floor 1

At Shear local axis: 3

(Bending local axis: 2)

Section Type: rcrws

Constant Properties

Knowledge Factor, = 1.00

```

Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength,  $f_c = f_{cm} = 33.00$ 
New material of Secondary Member: Steel Strength,  $f_s = f_{sm} = 555.56$ 
Concrete Elasticity,  $E_c = 26999.444$ 
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
New material: Steel Strength,  $f_s = 1.25 \cdot f_{sm} = 694.45$ 
#####
Total Height,  $H_{tot} = 3000.00$ 
Edges Width,  $W_{edg} = 250.00$ 
Edges Height,  $H_{edg} = 600.00$ 
Web Width,  $W_{web} = 250.00$ 
Cover Thickness,  $c = 25.00$ 
Mean Confinement Factor overall section = 1.00
Element Length,  $L = 3000.00$ 
Secondary 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
Lap Length  $l_o = 300.00$ 
No FRP Wrapping
-----

Stepwise Properties
-----
At local axis: 3
EDGE -A-
Shear Force,  $V_a = 1.5016185E-058$ 
EDGE -B-
Shear Force,  $V_b = -1.5016185E-058$ 
BOTH EDGES
Axial Force,  $F = -27588.841$ 
Longitudinal Reinforcement Area Distribution (in 2 divisions)
  -Tension:  $A_{sl,t} = 0.00$ 
  -Compression:  $A_{sl,c} = 7269.645$ 
Longitudinal Reinforcement Area Distribution (in 3 divisions)
  -Tension:  $A_{sl,ten} = 2865.133$ 
  -Compression:  $A_{sl,com} = 2865.133$ 
  -Middle:  $A_{sl,mid} = 0.00$ 
  (According to 10.7.2.3  $A_{sl,mid}$  is setted equal to zero)
-----
-----

Calculation of Shear Capacity ratio ,  $V_e/V_r = 0.69050088$ 
Member Controlled by Flexure ( $V_e/V_r < 1$ )
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14  $V_e = (M_{pr1} + M_{pr2})/l_n = 1.6587E+006$ 
with
 $M_{pr1} = \text{Max}(Mu_{1+} , Mu_{1-}) = 2.4881E+009$ 
   $Mu_{1+} = 2.1705E+009$ , 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
   $Mu_{1-} = 2.4881E+009$ , 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
 $M_{pr2} = \text{Max}(Mu_{2+} , Mu_{2-}) = 2.4881E+009$ 
   $Mu_{2+} = 2.1705E+009$ , 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
   $Mu_{2-} = 2.4881E+009$ , is the ultimate moment strength at the edge 2 of the member in the opposite moment
  direction which is defined for the the static loading combination
-----

Calculation of  $Mu_{1+}$ 
-----

```


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

$$u = 1.2902105E-006$$

$$Mu = 2.1705E+009$$

with full section properties:

$$b = 250.00$$

$$d = 2957.00$$

$$d' = 43.00$$

$$v = 0.00113091$$

$$N = 27588.841$$

$$f_c = 33.00$$

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

$$\text{Final value of } \phi_{cu}: \phi_{cu}^* = \text{shear_factor} * \text{Max}(\phi_{cu}, \phi_{cc}) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } \phi_{cu} = 0.0035$$

$$\phi_{we} (5.4c) = 0.00$$

$$\phi_{ase} ((5.4d), TBDY) = (\phi_{ase1} * A_{col1} + \phi_{ase2} * A_{col2} + \phi_{ase3} * A_{web}) / A_{sec} = 0.00$$

$$\phi_{ase1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$\phi_{ase2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$\phi_{ase3} = 0 \text{ (grid does not provide confinement)}$$

$$\phi_{psh,min} = \text{Min}(\phi_{psh,x}, \phi_{psh,y}) = 0.0010472$$

$$\phi_{psh,x} = \phi_{ps1,x} + \phi_{ps2,x} + \phi_{ps3,x} = 0.00439823$$

$$\phi_{ps1,x} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{ps2,x} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{ps3,x} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$\phi_{psh,y} = \phi_{ps1,y} + \phi_{ps2,y} + \phi_{ps3,y} = 0.0010472$$

$$\phi_{ps1,y} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{ps2,y} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$$

$$h_2 = 250.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{ps3,y} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00$$

$$h_3 = 250.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 157.0796$$

$$\text{No stirups, } n_{s3} = 0.00$$

$$A_{sec} = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$f_{ywe} = 694.45$$

$$f_{ce} = 33.00$$

$$\text{From ((5.A5), TBDY), TBDY: } \phi_{cc} = 0.002$$

$$\phi_c = \text{confinement factor} = 1.00$$

```

y1 = 0.00096384
sh1 = 0.00308428
ft1 = 321.2814
fy1 = 267.7345
su1 = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/d = 0.17128923
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/d)^ 2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 267.7345
    with Es1 = Es = 200000.00
y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.17128923
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/d)^ 2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 267.7345
    with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/d = 0.17128923
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/d)^ 2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 267.7345
    with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
---->
v < vs,y2 - LHS eq.(4.5) is satisfied
---->

```

$s_u(4.9) = 0.19157175$
 $\mu_u = M_{Rc}(4.14) = 2.1705E+009$
 $u = s_u(4.1) = 1.2902105E-006$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$

$l_b = 300.00$

$l_d = 1751.424$

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

l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$= 1$

$db = 16.35294$

Mean strength value of all re-bars: $f_y = 694.45$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$cb = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_{u1} -

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

$u = 1.2974768E-006$

$\mu_u = 2.4881E+009$

with full section properties:

$b = 250.00$

$d = 2957.00$

$d' = 43.00$

$v = 0.00113091$

$N = 27588.841$

$f_c = 33.00$

ϕ_c (5A.5, TBDY) = 0.002

Final value of ϕ_{cu} : $\phi_{cu} = \text{shear_factor} * \text{Max}(\phi_{cu}, \phi_c) = 0.0035$

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

From (5.4b), TBDY: $\phi_{cu} = 0.0035$

ϕ_{we} (5.4c) = 0.00

$\phi_{ase} ((5.4d), \text{TBDY}) = (\phi_{ase1} * A_{col1} + \phi_{ase2} * A_{col2} + \phi_{ase3} * A_{web}) / A_{sec} = 0.00$

$\phi_{ase1} = 0.00$

$\phi_{sh_1} = 100.00$

$\phi_{bo_1} = 190.00$

$\phi_{ho_1} = 540.00$

$\phi_{bi2_1} = 655400.00$

$\phi_{ase2} = 0.00$

$\phi_{sh_2} = 100.00$

$\phi_{bo_2} = 190.00$

$\phi_{ho_2} = 540.00$

$\phi_{bi2_2} = 655400.00$

$\phi_{ase3} = 0$ (grid does not provide confinement)

$\phi_{psh,min} = \text{Min}(\phi_{psh,x}, \phi_{psh,y}) = 0.0010472$

$\phi_{psh,x} = \phi_{ps1,x} + \phi_{ps2,x} + \phi_{ps3,x} = 0.00439823$

$\phi_{ps1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$\phi_{ps2,x}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$ps3,x \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00188496$
 $h3 = 1800.00$
 $As3 = Astir3 \cdot ns3 = 0.00$
 No stirups, $ns3 = 2.00$

$psh,y = ps1,y + ps2,y + ps3,y = 0.0010472$
 $ps1,y \text{ (column 1)} = (As1 \cdot h1 / s_1) / Ac = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 \cdot ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2,y \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 \cdot ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,y \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 \cdot ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

$Asec = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$

$fywe = 694.45$
 $fce = 33.00$

From ((5.A5), TBDY), TBDY: $cc = 0.002$
 $c = \text{confinement factor} = 1.00$

$y1 = 0.00096384$
 $sh1 = 0.00308428$
 $ft1 = 321.2814$
 $fy1 = 267.7345$
 $su1 = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $\text{Shear_factor} = 1.00$

$lo/lou,min = lb/ld = 0.17128923$
 $su1 = 0.4 \cdot esu1_nominal \text{ ((5.5), TBDY)} = 0.032$

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

For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered
 characteristic value $fsy1 = fs1 / 1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs1 = fs = 267.7345$
 with $Es1 = Es = 200000.00$

$y2 = 0.00096384$
 $sh2 = 0.00308428$
 $ft2 = 321.2814$
 $fy2 = 267.7345$
 $su2 = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $\text{Shear_factor} = 1.00$

$lo/lou,min = lb/lb,min = 0.17128923$
 $su2 = 0.4 \cdot esu2_nominal \text{ ((5.5), TBDY)} = 0.032$

From table 5A.1, TBDY: $esu2_nominal = 0.08$,

For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered
 characteristic value $fsy2 = fs2 / 1.2$, from table 5.1, TBDY.

$y2, sh2, ft2, fy2$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs2 = fs = 267.7345$
 with $Es2 = Es = 200000.00$

$yv = 0.00096384$
 $shv = 0.00308428$
 $ftv = 321.2814$
 $fyv = 267.7345$
 $suv = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $\text{Shear_factor} = 1.00$

$l_o/l_{ou,min} = l_b/l_d = 0.17128923$
 $s_{uv} = 0.4 * e_{suv_nominal} ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $e_{suv_nominal} = 0.08$,
 considering characteristic value $f_{sv} = f_{sv}/1.2$, from table 5.1, TBDY
 For calculation of $e_{suv_nominal}$ and y_v , sh_v , ft_v , f_{y_v} , it is considered
 characteristic value $f_{sv} = f_{sv}/1.2$, from table 5.1, TBDY.
 y_1 , sh_1 , ft_1 , f_{y_1} , are also multiplied by $\text{Min}(1, 1.25 * (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $f_{sv} = f_s = 267.7345$
 with $E_{sv} = E_s = 200000.00$
 $1 = A_{sl,ten}/(b*d) * (f_{s1}/f_c) = 0.03144444$
 $2 = A_{sl,com}/(b*d) * (f_{s2}/f_c) = 0.03144444$
 $v = A_{sl,mid}/(b*d) * (f_{sv}/f_c) = 0.01689449$

and confined core properties:

$b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $f_{cc} (5A.2, TBDY) = 33.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b*d) * (f_{s1}/f_c) = 0.04179832$
 $2 = A_{sl,com}/(b*d) * (f_{s2}/f_c) = 0.04179832$
 $v = A_{sl,mid}/(b*d) * (f_{sv}/f_c) = 0.02245743$

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.19609924$
 $Mu = MR_c (4.14) = 2.4881E+009$
 $u = su (4.1) = 1.2974768E-006$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$
 $l_b = 300.00$
 $l_d = 1751.424$
 Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 $l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Mu_{2+}

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 $u = 1.2902105E-006$
 $Mu = 2.1705E+009$

with full section properties:

$b = 250.00$
 $d = 2957.00$
 $d' = 43.00$
 $v = 0.00113091$
 $N = 27588.841$
 $f_c = 33.00$
 $co (5A.5, TBDY) = 0.002$

Final value of cu : $\text{cu}^* = \text{shear_factor} * \text{Max}(\text{cu}, \text{cc}) = 0.0035$

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

From (5.4b), TBDY: $\text{cu} = 0.0035$

we (5.4c) = 0.00

ase ((5.4d), TBDY) = $(\text{ase1} * \text{Acol1} + \text{ase2} * \text{Acol2} + \text{ase3} * \text{Aweb}) / \text{Asec} = 0.00$

ase1 = 0.00

sh_1 = 100.00

bo_1 = 190.00

ho_1 = 540.00

bi2_1 = 655400.00

ase2 = 0.00

sh_2 = 100.00

bo_2 = 190.00

ho_2 = 540.00

bi2_2 = 655400.00

ase3 = 0 (grid does not provide confinement)

psh,min = $\text{Min}(\text{psh},x, \text{psh},y) = 0.0010472$

psh,x = $\text{ps1},x + \text{ps2},x + \text{ps3},x = 0.00439823$

ps1,x (column 1) = $(\text{As1} * h1 / s_1) / \text{Ac} = 0.00125664$

h1 = 600.00

As1 = $\text{Astir1} * \text{ns1} = 157.0796$

No stirups, ns1 = 2.00

ps2,x (column 2) = $(\text{As2} * h2 / s_2) / \text{Ac} = 0.00125664$

h2 = 600.00

As2 = $\text{Astir2} * \text{ns2} = 157.0796$

No stirups, ns2 = 2.00

ps3,x (web) = $(\text{As3} * h3 / s_3) / \text{Ac} = 0.00188496$

h3 = 1800.00

As3 = $\text{Astir3} * \text{ns3} = 0.00$

No stirups, ns3 = 2.00

psh,y = $\text{ps1},y + \text{ps2},y + \text{ps3},y = 0.0010472$

ps1,y (column 1) = $(\text{As1} * h1 / s_1) / \text{Ac} = 0.0005236$

h1 = 250.00

As1 = $\text{Astir1} * \text{ns1} = 157.0796$

No stirups, ns1 = 2.00

ps2,y (column 2) = $(\text{As2} * h2 / s_2) / \text{Ac} = 0.0005236$

h2 = 250.00

As2 = $\text{Astir2} * \text{ns2} = 157.0796$

No stirups, ns2 = 2.00

ps3,y (web) = $(\text{As3} * h3 / s_3) / \text{Ac} = 0.00$

h3 = 250.00

As3 = $\text{Astir3} * \text{ns3} = 157.0796$

No stirups, ns3 = 0.00

Asec = 750000.00

s_1 = 100.00

s_2 = 100.00

s_3 = 200.00

fywe = 694.45

fce = 33.00

From ((5.A5), TBDY), TBDY: $\text{cc} = 0.002$

c = confinement factor = 1.00

y1 = 0.00096384

sh1 = 0.00308428

ft1 = 321.2814

fy1 = 267.7345

su1 = 0.00308428

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

and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00

lo/lou,min = $\text{lb} / \text{ld} = 0.17128923$

su1 = $0.4 * \text{esu1_nominal} ((5.5), \text{TBDY}) = 0.032$

From table 5A.1, TBDY: $\text{esu1_nominal} = 0.08$,

For calculation of esu1_nominal and y1, sh1, ft1, fy1, it is considered characteristic value $\text{fsy1} = \text{fs1} / 1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs1 = fs = 267.7345$
 with $Es1 = Es = 200000.00$
 $y2 = 0.00096384$
 $sh2 = 0.00308428$
 $ft2 = 321.2814$
 $fy2 = 267.7345$
 $su2 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $lo/lo_{min} = lb/lb_{min} = 0.17128923$
 $su2 = 0.4 \cdot esu2_{nominal} ((5.5), \text{TBDY}) = 0.032$
 From table 5A.1, TBDY: $esu2_{nominal} = 0.08$,
 For calculation of $esu2_{nominal}$ and $y2, sh2, ft2, fy2$, it is considered
 characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs2 = fs = 267.7345$
 with $Es2 = Es = 200000.00$
 $yv = 0.00096384$
 $shv = 0.00308428$
 $ftv = 321.2814$
 $fyv = 267.7345$
 $suv = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $lo/lo_{min} = lb/ld = 0.17128923$
 $suv = 0.4 \cdot esuv_{nominal} ((5.5), \text{TBDY}) = 0.032$
 From table 5A.1, TBDY: $esuv_{nominal} = 0.08$,
 considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
 For calculation of $esuv_{nominal}$ and yv, shv, ftv, fyv , it is considered
 characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fsv = fs = 267.7345$
 with $Esv = Es = 200000.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (fs1/fc) = 0.03144444$
 $2 = A_{sl,com}/(b \cdot d) \cdot (fs2/fc) = 0.03144444$
 $v = A_{sl,mid}/(b \cdot d) \cdot (fsv/fc) = 0.00$

and confined core properties:

$b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $f_{cc} (5A.2, \text{TBDY}) = 33.00$
 $cc (5A.5, \text{TBDY}) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (fs1/fc) = 0.04179832$
 $2 = A_{sl,com}/(b \cdot d) \cdot (fs2/fc) = 0.04179832$
 $v = A_{sl,mid}/(b \cdot d) \cdot (fsv/fc) = 0.00$

Case/Assumption: Unconfined full section - Steel rupture

' satisfies Eq. (4.3)

$v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

$su (4.9) = 0.19157175$

$\mu_u = M_{Rc} (4.14) = 2.1705E+009$

$u = su (4.1) = 1.2902105E-006$

Calculation of ratio lb/ld

Lap Length: $lb/ld = 0.17128923$

$lb = 300.00$

$ld = 1751.424$

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

ld_{min} from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

= 1

$db = 16.35294$
Mean strength value of all re-bars: $f_y = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of μ_2 -

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

$\mu = 1.2974768E-006$
 $\mu = 2.4881E+009$

with full section properties:

$b = 250.00$
 $d = 2957.00$
 $d' = 43.00$
 $v = 0.00113091$
 $N = 27588.841$
 $f_c = 33.00$
 $\alpha (5A.5, TBDY) = 0.002$
Final value of μ : $\mu^* = \text{shear_factor} * \text{Max}(\mu, \alpha) = 0.0035$
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: $\mu = 0.0035$
 $\alpha (5.4c) = 0.00$
 $\alpha ((5.4d), TBDY) = (\alpha_1 * A_{c1} + \alpha_2 * A_{c2} + \alpha_3 * A_{web}) / A_{sec} = 0.00$
 $\alpha_1 = 0.00$
 $sh_1 = 100.00$
 $bo_1 = 190.00$
 $ho_1 = 540.00$
 $bi2_1 = 655400.00$
 $\alpha_2 = 0.00$
 $sh_2 = 100.00$
 $bo_2 = 190.00$
 $ho_2 = 540.00$
 $bi2_2 = 655400.00$
 $\alpha_3 = 0$ (grid does not provide confinement)
 $psh, min = \text{Min}(psh, x, psh, y) = 0.0010472$

$psh, x = ps1, x + ps2, x + ps3, x = 0.00439823$
 $ps1, x$ (column 1) = $(A_s1 * h1 / s_1) / A_c = 0.00125664$
 $h1 = 600.00$
 $A_s1 = A_{stir1} * ns1 = 157.0796$
No stirups, $ns1 = 2.00$
 $ps2, x$ (column 2) = $(A_s2 * h2 / s_2) / A_c = 0.00125664$
 $h2 = 600.00$
 $A_s2 = A_{stir2} * ns2 = 157.0796$
No stirups, $ns2 = 2.00$
 $ps3, x$ (web) = $(A_s3 * h3 / s_3) / A_c = 0.00188496$
 $h3 = 1800.00$
 $A_s3 = A_{stir3} * ns3 = 0.00$
No stirups, $ns3 = 2.00$

$psh, y = ps1, y + ps2, y + ps3, y = 0.0010472$
 $ps1, y$ (column 1) = $(A_s1 * h1 / s_1) / A_c = 0.0005236$
 $h1 = 250.00$
 $A_s1 = A_{stir1} * ns1 = 157.0796$
No stirups, $ns1 = 2.00$
 $ps2, y$ (column 2) = $(A_s2 * h2 / s_2) / A_c = 0.0005236$
 $h2 = 250.00$
 $A_s2 = A_{stir2} * ns2 = 157.0796$

No stirups, ns2 = 2.00
 $ps3,y \text{ (web)} = (As3 \cdot h3 / s_3) / A_c = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 \cdot ns3 = 157.0796$
 No stirups, ns3 = 0.00

Asec = 750000.00
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$

$fy_{we} = 694.45$
 $f_{ce} = 33.00$

From ((5.A5), TBDY), TBDY: $cc = 0.002$
 $c = \text{confinement factor} = 1.00$

$y1 = 0.00096384$
 $sh1 = 0.00308428$

$ft1 = 321.2814$

$fy1 = 267.7345$

$su1 = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

$lo/lou, \min = lb/ld = 0.17128923$

$su1 = 0.4 \cdot esu1_{\text{nominal}} ((5.5), \text{TBDY}) = 0.032$

From table 5A.1, TBDY: $esu1_{\text{nominal}} = 0.08$,

For calculation of $esu1_{\text{nominal}}$ and $y1, sh1, ft1, fy1$, it is considered
 characteristic value $fsy1 = fs1/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs1 = fs = 267.7345$

with $Es1 = Es = 200000.00$

$y2 = 0.00096384$

$sh2 = 0.00308428$

$ft2 = 321.2814$

$fy2 = 267.7345$

$su2 = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

$lo/lou, \min = lb/lb, \min = 0.17128923$

$su2 = 0.4 \cdot esu2_{\text{nominal}} ((5.5), \text{TBDY}) = 0.032$

From table 5A.1, TBDY: $esu2_{\text{nominal}} = 0.08$,

For calculation of $esu2_{\text{nominal}}$ and $y2, sh2, ft2, fy2$, it is considered
 characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs2 = fs = 267.7345$

with $Es2 = Es = 200000.00$

$yv = 0.00096384$

$shv = 0.00308428$

$ftv = 321.2814$

$fyv = 267.7345$

$suv = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

$lo/lou, \min = lb/ld = 0.17128923$

$suv = 0.4 \cdot esuv_{\text{nominal}} ((5.5), \text{TBDY}) = 0.032$

From table 5A.1, TBDY: $esuv_{\text{nominal}} = 0.08$,

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

For calculation of $esuv_{\text{nominal}}$ and yv, shv, ftv, fyv , it is considered
 characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fsv = fs = 267.7345$

with $Esv = Es = 200000.00$

$1 = Asl, \text{ten} / (b \cdot d) \cdot (fs1 / f_c) = 0.03144444$

$2 = Asl, \text{com} / (b \cdot d) \cdot (fs2 / f_c) = 0.03144444$

$v = Asl, \text{mid} / (b \cdot d) \cdot (fsv / f_c) = 0.01689449$

and confined core properties:

$b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $f_{cc} (5A.2, TBDY) = 33.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.04179832$
 $2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.04179832$
 $v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02245743$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.19609924$
 $Mu = MRc (4.14) = 2.4881E+009$
 $u = su (4.1) = 1.2974768E-006$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$
 $l_b = 300.00$
 $l_d = 1751.424$
 Calculation of l_b, \min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d, \min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Shear Strength $V_r = \min(V_{r1}, V_{r2}) = 2.4022E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 2.4022E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f_c'^{0.5}*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$
 $Mu/V_u - l_w/2 = 0.00 <= 0$
 $= 1$ (normal-weight concrete)
 $f_c' = 33.00$, but $f_c'^{0.5} <= 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $l_w = 3000.00$
 $Mu = 1.2001755E-010$
 $V_u = 1.5016185E-058$
 $Nu = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$
 $V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)
 $V_{s2} = 418882.372$ is calculated for pseudo-Column 2, with:
 $d = 480.00$
 $A_v = 157079.633$

$s = 100.00$
 $f_y = 555.56$
 V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s3} = 628323.557$ is calculated for web, with:
 $d = 1440.00$
 $A_v = 157079.633$
 $s = 200.00$
 $f_y = 555.56$
 V_{s3} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$
 From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$
 $b_w = 250.00$

Calculation of Shear Strength at edge 2, $V_{r2} = 2.4022E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c'^{0.5} \cdot h \cdot d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
 where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$
 $\mu_u / V_u - l_w / 2 = 0.00 \leq 0$
 $= 1$ (normal-weight concrete)
 $f_c' = 33.00$, but $f_c'^{0.5} \leq 8.3 \text{ MPa}$ (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $l_w = 3000.00$
 $\mu_u = 1.2001755E-010$
 $V_u = 1.5016185E-058$
 $N_u = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$
 $V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s2} = 418882.372$ is calculated for pseudo-Column 2, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s3} = 628323.557$ is calculated for web, with:
 $d = 1440.00$
 $A_v = 157079.633$
 $s = 200.00$
 $f_y = 555.56$
 V_{s3} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$
 From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$
 $b_w = 250.00$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
 At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
 At Shear local axis: 2
 (Bending local axis: 3)
 Section Type: rcrws

Constant Properties

Knowledge Factor, $= 1.00$
 Mean strength values are used for both shear and moment calculations.

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 25.00$

New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 500.00$

Concrete Elasticity, $E_c = 26999.444$

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

New material: Steel Strength, $f_s = 1.25 \cdot f_{sm} = 625.00$

#####

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Mean Confinement Factor overall section = 1.00

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_o = 300.00$

No FRP Wrapping

Stepwise Properties

At local axis: 2

EDGE -A-

Shear Force, $V_a = 0.00$

EDGE -B-

Shear Force, $V_b = 0.00$

BOTH EDGES

Axial Force, $F = -27588.841$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $A_{sl,t} = 0.00$

-Compression: $A_{sl,c} = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $A_{sl,ten} = 2830.575$

-Compression: $A_{sl,com} = 2830.575$

-Middle: $A_{sl,mid} = 0.00$

(According to 10.7.2.3 $A_{sl,mid}$ is setted equal to zero)

Calculation of Shear Capacity ratio, $V_e/V_r = 0.08521711$

Member Controlled by Flexure ($V_e/V_r < 1$)

Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 $V_e = (M_{pr1} + M_{pr2})/l_n = 96267.817$

with

$M_{pr1} = \max(\mu_{u1+}, \mu_{u1-}) = 1.4440E+008$

$\mu_{u1+} = 1.2341E+008$, 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

$\mu_{u1-} = 1.4440E+008$, 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

$M_{pr2} = \max(\mu_{u2+}, \mu_{u2-}) = 1.4440E+008$

$\mu_{u2+} = 1.2341E+008$, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the static loading combination

$\mu_{u2-} = 1.4440E+008$, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the static loading combination

Calculation of μ_{u1+}

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

$$u = 1.8630672E-005$$

$$\mu = 1.2341E+008$$

with full section properties:

$$b = 3000.00$$

$$d = 208.00$$

$$d' = 42.00$$

$$v = 0.00176852$$

$$N = 27588.841$$

$$f_c = 25.00$$

$$\phi_c(5A.5, \text{TBDY}) = 0.002$$

$$\text{Final value of } \phi_u: \phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } \phi_u = 0.0035$$

$$w_e(5.4c) = 0.00$$

$$a_{se}((5.4d), \text{TBDY}) = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$$

$$a_{se1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$a_{se2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$a_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$psh_{min} = \text{Min}(psh_x, psh_y) = 0.0010472$$

$$psh_x = ps1_x + ps2_x + ps3_x = 0.00439823$$

$$ps1_x(\text{column 1}) = (A_{s1} * h1 / s_1) / A_c = 0.00125664$$

$$h1 = 600.00$$

$$A_{s1} = A_{stir1} * ns1 = 157.0796$$

$$\text{No stirups, } ns1 = 2.00$$

$$ps2_x(\text{column 2}) = (A_{s2} * h2 / s_2) / A_c = 0.00125664$$

$$h2 = 600.00$$

$$A_{s2} = A_{stir2} * ns2 = 157.0796$$

$$\text{No stirups, } ns2 = 2.00$$

$$ps3_x(\text{web}) = (A_{s3} * h3 / s_3) / A_c = 0.00188496$$

$$h3 = 1800.00$$

$$A_{s3} = A_{stir3} * ns3 = 0.00$$

$$\text{No stirups, } ns3 = 2.00$$

$$psh_y = ps1_y + ps2_y + ps3_y = 0.0010472$$

$$ps1_y(\text{column 1}) = (A_{s1} * h1 / s_1) / A_c = 0.0005236$$

$$h1 = 250.00$$

$$A_{s1} = A_{stir1} * ns1 = 157.0796$$

$$\text{No stirups, } ns1 = 2.00$$

$$ps2_y(\text{column 2}) = (A_{s2} * h2 / s_2) / A_c = 0.0005236$$

$$h2 = 250.00$$

$$A_{s2} = A_{stir2} * ns2 = 157.0796$$

$$\text{No stirups, } ns2 = 2.00$$

$$ps3_y(\text{web}) = (A_{s3} * h3 / s_3) / A_c = 0.00$$

$$h3 = 250.00$$

$$A_{s3} = A_{stir3} * ns3 = 157.0796$$

$$\text{No stirups, } ns3 = 0.00$$

$$A_{sec} = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$f_{ywe} = 625.00$$

$$f_{ce} = 25.00$$

$$\text{From ((5.A5), TBDY), TBDY: } \phi_c = 0.002$$

$$c = \text{confinement factor} = 1.00$$

$$y1 = 0.00094258$$

```

sh1 = 0.00301626
ft1 = 282.7748
fy1 = 235.6456
su1 = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.16565482
    su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu1_nominal = 0.08,
    For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
    characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
    with fs1 = fs = 235.6456
    with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.16565482
    su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esu2_nominal = 0.08,
    For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
    characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
    with fs2 = fs = 235.6456
    with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
    using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
    and also multiplied by the shear_factor according to 15.7.1.4, with
    Shear_factor = 1.00
    lo/lou,min = lb/lb,min = 0.16565482
    suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
    From table 5A.1, TBDY: esuv_nominal = 0.08,
    considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
    For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
    characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
    y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb,min)^ 2/3), from 10.3.5, ASCE 41-17.
    with fsv = fs = 235.6456
    with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.22164534

```

$$\begin{aligned} \mu &= M/R_c (4.14) = 1.2341E+008 \\ u &= s_u (4.1) = 1.8630672E-005 \end{aligned}$$

Calculation of ratio l_b/l_d

$$\text{Lap Length: } l_b/l_d = 0.16565482$$

$$l_b = 300.00$$

$$l_d = 1810.995$$

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

l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$$= 1$$

$$d_b = 16.35294$$

Mean strength value of all re-bars: $f_y = 625.00$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

Calculation of μ_1 -

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

$$u = 1.8844503E-005$$

$$\mu = 1.4440E+008$$

with full section properties:

$$b = 3000.00$$

$$d = 208.00$$

$$d' = 42.00$$

$$v = 0.00176852$$

$$N = 27588.841$$

$$f_c = 25.00$$

$$c_o (5A.5, \text{TB DY}) = 0.002$$

$$\text{Final value of } c_u: c_u^* = \text{shear_factor} * \text{Max}(c_u, c_c) = 0.0035$$

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

$$\text{From (5.4b), TB DY: } c_u = 0.0035$$

$$w_e (5.4c) = 0.00$$

$$a_{se} ((5.4d), \text{TB DY}) = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$$

$$a_{se1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$a_{se2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$a_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$psh_{min} = \text{Min}(psh_x, psh_y) = 0.0010472$$

$$psh_x = ps1_x + ps2_x + ps3_x = 0.00439823$$

$$ps1_x \text{ (column 1)} = (As1 * h1 / s_1) / A_c = 0.00125664$$

$$h1 = 600.00$$

$$As1 = A_{stir1} * ns1 = 157.0796$$

No stirups, $ns1 = 2.00$

$$ps2_x \text{ (column 2)} = (As2 * h2 / s_2) / A_c = 0.00125664$$

$$h2 = 600.00$$

$$As2 = A_{stir2} * ns2 = 157.0796$$

No stirups, $ns2 = 2.00$

$$ps3_x \text{ (web)} = (As3 * h3 / s_3) / A_c = 0.00188496$$

h3 = 1800.00
 As3 = Astir3*ns3 = 0.00
 No stirups, ns3 = 2.00

 psh,y = ps1,y+ps2,y+ps3,y = 0.0010472
 ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236
 h1 = 250.00
 As1 = Astir1*ns1 = 157.0796
 No stirups, ns1 = 2.00
 ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236
 h2 = 250.00
 As2 = Astir2*ns2 = 157.0796
 No stirups, ns2 = 2.00
 ps3,y (web) = (As3*h3/s_3)/Ac = 0.00
 h3 = 250.00
 As3 = Astir3*ns3 = 157.0796
 No stirups, ns3 = 0.00

 Asec = 750000.00
 s_1 = 100.00
 s_2 = 100.00
 s_3 = 200.00

fywe = 625.00
 fce = 25.00

From ((5.A5), TBDY), TBDY: cc = 0.002
 c = confinement factor = 1.00

y1 = 0.00094258
 sh1 = 0.00301626
 ft1 = 282.7748
 fy1 = 235.6456
 su1 = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

lo/lou,min = lb/lb = 0.16565482

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

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
 characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs1 = fs = 235.6456

with Es1 = Es = 200000.00

y2 = 0.00094258
 sh2 = 0.00301626
 ft2 = 282.7748
 fy2 = 235.6456
 su2 = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

lo/lou,min = lb/lb,min = 0.16565482

su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
 characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/lb)^{2/3})$, from 10.3.5, ASCE 41-17.

with fs2 = fs = 235.6456

with Es2 = Es = 200000.00

yv = 0.00094258
 shv = 0.00301626
 ftv = 282.7748
 fyv = 235.6456
 suv = 0.00301626

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

lo/lou,min = lb/lb = 0.16565482

$suv = 0.4 * esuv_nominal ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esuv_nominal = 0.08$,
 considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
 For calculation of $esuv_nominal$ and yv , shv , ftv , fyv , it is considered
 characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
 $y1$, $sh1$, $ft1$, $fy1$, are also multiplied by $Min(1, 1.25 * (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fsv = fs = 235.6456$
 with $Esv = Es = 200000.00$
 $1 = Asl,ten / (b * d) * (fs1 / fc) = 0.04275722$
 $2 = Asl,com / (b * d) * (fs2 / fc) = 0.04275722$
 $v = Asl,mid / (b * d) * (fsv / fc) = 0.02429711$

and confined core properties:

$b = 2940.00$
 $d = 178.00$
 $d' = 12.00$
 $fcc (5A.2, TBDY) = 25.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = Asl,ten / (b * d) * (fs1 / fc) = 0.05098316$
 $2 = Asl,com / (b * d) * (fs2 / fc) = 0.05098316$
 $v = Asl,mid / (b * d) * (fsv / fc) = 0.02897156$

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < vs,y2$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.23047746$
 $Mu = MRc (4.14) = 1.4440E+008$
 $u = su (4.1) = 1.8844503E-005$

Calculation of ratio lb/ld

Lap Length: $lb/ld = 0.16565482$
 $lb = 300.00$
 $ld = 1810.995$
 Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $fy = 625.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $Ktr = 1.848$
 $n = 34.00$

Calculation of $Mu2+$

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 $u = 1.8630672E-005$
 $Mu = 1.2341E+008$

with full section properties:

$b = 3000.00$
 $d = 208.00$
 $d' = 42.00$
 $v = 0.00176852$
 $N = 27588.841$
 $fc = 25.00$
 $co (5A.5, TBDY) = 0.002$
 Final value of cu : $cu^* = \text{shear_factor} * \text{Max}(cu, cc) = 0.0035$

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

From (5.4b), TBDY: $c_u = 0.0035$

w_e (5.4c) = 0.00

a_{se} ((5.4d), TBDY) = $(a_{se1} \cdot A_{col1} + a_{se2} \cdot A_{col2} + a_{se3} \cdot A_{web}) / A_{sec} = 0.00$

$a_{se1} = 0.00$

$sh_1 = 100.00$

$bo_1 = 190.00$

$ho_1 = 540.00$

$bi2_1 = 655400.00$

$a_{se2} = 0.00$

$sh_2 = 100.00$

$bo_2 = 190.00$

$ho_2 = 540.00$

$bi2_2 = 655400.00$

$a_{se3} = 0$ (grid does not provide confinement)

$p_{sh,min} = \text{Min}(p_{sh,x}, p_{sh,y}) = 0.0010472$

$p_{sh,x} = p_{s1,x} + p_{s2,x} + p_{s3,x} = 0.00439823$

$p_{s1,x}$ (column 1) = $(A_{s1} \cdot h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} \cdot n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$p_{s2,x}$ (column 2) = $(A_{s2} \cdot h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} \cdot n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$p_{s3,x}$ (web) = $(A_{s3} \cdot h_3 / s_3) / A_c = 0.00188496$

$h_3 = 1800.00$

$A_{s3} = A_{stir3} \cdot n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

$p_{sh,y} = p_{s1,y} + p_{s2,y} + p_{s3,y} = 0.0010472$

$p_{s1,y}$ (column 1) = $(A_{s1} \cdot h_1 / s_1) / A_c = 0.0005236$

$h_1 = 250.00$

$A_{s1} = A_{stir1} \cdot n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$p_{s2,y}$ (column 2) = $(A_{s2} \cdot h_2 / s_2) / A_c = 0.0005236$

$h_2 = 250.00$

$A_{s2} = A_{stir2} \cdot n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$p_{s3,y}$ (web) = $(A_{s3} \cdot h_3 / s_3) / A_c = 0.00$

$h_3 = 250.00$

$A_{s3} = A_{stir3} \cdot n_{s3} = 157.0796$

No stirups, $n_{s3} = 0.00$

$A_{sec} = 750000.00$

$s_1 = 100.00$

$s_2 = 100.00$

$s_3 = 200.00$

$f_{ywe} = 625.00$

$f_{ce} = 25.00$

From ((5.A5), TBDY), TBDY: $c_c = 0.002$

c = confinement factor = 1.00

$y_1 = 0.00094258$

$sh_1 = 0.00301626$

$ft_1 = 282.7748$

$fy_1 = 235.6456$

$su_1 = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$lo/lo_{u,min} = lb/ld = 0.16565482$

$su_1 = 0.4 \cdot esu_{1,nominal}$ ((5.5), TBDY) = 0.032

From table 5A.1, TBDY: $esu_{1,nominal} = 0.08$,

For calculation of $esu_{1,nominal}$ and y_1 , sh_1 , ft_1 , fy_1 , it is considered
characteristic value $fsy_1 = fs_1/1.2$, from table 5.1, TBDY.

y_1 , sh_1 , ft_1 , fy_1 , are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

```

with fs1 = fs = 235.6456
with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.16565482
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 235.6456
with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.16565482
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 235.6456
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.22164534
Mu = MRc (4.14) = 1.2341E+008
u = su (4.1) = 1.8630672E-005

```

Calculation of ratio lb/lb

```

Lap Length: lb/lb = 0.16565482
lb = 300.00
lb = 1810.995
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
lb,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294

```

Mean strength value of all re-bars: $f_y = 625.00$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$cb = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_2 -

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

$\mu = 1.8844503E-005$

$\mu = 1.4440E+008$

with full section properties:

$b = 3000.00$

$d = 208.00$

$d' = 42.00$

$v = 0.00176852$

$N = 27588.841$

$f_c = 25.00$

$\alpha (5A.5, TBDY) = 0.002$

Final value of μ : $\mu^* = \text{shear_factor} * \text{Max}(\mu, \mu_c) = 0.0035$

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

From (5.4b), TBDY: $\mu = 0.0035$

$\mu_e (5.4c) = 0.00$

$\mu_{se} ((5.4d), TBDY) = (\mu_{se1} * A_{col1} + \mu_{se2} * A_{col2} + \mu_{se3} * A_{web}) / A_{sec} = 0.00$

$\mu_{se1} = 0.00$

$sh_1 = 100.00$

$bo_1 = 190.00$

$ho_1 = 540.00$

$bi2_1 = 655400.00$

$\mu_{se2} = 0.00$

$sh_2 = 100.00$

$bo_2 = 190.00$

$ho_2 = 540.00$

$bi2_2 = 655400.00$

$\mu_{se3} = 0$ (grid does not provide confinement)

$\mu_{sh,min} = \text{Min}(\mu_{sh,x}, \mu_{sh,y}) = 0.0010472$

$\mu_{sh,x} = \mu_{s1,x} + \mu_{s2,x} + \mu_{s3,x} = 0.00439823$

$\mu_{s1,x} (\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirrups, $n_{s1} = 2.00$

$\mu_{s2,x} (\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$

$h_2 = 600.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirrups, $n_{s2} = 2.00$

$\mu_{s3,x} (\text{web}) = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$

$h_3 = 1800.00$

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirrups, $n_{s3} = 2.00$

$\mu_{sh,y} = \mu_{s1,y} + \mu_{s2,y} + \mu_{s3,y} = 0.0010472$

$\mu_{s1,y} (\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$

$h_1 = 250.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirrups, $n_{s1} = 2.00$

$\mu_{s2,y} (\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$

$h_2 = 250.00$

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirrups, $n_{s2} = 2.00$

$$ps3,y \text{ (web)} = (As3 \cdot h3/s_3)/Ac = 0.00$$

$$h3 = 250.00$$

$$As3 = Astir3 \cdot ns3 = 157.0796$$

$$\text{No stirups, } ns3 = 0.00$$

$$Asec = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$fywe = 625.00$$

$$fce = 25.00$$

$$\text{From } ((5.A5), \text{ TBDY}), \text{ TBDY: } cc = 0.002$$

$$c = \text{confinement factor} = 1.00$$

$$y1 = 0.00094258$$

$$sh1 = 0.00301626$$

$$ft1 = 282.7748$$

$$fy1 = 235.6456$$

$$su1 = 0.00301626$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/ld = 0.16565482$$

$$su1 = 0.4 \cdot esu1_nominal ((5.5), \text{ TBDY}) = 0.032$$

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

$$\text{with } fs1 = fs = 235.6456$$

$$\text{with } Es1 = Es = 200000.00$$

$$y2 = 0.00094258$$

$$sh2 = 0.00301626$$

$$ft2 = 282.7748$$

$$fy2 = 235.6456$$

$$su2 = 0.00301626$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/lb,min = 0.16565482$$

$$su2 = 0.4 \cdot esu2_nominal ((5.5), \text{ TBDY}) = 0.032$$

From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

$$\text{with } fs2 = fs = 235.6456$$

$$\text{with } Es2 = Es = 200000.00$$

$$yv = 0.00094258$$

$$shv = 0.00301626$$

$$ftv = 282.7748$$

$$fyv = 235.6456$$

$$suv = 0.00301626$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/ld = 0.16565482$$

$$suv = 0.4 \cdot esuv_nominal ((5.5), \text{ TBDY}) = 0.032$$

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

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

For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

$$\text{with } fsv = fs = 235.6456$$

$$\text{with } Esv = Es = 200000.00$$

$$1 = Asl,ten/(b \cdot d) \cdot (fs1/fc) = 0.04275722$$

$$2 = Asl,com/(b \cdot d) \cdot (fs2/fc) = 0.04275722$$

$$v = Asl,mid/(b \cdot d) \cdot (fsv/fc) = 0.02429711$$

and confined core properties:

$$b = 2940.00$$

$d = 178.00$
 $d' = 12.00$
 $f_{cc} (5A.2, TBDY) = 25.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.05098316$
 $2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.05098316$
 $v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02897156$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.23047746$
 $Mu = MRc (4.14) = 1.4440E+008$
 $u = su (4.1) = 1.8844503E-005$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$
 $l_b = 300.00$
 $l_d = 1810.995$
 Calculation of l_b, \min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d, \min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 625.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Shear Strength $V_r = \min(V_{r1}, V_{r2}) = 1.1297E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 1.1297E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f_c'^{0.5}*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$
 $Mu/V_u - l_w/2 = 0.00 \leq 0$
 $= 1$ (normal-weight concrete)
 $f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 3000.00$
 $d = 200.00$
 $l_w = 250.00$
 $Mu = 2.5788780E-012$
 $V_u = 0.00$
 $Nu = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$
 $V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)
 $V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$

$f_y = 500.00$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

$d = 200.00$

$A_v = 0.00$

$s = 200.00$

$f_y = 500.00$

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$2(1-s/d) = 0.00$

$V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$

From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$

$b_w = 3000.00$

Calculation of Shear Strength at edge 2, $V_{r2} = 1.1297E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c' \cdot h \cdot d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$

$\mu_u / \mu - l_w / 2 = 0.00 \leq 0$

= 1 (normal-weight concrete)

$f_c' = 25.00$, but $f_c' \cdot 0.5 \leq 8.3 \text{ MPa}$ (22.5.3.1, ACI 318-14)

$h = 3000.00$

$d = 200.00$

$l_w = 250.00$

$\mu_u = 2.5788780E-012$

$V_u = 0.00$

$N_u = 27588.841$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$

Vs1 = 157079.633 is calculated for pseudo-Column 1, with:

$d = 200.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 500.00$

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

Vs2 = 157079.633 is calculated for pseudo-Column 2, with:

$d = 200.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 500.00$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

$d = 200.00$

$A_v = 0.00$

$s = 200.00$

$f_y = 500.00$

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$2(1-s/d) = 0.00$

$V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$

From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$

$b_w = 3000.00$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1

At local axis: 2

Integration Section: (a)

Section Type: rcrws

Constant Properties

Knowledge Factor, = 1.00

According to 10.7.2.3, ASCE 41-17, shear walls with transverse reinforcement percentage, $n < 0.0015$ are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
 $n = 0.0010472$

with $n = ps1 + ps2 + ps3$, being the shear reinf. ratio in a plane perpendicular to the shear axis 3

(pseudo-col.1 $ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236$

$h1 = 250.00$

$s1 = 100.00$

total area of hoops perpendicular to shear axis, $As1 = 157.0796$

(pseudo-col.2 $ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236$

$h2 = 250.00$

$s2 = 100.00$

total area of hoops perpendicular to shear axis, $As2 = 157.0796$

(grid $ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00$

$h3 = 250.00$

$s3 = 200.00$

total area of hoops perpendicular to shear axis, $As3 = 0.00$

total section area, $Ac = 750000.00$

Consequently:

New material of Secondary Member: Concrete Strength, $fc = fc_lower_bound = 25.00$

New material of Secondary Member: Steel Strength, $fs = fs_lower_bound = 500.00$

Concrete Elasticity, $Ec = 26999.444$

Steel Elasticity, $Es = 200000.00$

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_b = 300.00$

No FRP Wrapping

Stepwise Properties

Bending Moment, $M = 1.6093E+008$

Shear Force, $V2 = -1.1969937E-013$

Shear Force, $V3 = -53656.852$

Axial Force, $F = -27994.722$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $As_{lt} = 0.00$

-Compression: $As_{lc} = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $As_{l,ten} = 2865.133$

-Compression: $As_{l,com} = 2865.133$

-Middle: $As_{l,mid} = 1539.38$

Mean Diameter of Tension Reinforcement, $DbL = 17.33333$

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $u_R = 1.0^*$ $u = 0.01246271$

$u = y + p = 0.01246271$

- Calculation of y -

$y = (M_y * I_p) / (EI)_{Eff} = 0.00046271 ((10-5), ASCE 41-17))$

$M_y = 2.0496E+009$

$(EI)_{Eff} = 0.35 * E_c * I$ (table 10-5)

$$E_c I = 1.5187E+016$$

$$I_p = 0.5 \cdot d = 0.5 \cdot (0.8 \cdot h) = 1200.00$$

Calculation of Yielding Moment M_y

Calculation of y and M_y according to Annex 7 -

$$y = \text{Min}(y_{\text{ten}}, y_{\text{com}})$$

$$y_{\text{ten}} = 4.6950448E-007$$

with ((10.1), ASCE 41-17) $f_y = \text{Min}(f_y, 1.25 \cdot f_y \cdot (l_b/l_d)^{2/3}) = 218.754$

$$d = 2957.00$$

$$y = 0.21216547$$

$$A = 0.01000692$$

$$B = 0.00516152$$

with $p_t = 0.00387573$

$$p_c = 0.00387573$$

$$p_v = 0.00208235$$

$$N = 27994.722$$

$$b = 250.00$$

$$\mu = 0.01454177$$

$$y_{\text{comp}} = 2.6939913E-006$$

with $f_c = 25.00$

$$E_c = 26999.444$$

$$y = 0.20922336$$

$$A = 0.00972021$$

$$B = 0.00498841$$

with $E_s = 200000.00$

Calculation of ratio l_b/l_d

Lap Length: $l_d/l_{d,\text{min}} = 0.20706852$

$$l_b = 300.00$$

$$l_d = 1448.796$$

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

$l_{d,\text{min}}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)

$$= 1$$

$$d_b = 16.35294$$

Mean strength value of all re-bars: $f_y = 500.00$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

- Calculation of p -

Considering wall controlled by flexure (shear control ratio ≤ 1),
from table 10-19: $p = 0.012$

with:

- Condition i (shear wall and wall segments)

$$-(A_s - A_s') \cdot f_y + P / (t_w \cdot l_w \cdot f_c') = -0.19236416$$

$$A_s = 0.00$$

$$A_s' = 7269.645$$

$$f_y = 500.00$$

$$P = 27994.722$$

$$t_w = 250.00$$

$$l_w = 3000.00$$

$$f_c = 25.00$$

$$-V / (t_w \cdot l_w \cdot f_c'^{0.5}) = 0.17231265, \text{ NOTE: units in lb \& in}$$

- Confined Boundary: Yes

Table values have been multiplied by 0.8 according to subnote b

Boundary Trans. Reinf. exceeds 75% of ACI 318 provision ($V_{w1} + V_{w2} > 0.50 \cdot (V - V_c - V_{w3})$)

Boundary hoops spacing does not exceed $8d_b$ ($s_1 < 8 \cdot d_b$ and $s_2 < 8 \cdot d_b$)

With

Boundary Element 1:

$$V_{w1} = 376991.118$$

$$s_1 = 100.00$$

Boundary Element 2:

$$V_{w2} = 376991.118$$

$$s_2 = 100.00$$

Grid Shear Force, $V_{w3} = 0.00$

Concrete Shear Force, $V_c = 759275.539$

(The variables above have already been given in Shear control ratio calculation)

Mean diameter of all bars, $d_b = 17.33333$

Design Shear Force, $V = 53656.852$

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1

At local axis: 2

Integration Section: (a)

Calculation No. 11

wall W1, Floor 1

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

Analysis: Uniform +X

Check: Shear capacity V_{Rd}

Edge: Start

Local Axis: (3)



Start Of Calculation of Shear Capacity for element: wall W1 of floor 1

At local axis: 3

Integration Section: (a)

Section Type: rcwvs

Constant Properties

Knowledge Factor, $\phi = 1.00$
 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:
 New material of Secondary Member: Concrete Strength, $f_c = f_{c_lower_bound} = 25.00$
 New material of Secondary Member: Steel Strength, $f_s = f_{s_lower_bound} = 500.00$
 Concrete Elasticity, $E_c = 26999.444$
 Steel Elasticity, $E_s = 200000.00$
 Total Height, $H_{tot} = 3000.00$
 Edges Width, $W_{edg} = 250.00$
 Edges Height, $H_{edg} = 600.00$
 Web Width, $W_{web} = 250.00$
 Cover Thickness, $c = 25.00$
 Element Length, $L = 3000.00$
 Secondary 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
 Lap Length $l_o = l_b = 300.00$
 No FRP Wrapping

Stepwise Properties

EDGE -A-
 Bending Moment, $M_a = 1.6093E+008$
 Shear Force, $V_a = -53656.852$
 EDGE -B-
 Bending Moment, $M_b = 59475.088$
 Shear Force, $V_b = 53656.852$
 BOTH EDGES
 Axial Force, $F = -27994.722$
 Longitudinal Reinforcement Area Distribution (in 2 divisions)
 -Tension: $A_{sl,t} = 0.00$
 -Compression: $A_{sl,c} = 7269.645$
 Longitudinal Reinforcement Area Distribution (in 3 divisions)
 -Tension: $A_{sl,ten} = 2865.133$
 -Compression: $A_{sl,com} = 2865.133$
 -Middle: $A_{sl,mid} = 1539.38$
 Mean Diameter of Tension Reinforcement, $Db_{L,ten} = 17.33333$

New component: From table 7-7, ASCE 41_17: Final Shear Capacity $V_R = 1.0 \cdot V_n = 2.0787E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_n < 0.83 \cdot f_c^{0.5} \cdot h \cdot d = 2.0787E+006$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
 where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 759275.539$
 $M_u/V_u - l_w/2 = 1499.219 > 0$
 = 1 (normal-weight concrete)
 $f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $l_w = 3000.00$
 $M_u = 1.6093E+008$
 $V_u = 53656.852$
 $N_u = 27994.722$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.3195E+006$
 $V_{s1} = 376991.118$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$

$f_y = 500.00$

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

Vs2 = 376991.118 is calculated for pseudo-Column 2, with:

$d = 480.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 500.00$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 565486.678 is calculated for web, with:

$d = 1440.00$

$A_v = 157079.633$

$s = 200.00$

$f_y = 500.00$

Vs3 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$

From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$

$b_w = 250.00$

End Of Calculation of Shear Capacity for element: wall W1 of floor 1

At local axis: 3

Integration Section: (a)

Calculation No. 12

wall W1, Floor 1

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

Analysis: Uniform +X

Check: Chord rotation capacity (μ)

Edge: Start

Local Axis: (3)



Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At Shear local axis: 3

(Bending local axis: 2)

Section Type: rcwrs

Constant Properties

Knowledge Factor, $\phi = 1.00$
 Mean strength values are used for both shear and moment calculations.
 Consequently:
 New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 33.00$
 New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 555.56$
 Concrete Elasticity, $E_c = 26999.444$
 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
 New material: Steel Strength, $f_s = 1.25 \cdot f_{sm} = 694.45$
 #####
 Total Height, $H_{tot} = 3000.00$
 Edges Width, $W_{edg} = 250.00$
 Edges Height, $H_{edg} = 600.00$
 Web Width, $W_{web} = 250.00$
 Cover Thickness, $c = 25.00$
 Mean Confinement Factor overall section = 1.00
 Element Length, $L = 3000.00$
 Secondary 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
 Lap Length $l_o = 300.00$
 No FRP Wrapping

Stepwise Properties

At local axis: 3
 EDGE -A-
 Shear Force, $V_a = 1.5016185E-058$
 EDGE -B-
 Shear Force, $V_b = -1.5016185E-058$
 BOTH EDGES
 Axial Force, $F = -27588.841$
 Longitudinal Reinforcement Area Distribution (in 2 divisions)
 -Tension: $As_t = 0.00$
 -Compression: $As_c = 7269.645$
 Longitudinal Reinforcement Area Distribution (in 3 divisions)
 -Tension: $As_{l,ten} = 2865.133$
 -Compression: $As_{l,com} = 2865.133$
 -Middle: $As_{l,mid} = 0.00$
 (According to 10.7.2.3 $As_{l,mid}$ is setted equal to zero)

Calculation of Shear Capacity ratio, $V_e/V_r = 0.69050088$
 Member Controlled by Flexure ($V_e/V_r < 1$)
 Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 $V_e = (M_{pr1} + M_{pr2})/l_n = 1.6587E+006$
 with
 $M_{pr1} = \text{Max}(Mu_{1+}, Mu_{1-}) = 2.4881E+009$
 $Mu_{1+} = 2.1705E+009$, 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
 $Mu_{1-} = 2.4881E+009$, 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
 $M_{pr2} = \text{Max}(Mu_{2+}, Mu_{2-}) = 2.4881E+009$
 $Mu_{2+} = 2.1705E+009$, 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
 $Mu_{2-} = 2.4881E+009$, is the ultimate moment strength at the edge 2 of the member in the opposite moment
 direction which is defined for the the static loading combination

Calculation of Mu_{1+}

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

$$u = 1.2902105E-006$$

$$\mu = 2.1705E+009$$

with full section properties:

$$b = 250.00$$

$$d = 2957.00$$

$$d' = 43.00$$

$$v = 0.00113091$$

$$N = 27588.841$$

$$f_c = 33.00$$

$$\alpha (5A.5, TBDY) = 0.002$$

$$\text{Final value of } \phi_u: \phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } \phi_u = 0.0035$$

$$\omega_e (5.4c) = 0.00$$

$$\alpha_e ((5.4d), TBDY) = (\alpha_e1 * A_{col1} + \alpha_e2 * A_{col2} + \alpha_e3 * A_{web}) / A_{sec} = 0.00$$

$$\alpha_e1 = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$\alpha_e2 = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$\alpha_e3 = 0 \text{ (grid does not provide confinement)}$$

$$\phi_{sh,min} = \text{Min}(\phi_{sh,x}, \phi_{sh,y}) = 0.0010472$$

$$\phi_{sh,x} = \phi_{s1,x} + \phi_{s2,x} + \phi_{s3,x} = 0.00439823$$

$$\phi_{s1,x} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{s2,x} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{s3,x} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$\phi_{sh,y} = \phi_{s1,y} + \phi_{s2,y} + \phi_{s3,y} = 0.0010472$$

$$\phi_{s1,y} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{s2,y} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$$

$$h_2 = 250.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{s3,y} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00$$

$$h_3 = 250.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 157.0796$$

$$\text{No stirups, } n_{s3} = 0.00$$

$$A_{sec} = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$f_{ywe} = 694.45$$

$$f_{ce} = 33.00$$

```

From ((5.A.5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00096384
sh1 = 0.00308428
ft1 = 321.2814
fy1 = 267.7345
su1 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.17128923
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
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 = 267.7345
with Es1 = Es = 200000.00
y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.17128923
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
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 = 267.7345
with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.17128923
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
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 = 267.7345
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
--->

```

$v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

---->

$$s_u(4.9) = 0.19157175$$

$$M_u = M_{Rc}(4.14) = 2.1705E+009$$

$$u = s_u(4.1) = 1.2902105E-006$$

Calculation of ratio I_b/I_d

$$\text{Lap Length: } I_b/I_d = 0.17128923$$

$$I_b = 300.00$$

$$I_d = 1751.424$$

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

I_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$$= 1$$

$$d_b = 16.35294$$

$$\text{Mean strength value of all re-bars: } f_y = 694.45$$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

Calculation of M_{u1} -

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

$$u = 1.2974768E-006$$

$$M_u = 2.4881E+009$$

with full section properties:

$$b = 250.00$$

$$d = 2957.00$$

$$d' = 43.00$$

$$v = 0.00113091$$

$$N = 27588.841$$

$$f_c = 33.00$$

$$c_o(5A.5, \text{TB DY}) = 0.002$$

$$\text{Final value of } c_u: c_u^* = \text{shear_factor} * \text{Max}(c_u, c_c) = 0.0035$$

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

$$\text{From (5.4b), TB DY: } c_u = 0.0035$$

$$w_e(5.4c) = 0.00$$

$$a_{se}((5.4d), \text{TB DY}) = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$$

$$a_{se1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$a_{se2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$a_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$p_{sh,min} = \text{Min}(p_{sh,x}, p_{sh,y}) = 0.0010472$$

$$p_{sh,x} = p_{s1,x} + p_{s2,x} + p_{s3,x} = 0.00439823$$

$$p_{s1,x}(\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$p_{s2,x}(\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,x \text{ (web)} = (As3 * h3 / s_3) / Ac = 0.00188496$
 $h3 = 1800.00$
 $As3 = Astir3 * ns3 = 0.00$
 No stirups, $ns3 = 2.00$

$psh,y = ps1,y + ps2,y + ps3,y = 0.0010472$
 $ps1,y \text{ (column 1)} = (As1 * h1 / s_1) / Ac = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 * ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2,y \text{ (column 2)} = (As2 * h2 / s_2) / Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,y \text{ (web)} = (As3 * h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 * ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

$Asec = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $fywe = 694.45$
 $fce = 33.00$
 From ((5.A.5), TBDY), TBDY: $cc = 0.002$
 $c = \text{confinement factor} = 1.00$
 $y1 = 0.00096384$
 $sh1 = 0.00308428$
 $ft1 = 321.2814$
 $fy1 = 267.7345$
 $su1 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/l_d = 0.17128923$
 $su1 = 0.4 * esu1_nominal \text{ ((5.5), TBDY)} = 0.032$
 From table 5A.1, TBDY: $esu1_nominal = 0.08$,
 For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered
 characteristic value $fsy1 = fs1 / 1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 * (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs1 = fs = 267.7345$
 with $Es1 = Es = 200000.00$
 $y2 = 0.00096384$
 $sh2 = 0.00308428$
 $ft2 = 321.2814$
 $fy2 = 267.7345$
 $su2 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/l_b,min = 0.17128923$
 $su2 = 0.4 * esu2_nominal \text{ ((5.5), TBDY)} = 0.032$
 From table 5A.1, TBDY: $esu2_nominal = 0.08$,
 For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered
 characteristic value $fsy2 = fs2 / 1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 * (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs2 = fs = 267.7345$
 with $Es2 = Es = 200000.00$
 $yv = 0.00096384$
 $shv = 0.00308428$
 $ftv = 321.2814$
 $fyv = 267.7345$
 $suv = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $l_o/l_{ou,min} = l_b/l_d = 0.17128923$
 $suv = 0.4 * esuv_{nominal} ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esuv_{nominal} = 0.08$,
 considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
 For calculation of $esuv_{nominal}$ and yv, shv,ftv,fyv , it is considered
 characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
 $y1, sh1,ft1,fy1$, are also multiplied by $Min(1,1.25*(l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fsv = fs = 267.7345$
 with $Esv = Es = 200000.00$
 $1 = Asl_{ten}/(b*d)*(fs1/fc) = 0.03144444$
 $2 = Asl_{com}/(b*d)*(fs2/fc) = 0.03144444$
 $v = Asl_{mid}/(b*d)*(fsv/fc) = 0.01689449$
 and confined core properties:
 $b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $f_{cc} (5A.2, TBDY) = 33.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = Asl_{ten}/(b*d)*(fs1/fc) = 0.04179832$
 $2 = Asl_{com}/(b*d)*(fs2/fc) = 0.04179832$
 $v = Asl_{mid}/(b*d)*(fsv/fc) = 0.02245743$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)
 --->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.19609924$
 $Mu = MRc (4.14) = 2.4881E+009$
 $u = su (4.1) = 1.2974768E-006$

 Calculation of ratio l_b/l_d

 Lap Length: $l_b/l_d = 0.17128923$
 $l_b = 300.00$
 $l_d = 1751.424$
 Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 $l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $fy = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

 Calculation of Mu_{2+}

 Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 $u = 1.2902105E-006$
 $Mu = 2.1705E+009$

 with full section properties:
 $b = 250.00$
 $d = 2957.00$
 $d' = 43.00$
 $v = 0.00113091$
 $N = 27588.841$

$f_c = 33.00$
 $c_o (5A.5, TBDY) = 0.002$
 Final value of c_u : $c_u^* = \text{shear_factor} * \text{Max}(c_u, c_c) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)
 From (5.4b), TBDY: $c_u = 0.0035$
 $w_e (5.4c) = 0.00$
 $a_{se} ((5.4d), TBDY) = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$
 $a_{se1} = 0.00$
 $sh_1 = 100.00$
 $bo_1 = 190.00$
 $ho_1 = 540.00$
 $bi2_1 = 655400.00$
 $a_{se2} = 0.00$
 $sh_2 = 100.00$
 $bo_2 = 190.00$
 $ho_2 = 540.00$
 $bi2_2 = 655400.00$
 $a_{se3} = 0$ (grid does not provide confinement)
 $psh, \min = \text{Min}(psh, x, psh, y) = 0.0010472$

$psh, x = ps1, x + ps2, x + ps3, x = 0.00439823$
 $ps1, x \text{ (column 1)} = (As1 * h1 / s_1) / A_c = 0.00125664$
 $h1 = 600.00$
 $As1 = Astir1 * ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2, x \text{ (column 2)} = (As2 * h2 / s_2) / A_c = 0.00125664$
 $h2 = 600.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3, x \text{ (web)} = (As3 * h3 / s_3) / A_c = 0.00188496$
 $h3 = 1800.00$
 $As3 = Astir3 * ns3 = 0.00$
 No stirups, $ns3 = 2.00$

$psh, y = ps1, y + ps2, y + ps3, y = 0.0010472$
 $ps1, y \text{ (column 1)} = (As1 * h1 / s_1) / A_c = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 * ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2, y \text{ (column 2)} = (As2 * h2 / s_2) / A_c = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3, y \text{ (web)} = (As3 * h3 / s_3) / A_c = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 * ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

$A_{sec} = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $fy_{we} = 694.45$
 $f_{ce} = 33.00$

From ((5.A5), TBDY), TBDY: $c_c = 0.002$
 $c = \text{confinement factor} = 1.00$
 $y1 = 0.00096384$
 $sh1 = 0.00308428$
 $ft1 = 321.2814$
 $fy1 = 267.7345$
 $su1 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $lo/lou, \min = lb/ld = 0.17128923$
 $su1 = 0.4 * esu1_nominal ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu1_nominal = 0.08$,

For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered characteristic value $fsy1 = fs1/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs1 = fs = 267.7345$
 with $Es1 = Es = 200000.00$
 $y2 = 0.00096384$
 $sh2 = 0.00308428$
 $ft2 = 321.2814$
 $fy2 = 267.7345$
 $su2 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $lo/lou, min = lb/lb, min = 0.17128923$
 $su2 = 0.4 \cdot esu2_nominal \cdot ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu2_nominal = 0.08$,
 For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs2 = fs = 267.7345$
 with $Es2 = Es = 200000.00$
 $yv = 0.00096384$
 $shv = 0.00308428$
 $ftv = 321.2814$
 $fyv = 267.7345$
 $suv = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $lo/lou, min = lb/ld = 0.17128923$
 $suv = 0.4 \cdot esuv_nominal \cdot ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esuv_nominal = 0.08$,
 considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
 For calculation of $esuv_nominal$ and yv, shv, ftv, fyv , it is considered characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fsv = fs = 267.7345$
 with $Esv = Es = 200000.00$
 $1 = Asl, ten / (b \cdot d) \cdot (fs1 / fc) = 0.03144444$
 $2 = Asl, com / (b \cdot d) \cdot (fs2 / fc) = 0.03144444$
 $v = Asl, mid / (b \cdot d) \cdot (fsv / fc) = 0.00$

and confined core properties:

$b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $fcc \text{ (5A.2, TBDY)} = 33.00$
 $cc \text{ (5A.5, TBDY)} = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = Asl, ten / (b \cdot d) \cdot (fs1 / fc) = 0.04179832$
 $2 = Asl, com / (b \cdot d) \cdot (fs2 / fc) = 0.04179832$
 $v = Asl, mid / (b \cdot d) \cdot (fsv / fc) = 0.00$

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < vs, y2$ - LHS eq.(4.5) is satisfied
 --->
 $su \text{ (4.9)} = 0.19157175$
 $Mu = MRc \text{ (4.14)} = 2.1705E+009$
 $u = su \text{ (4.1)} = 1.2902105E-006$

Calculation of ratio lb/ld

Lap Length: $lb/ld = 0.17128923$
 $lb = 300.00$
 $ld = 1751.424$

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

Id,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

= 1

db = 16.35294

Mean strength value of all re-bars: fy = 694.45

t = 1.00

s = 0.80

e = 1.00

cb = 25.00

Ktr = 1.848

n = 34.00

Calculation of Mu2-

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

$\phi_u = 1.2974768E-006$

Mu = 2.4881E+009

with full section properties:

b = 250.00

d = 2957.00

d' = 43.00

v = 0.00113091

N = 27588.841

fc = 33.00

co (5A.5, TBDY) = 0.002

Final value of ϕ_u : $\phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$

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

From (5.4b), TBDY: $\phi_u = 0.0035$

we (5.4c) = 0.00

ase ((5.4d), TBDY) = $(\text{ase1} * A_{col1} + \text{ase2} * A_{col2} + \text{ase3} * A_{web}) / A_{sec} = 0.00$

ase1 = 0.00

sh_1 = 100.00

bo_1 = 190.00

ho_1 = 540.00

bi2_1 = 655400.00

ase2 = 0.00

sh_2 = 100.00

bo_2 = 190.00

ho_2 = 540.00

bi2_2 = 655400.00

ase3 = 0 (grid does not provide confinement)

psh,min = Min(psh,x , psh,y) = 0.0010472

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823

ps1,x (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

h1 = 600.00

As1 = Astir1*ns1 = 157.0796

No stirups, ns1 = 2.00

ps2,x (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$

h2 = 600.00

As2 = Astir2*ns2 = 157.0796

No stirups, ns2 = 2.00

ps3,x (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$

h3 = 1800.00

As3 = Astir3*ns3 = 0.00

No stirups, ns3 = 2.00

psh,y = ps1,y+ps2,y+ps3,y = 0.0010472

ps1,y (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.0005236$

h1 = 250.00

As1 = Astir1*ns1 = 157.0796

No stirups, ns1 = 2.00

ps2,y (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.0005236$

$h2 = 250.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,y (web) = (As3 * h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 * ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

 $Asec = 750000.00$

$s_1 = 100.00$

$s_2 = 100.00$

$s_3 = 200.00$

$fywe = 694.45$

$fce = 33.00$

From ((5.A5), TBDY), TBDY: $cc = 0.002$

$c =$ confinement factor $= 1.00$

$y1 = 0.00096384$

$sh1 = 0.00308428$

$ft1 = 321.2814$

$fy1 = 267.7345$

$su1 = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor $= 1.00$

$lo/lou,min = lb/d = 0.17128923$

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

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

For calculation of $esu1_nominal$ and $y1$, $sh1$, $ft1$, $fy1$, it is considered
 characteristic value $fsy1 = fs1/1.2$, from table 5.1, TBDY.

$y1$, $sh1$, $ft1$, $fy1$, are also multiplied by $Min(1, 1.25 * (lb/d)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs1 = fs = 267.7345$

with $Es1 = Es = 200000.00$

$y2 = 0.00096384$

$sh2 = 0.00308428$

$ft2 = 321.2814$

$fy2 = 267.7345$

$su2 = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor $= 1.00$

$lo/lou,min = lb/lb,min = 0.17128923$

$su2 = 0.4 * esu2_nominal ((5.5), TBDY) = 0.032$

From table 5A.1, TBDY: $esu2_nominal = 0.08$,

For calculation of $esu2_nominal$ and $y2$, $sh2$, $ft2$, $fy2$, it is considered
 characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.

$y1$, $sh1$, $ft1$, $fy1$, are also multiplied by $Min(1, 1.25 * (lb/d)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs2 = fs = 267.7345$

with $Es2 = Es = 200000.00$

$yv = 0.00096384$

$shv = 0.00308428$

$ftv = 321.2814$

$fyv = 267.7345$

$suv = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor $= 1.00$

$lo/lou,min = lb/d = 0.17128923$

$suv = 0.4 * esuv_nominal ((5.5), TBDY) = 0.032$

From table 5A.1, TBDY: $esuv_nominal = 0.08$,

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

For calculation of $esuv_nominal$ and yv , shv , ftv , fyv , it is considered
 characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.

$y1$, $sh1$, $ft1$, $fy1$, are also multiplied by $Min(1, 1.25 * (lb/d)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fsv = fs = 267.7345$

with $Esv = Es = 200000.00$

1 = $Asl,ten / (b * d) * (fs1 / fc) = 0.03144444$

2 = $Asl,com / (b * d) * (fs2 / fc) = 0.03144444$

$v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.01689449$
 and confined core properties:
 $b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $f_{cc} (5A.2, TBDY) = 33.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.04179832$
 $2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.04179832$
 $v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02245743$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)
 --->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.19609924$
 $Mu = MRc (4.14) = 2.4881E+009$
 $u = su (4.1) = 1.2974768E-006$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$
 $l_b = 300.00$
 $l_d = 1751.424$
 Calculation of l_b,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Shear Strength $V_r = \text{Min}(V_{r1}, V_{r2}) = 2.4022E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 2.4022E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f_c'^{0.5}*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$
 $Mu/V_u - l_w/2 = 0.00 \leq 0$
 $= 1$ (normal-weight concrete)
 $f_c' = 33.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $l_w = 3000.00$
 $Mu = 1.2001755E-010$
 $V_u = 1.5016185E-058$
 $Nu = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$
 $V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)
 $V_{s2} = 418882.372$ is calculated for pseudo-Column 2, with:

$d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s3} = 628323.557$ is calculated for web, with:
 $d = 1440.00$
 $A_v = 157079.633$
 $s = 200.00$
 $f_y = 555.56$
 V_{s3} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$
 From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$
 $b_w = 250.00$

Calculation of Shear Strength at edge 2, $V_{r2} = 2.4022E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c' \cdot h \cdot d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
 where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$
 $M_u/V_u - l_w/2 = 0.00 \leq 0$
 $= 1$ (normal-weight concrete)
 $f_c' = 33.00$, but $f_c' \cdot 0.5 \leq 8.3 \text{ MPa}$ (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $l_w = 3000.00$
 $M_u = 1.2001755E-010$
 $V_u = 1.5016185E-058$
 $N_u = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$
 $V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s2} = 418882.372$ is calculated for pseudo-Column 2, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 555.56$
 V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_{s3} = 628323.557$ is calculated for web, with:
 $d = 1440.00$
 $A_v = 157079.633$
 $s = 200.00$
 $f_y = 555.56$
 V_{s3} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
 $V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$
 From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$
 $b_w = 250.00$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
 At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
 At Shear local axis: 2
 (Bending local axis: 3)
 Section Type: rcrws

Constant Properties


```

Knowledge Factor,  $\gamma = 1.00$ 
Mean strength values are used for both shear and moment calculations.
Consequently:
New material of Secondary Member: Concrete Strength,  $f_c = f_{cm} = 25.00$ 
New material of Secondary Member: Steel Strength,  $f_s = f_{sm} = 500.00$ 
Concrete Elasticity,  $E_c = 26999.444$ 
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
New material: Steel Strength,  $f_s = 1.25 \cdot f_{sm} = 625.00$ 
#####
Total Height,  $H_{tot} = 3000.00$ 
Edges Width,  $W_{edg} = 250.00$ 
Edges Height,  $H_{edg} = 600.00$ 
Web Width,  $W_{web} = 250.00$ 
Cover Thickness,  $c = 25.00$ 
Mean Confinement Factor overall section = 1.00
Element Length,  $L = 3000.00$ 
Secondary 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
Lap Length  $l_o = 300.00$ 
No FRP Wrapping
-----

Stepwise Properties
-----
At local axis: 2
EDGE -A-
Shear Force,  $V_a = 0.00$ 
EDGE -B-
Shear Force,  $V_b = 0.00$ 
BOTH EDGES
Axial Force,  $F = -27588.841$ 
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension:  $A_{slt} = 0.00$ 
-Compression:  $A_{slc} = 7269.645$ 
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension:  $A_{sl,ten} = 2830.575$ 
-Compression:  $A_{sl,com} = 2830.575$ 
-Middle:  $A_{sl,mid} = 0.00$ 
(According to 10.7.2.3  $A_{sl,mid}$  is setted equal to zero)
-----
-----

Calculation of Shear Capacity ratio ,  $V_e/V_r = 0.08521711$ 
Member Controlled by Flexure ( $V_e/V_r < 1$ )
Calculation of Shear Demand from fig. R18.6.5, ACI 318-14  $V_e = (M_{pr1} + M_{pr2})/l_n = 96267.817$ 
with
 $M_{pr1} = \text{Max}(M_{u1+}, M_{u1-}) = 1.4440\text{E}+008$ 
 $M_{u1+} = 1.2341\text{E}+008$ , 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
 $M_{u1-} = 1.4440\text{E}+008$ , 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
 $M_{pr2} = \text{Max}(M_{u2+}, M_{u2-}) = 1.4440\text{E}+008$ 
 $M_{u2+} = 1.2341\text{E}+008$ , 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
 $M_{u2-} = 1.4440\text{E}+008$ , is the ultimate moment strength at the edge 2 of the member in the opposite moment
direction which is defined for the the static loading combination
-----

Calculation of  $M_{u1+}$ 
-----

```

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

$$\phi_u = 1.8630672E-005$$

$$\mu = 1.2341E+008$$

with full section properties:

$$b = 3000.00$$

$$d = 208.00$$

$$d' = 42.00$$

$$\nu = 0.00176852$$

$$N = 27588.841$$

$$f_c = 25.00$$

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

$$\text{Final value of } \phi_{cu}: \phi_{cu}^* = \text{shear_factor} * \text{Max}(\phi_{cu}, \phi_{cc}) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } \phi_{cu} = 0.0035$$

$$\phi_{we} (5.4c) = 0.00$$

$$\phi_{ase} ((5.4d), TBDY) = (\phi_{ase1} * A_{col1} + \phi_{ase2} * A_{col2} + \phi_{ase3} * A_{web}) / A_{sec} = 0.00$$

$$\phi_{ase1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$\phi_{ase2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$\phi_{ase3} = 0 \text{ (grid does not provide confinement)}$$

$$\phi_{psh,min} = \text{Min}(\phi_{psh,x}, \phi_{psh,y}) = 0.0010472$$

$$\phi_{psh,x} = \phi_{ps1,x} + \phi_{ps2,x} + \phi_{ps3,x} = 0.00439823$$

$$\phi_{ps1,x} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{ps2,x} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{ps3,x} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$\phi_{psh,y} = \phi_{ps1,y} + \phi_{ps2,y} + \phi_{ps3,y} = 0.0010472$$

$$\phi_{ps1,y} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{ps2,y} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$$

$$h_2 = 250.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{ps3,y} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00$$

$$h_3 = 250.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 157.0796$$

$$\text{No stirups, } n_{s3} = 0.00$$

$$A_{sec} = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$f_{ywe} = 625.00$$

$$f_{ce} = 25.00$$

$$\text{From ((5.A5), TBDY), TBDY: } \phi_{cc} = 0.002$$

```

c = confinement factor = 1.00
y1 = 0.00094258
sh1 = 0.00301626
ft1 = 282.7748
fy1 = 235.6456
su1 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16565482
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
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 = 235.6456
with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.16565482
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
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 = 235.6456
with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16565482
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
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 = 235.6456
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied

```

--->

$$su(4.9) = 0.22164534$$

$$Mu = MRc(4.14) = 1.2341E+008$$

$$u = su(4.1) = 1.8630672E-005$$

Calculation of ratio lb/ld

$$\text{Lap Length: } lb/ld = 0.16565482$$

$$lb = 300.00$$

$$ld = 1810.995$$

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

ld_{min} from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$$= 1$$

$$db = 16.35294$$

Mean strength value of all re-bars: $f_y = 625.00$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$cb = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

Calculation of Mu_1 -

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

$$u = 1.8844503E-005$$

$$Mu = 1.4440E+008$$

with full section properties:

$$b = 3000.00$$

$$d = 208.00$$

$$d' = 42.00$$

$$v = 0.00176852$$

$$N = 27588.841$$

$$f_c = 25.00$$

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

$$\text{Final value of } cu: cu^* = \text{shear_factor} * \text{Max}(cu, cc) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } cu = 0.0035$$

$$we(5.4c) = 0.00$$

$$ase((5.4d), TBDY) = (ase1 * A_{col1} + ase2 * A_{col2} + ase3 * A_{web}) / A_{sec} = 0.00$$

$$ase1 = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$ase2 = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$ase3 = 0 \text{ (grid does not provide confinement)}$$

$$psh_{min} = \text{Min}(psh_x, psh_y) = 0.0010472$$

$$psh_x = ps1_x + ps2_x + ps3_x = 0.00439823$$

$$ps1_x(\text{column 1}) = (As1 * h1 / s_1) / A_c = 0.00125664$$

$$h1 = 600.00$$

$$As1 = Astir1 * ns1 = 157.0796$$

$$\text{No stirups, } ns1 = 2.00$$

$$ps2_x(\text{column 2}) = (As2 * h2 / s_2) / A_c = 0.00125664$$

$$h2 = 600.00$$

$$As2 = Astir2 * ns2 = 157.0796$$

No stirups, ns2 = 2.00
 $ps3,x \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00188496$
 $h3 = 1800.00$
 $As3 = Astir3 \cdot ns3 = 0.00$
 No stirups, ns3 = 2.00

$psh,y = ps1,y + ps2,y + ps3,y = 0.0010472$
 $ps1,y \text{ (column 1)} = (As1 \cdot h1 / s_1) / Ac = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 \cdot ns1 = 157.0796$
 No stirups, ns1 = 2.00
 $ps2,y \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 \cdot ns2 = 157.0796$
 No stirups, ns2 = 2.00
 $ps3,y \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 \cdot ns3 = 157.0796$
 No stirups, ns3 = 0.00

$Asec = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $fywe = 625.00$
 $fce = 25.00$
 From ((5.A5), TBDY), TBDY: $cc = 0.002$
 $c = \text{confinement factor} = 1.00$
 $y1 = 0.00094258$
 $sh1 = 0.00301626$
 $ft1 = 282.7748$
 $fy1 = 235.6456$
 $su1 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/l_d = 0.16565482$
 $su1 = 0.4 \cdot esu1_nominal \text{ ((5.5), TBDY)} = 0.032$
 From table 5A.1, TBDY: $esu1_nominal = 0.08$,
 For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered
 characteristic value $fsy1 = fs1 / 1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs1 = fs = 235.6456$
 with $Es1 = Es = 200000.00$
 $y2 = 0.00094258$
 $sh2 = 0.00301626$
 $ft2 = 282.7748$
 $fy2 = 235.6456$
 $su2 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/l_b,min = 0.16565482$
 $su2 = 0.4 \cdot esu2_nominal \text{ ((5.5), TBDY)} = 0.032$
 From table 5A.1, TBDY: $esu2_nominal = 0.08$,
 For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered
 characteristic value $fsy2 = fs2 / 1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs2 = fs = 235.6456$
 with $Es2 = Es = 200000.00$
 $yv = 0.00094258$
 $shv = 0.00301626$
 $ftv = 282.7748$
 $fyv = 235.6456$
 $suv = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with

Shear_factor = 1.00
 $l_o/l_{o,min} = l_b/l_d = 0.16565482$
 $s_u = 0.4 * e_{suv_nominal} ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $e_{suv_nominal} = 0.08$,
 considering characteristic value $f_{syv} = f_{sv}/1.2$, from table 5.1, TBDY
 For calculation of $e_{suv_nominal}$ and γ_v , sh_v, ft_v, f_y_v , it is considered
 characteristic value $f_{syv} = f_{sv}/1.2$, from table 5.1, TBDY.
 $\gamma_1, sh_1, ft_1, f_{y1}$, are also multiplied by $\text{Min}(1, 1.25 * (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $f_{sv} = f_s = 235.6456$
 with $E_{sv} = E_s = 200000.00$
 $1 = A_{sl,ten}/(b*d) * (f_{s1}/f_c) = 0.04275722$
 $2 = A_{sl,com}/(b*d) * (f_{s2}/f_c) = 0.04275722$
 $v = A_{sl,mid}/(b*d) * (f_{sv}/f_c) = 0.02429711$

and confined core properties:

$b = 2940.00$
 $d = 178.00$
 $d' = 12.00$
 $f_{cc} (5A.2, TBDY) = 25.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b*d) * (f_{s1}/f_c) = 0.05098316$
 $2 = A_{sl,com}/(b*d) * (f_{s2}/f_c) = 0.05098316$
 $v = A_{sl,mid}/(b*d) * (f_{sv}/f_c) = 0.02897156$

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $s_u (4.9) = 0.23047746$
 $\mu_u = M_{Rc} (4.14) = 1.4440E+008$
 $u = s_u (4.1) = 1.8844503E-005$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$
 $l_b = 300.00$
 $l_d = 1810.995$
 Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 $l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 625.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of μ_{u2+}

Calculation of ultimate curvature μ_u according to 4.1, Biskinis/Fardis 2013:
 $u = 1.8630672E-005$
 $\mu_u = 1.2341E+008$

with full section properties:

$b = 3000.00$
 $d = 208.00$
 $d' = 42.00$
 $v = 0.00176852$
 $N = 27588.841$
 $f_c = 25.00$

$co (5A.5, TBDY) = 0.002$
 Final value of cu : $cu^* = shear_factor * Max(cu, cc) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)
 From (5.4b), TBDY: $cu = 0.0035$
 $we (5.4c) = 0.00$
 $ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00$
 $ase1 = 0.00$
 $sh_1 = 100.00$
 $bo_1 = 190.00$
 $ho_1 = 540.00$
 $bi2_1 = 655400.00$
 $ase2 = 0.00$
 $sh_2 = 100.00$
 $bo_2 = 190.00$
 $ho_2 = 540.00$
 $bi2_2 = 655400.00$
 $ase3 = 0$ (grid does not provide confinement)
 $psh,min = Min(psh,x , psh,y) = 0.0010472$

$psh,x = ps1,x+ps2,x+ps3,x = 0.00439823$
 $ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664$
 $h1 = 600.00$
 $As1 = Astir1*ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664$
 $h2 = 600.00$
 $As2 = Astir2*ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,x (web) = (As3*h3/s_3)/Ac = 0.00188496$
 $h3 = 1800.00$
 $As3 = Astir3*ns3 = 0.00$
 No stirups, $ns3 = 2.00$

$psh,y = ps1,y+ps2,y+ps3,y = 0.0010472$
 $ps1,y (column 1) = (As1*h1/s_1)/Ac = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1*ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2,y (column 2) = (As2*h2/s_2)/Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2*ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,y (web) = (As3*h3/s_3)/Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3*ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

$Asec = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $fywe = 625.00$
 $fce = 25.00$

From ((5.A5), TBDY), TBDY: $cc = 0.002$
 $c =$ confinement factor $= 1.00$
 $y1 = 0.00094258$
 $sh1 = 0.00301626$
 $ft1 = 282.7748$
 $fy1 = 235.6456$
 $su1 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor $= 1.00$
 $lo/lou,min = lb/d = 0.16565482$
 $su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu1_nominal = 0.08$,
 For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered

characteristic value $f_{sy1} = f_{s1}/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $f_{s1} = f_s = 235.6456$
 with $E_{s1} = E_s = 200000.00$
 $y2 = 0.00094258$
 $sh2 = 0.00301626$
 $ft2 = 282.7748$
 $fy2 = 235.6456$
 $su2 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $l_o/l_{o,min} = l_b/l_{b,min} = 0.16565482$
 $su2 = 0.4 \cdot esu2_{nominal} ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu2_{nominal} = 0.08$,
 For calculation of $esu2_{nominal}$ and $y2, sh2, ft2, fy2$, it is considered
 characteristic value $f_{sy2} = f_{s2}/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $f_{s2} = f_s = 235.6456$
 with $E_{s2} = E_s = 200000.00$
 $yv = 0.00094258$
 $shv = 0.00301626$
 $ftv = 282.7748$
 $fyv = 235.6456$
 $suv = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $l_o/l_{o,min} = l_b/l_d = 0.16565482$
 $suv = 0.4 \cdot esuv_{nominal} ((5.5), TBDY) = 0.032$
 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 yv, shv, ftv, fyv , it is considered
 characteristic value $f_{syv} = f_{sv}/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $f_{sv} = f_s = 235.6456$
 with $E_{sv} = E_s = 200000.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.04275722$
 $2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.04275722$
 $v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.00$

and confined core properties:

$b = 2940.00$
 $d = 178.00$
 $d' = 12.00$
 $f_{cc} (5A.2, TBDY) = 25.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (f_{s1}/f_c) = 0.05098316$
 $2 = A_{sl,com}/(b \cdot d) \cdot (f_{s2}/f_c) = 0.05098316$
 $v = A_{sl,mid}/(b \cdot d) \cdot (f_{sv}/f_c) = 0.00$

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.22164534$
 $M_u = M_{Rc} (4.14) = 1.2341E+008$
 $u = su (4.1) = 1.8630672E-005$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$
 $l_b = 300.00$
 $l_d = 1810.995$
 Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 $l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)


```

= 1
db = 16.35294
Mean strength value of all re-bars: fy = 625.00
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 1.848
n = 34.00

```

Calculation of Mu2-

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

```

u = 1.8844503E-005
Mu = 1.4440E+008

```

with full section properties:

```

b = 3000.00
d = 208.00
d' = 42.00
v = 0.00176852
N = 27588.841
fc = 25.00
co (5A.5, TBDY) = 0.002
Final value of  $\phi_u$ :  $\phi_u = \text{shear\_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$ 
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY:  $\phi_u = 0.0035$ 
we (5.4c) = 0.00
ase ((5.4d), TBDY) =  $(\text{ase1} * A_{col1} + \text{ase2} * A_{col2} + \text{ase3} * A_{web}) / A_{sec} = 0.00$ 
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
bi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
bi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min =  $\text{Min}(psh,x, psh,y) = 0.0010472$ 

```

```

psh,x =  $\text{ps1,x} + \text{ps2,x} + \text{ps3,x} = 0.00439823$ 
ps1,x (column 1) =  $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$ 
h1 = 600.00
As1 =  $A_{stir1} * n_{s1} = 157.0796$ 
No stirups,  $n_{s1} = 2.00$ 
ps2,x (column 2) =  $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$ 
h2 = 600.00
As2 =  $A_{stir2} * n_{s2} = 157.0796$ 
No stirups,  $n_{s2} = 2.00$ 
ps3,x (web) =  $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$ 
h3 = 1800.00
As3 =  $A_{stir3} * n_{s3} = 0.00$ 
No stirups,  $n_{s3} = 2.00$ 

```

```

psh,y =  $\text{ps1,y} + \text{ps2,y} + \text{ps3,y} = 0.0010472$ 
ps1,y (column 1) =  $(A_{s1} * h_1 / s_1) / A_c = 0.0005236$ 
h1 = 250.00
As1 =  $A_{stir1} * n_{s1} = 157.0796$ 
No stirups,  $n_{s1} = 2.00$ 
ps2,y (column 2) =  $(A_{s2} * h_2 / s_2) / A_c = 0.0005236$ 
h2 = 250.00

```

$As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,y (web) = (As3 * h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 * ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

$Asec = 750000.00$

$s_1 = 100.00$

$s_2 = 100.00$

$s_3 = 200.00$

$fywe = 625.00$

$fce = 25.00$

From ((5.A5), TBDY), TBDY: $cc = 0.002$

$c =$ confinement factor $= 1.00$

$y1 = 0.00094258$

$sh1 = 0.00301626$

$ft1 = 282.7748$

$fy1 = 235.6456$

$su1 = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor $= 1.00$

$lo/lou,min = lb/ld = 0.16565482$

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

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

For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered
characteristic value $fsy1 = fs1/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 * (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs1 = fs = 235.6456$

with $Es1 = Es = 200000.00$

$y2 = 0.00094258$

$sh2 = 0.00301626$

$ft2 = 282.7748$

$fy2 = 235.6456$

$su2 = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor $= 1.00$

$lo/lou,min = lb/lb,min = 0.16565482$

$su2 = 0.4 * esu2_nominal ((5.5), TBDY) = 0.032$

From table 5A.1, TBDY: $esu2_nominal = 0.08$,

For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered
characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 * (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs2 = fs = 235.6456$

with $Es2 = Es = 200000.00$

$yv = 0.00094258$

$shv = 0.00301626$

$ftv = 282.7748$

$fyv = 235.6456$

$suv = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor $= 1.00$

$lo/lou,min = lb/ld = 0.16565482$

$suv = 0.4 * esuv_nominal ((5.5), TBDY) = 0.032$

From table 5A.1, TBDY: $esuv_nominal = 0.08$,

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

For calculation of $esuv_nominal$ and yv, shv, ftv, fyv , it is considered
characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 * (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fsv = fs = 235.6456$

with $Esv = Es = 200000.00$

$1 = Asl,ten / (b * d) * (fs1 / fc) = 0.04275722$

$2 = Asl,com / (b * d) * (fs2 / fc) = 0.04275722$

$v = Asl,mid / (b * d) * (fsv / fc) = 0.02429711$

and confined core properties:

$$b = 2940.00$$

$$d = 178.00$$

$$d' = 12.00$$

$$f_{cc} (5A.2, TBDY) = 25.00$$

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

$$c = \text{confinement factor} = 1.00$$

$$1 = A_{s1,ten}/(b*d)*(f_{s1}/f_c) = 0.05098316$$

$$2 = A_{s2,com}/(b*d)*(f_{s2}/f_c) = 0.05098316$$

$$v = A_{s,mid}/(b*d)*(f_{sv}/f_c) = 0.02897156$$

Case/Assumption: Unconfined full section - Steel rupture

' satisfies Eq. (4.3)

--->

$v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

--->

$$s_u (4.9) = 0.23047746$$

$$\mu_u = M_{Rc} (4.14) = 1.4440E+008$$

$$u = s_u (4.1) = 1.8844503E-005$$

Calculation of ratio l_b/d

Lap Length: $l_b/d = 0.16565482$

$$l_b = 300.00$$

$$d = 1810.995$$

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

l_d, \min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$$= 1$$

$$d_b = 16.35294$$

Mean strength value of all re-bars: $f_y = 625.00$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

Calculation of Shear Strength $V_r = \min(V_{r1}, V_{r2}) = 1.1297E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 1.1297E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f'_c^{0.5}*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$

$$\mu_u/V_u - l_w/2 = 0.00 \leq 0$$

$$= 1 \text{ (normal-weight concrete)}$$

$$f'_c = 25.00, \text{ but } f'_c^{0.5} \leq 8.3 \text{ MPa (22.5.3.1, ACI 318-14)}$$

$$h = 3000.00$$

$$d = 200.00$$

$$l_w = 250.00$$

$$\mu_u = 2.5788780E-012$$

$$V_u = 0.00$$

$$N_u = 27588.841$$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$

$V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)

$V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

$$d = 200.00$$

$$A_v = 0.00$$

$$s = 200.00$$

$$f_y = 500.00$$

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$$2(1-s/d) = 0.00$$

$$V_f ((11-3)-(11.4), \text{ACI 440}) = 0.00$$

$$\text{From (11-11), ACI 440: } V_s + V_f \leq 1.9929E+006$$

$$b_w = 3000.00$$

Calculation of Shear Strength at edge 2, $V_{r2} = 1.1297E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83f_c'^{0.5}h*d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f^*V_f$ '

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$

$$\mu_u/V_u - l_w/2 = 0.00 \leq 0$$

= 1 (normal-weight concrete)

$$f_c' = 25.00, \text{ but } f_c'^{0.5} \leq 8.3 \text{ MPa (22.5.3.1, ACI 318-14)}$$

$$h = 3000.00$$

$$d = 200.00$$

$$l_w = 250.00$$

$$\mu_u = 2.5788780E-012$$

$$V_u = 0.00$$

$$N_u = 27588.841$$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$

Vs1 = 157079.633 is calculated for pseudo-Column 1, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

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

Vs2 = 157079.633 is calculated for pseudo-Column 2, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

$$d = 200.00$$

$$A_v = 0.00$$

$$s = 200.00$$

$$f_y = 500.00$$

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$$2(1-s/d) = 0.00$$

$$V_f ((11-3)-(11.4), \text{ACI 440}) = 0.00$$

$$\text{From (11-11), ACI 440: } V_s + V_f \leq 1.9929E+006$$

$$b_w = 3000.00$$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1

At local axis: 3

Integration Section: (a)

Section Type: rcrws

Constant Properties

Knowledge Factor, $\phi = 1.00$
According to 10.7.2.3, ASCE 41-17, shear walls with
transverse reinforcement percentage, $n < 0.0015$
are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
 $n = 0.0010472$

with $n = ps1 + ps2 + ps3$, being the shear reinf. ratio in a plane perpendicular to the shear axis 2
(pseudo-col.1 $ps1 = As1*b1/s1 = (As1*h1/s1) / Ac = 0.0005236$
 $h1 = 250.00$
 $s1 = 100.00$
total area of hoops perpendicular to shear axis, $As1 = 157.0796$
(pseudo-col.2 $ps2 = As2*b2/s2 = (As2*h2/s2) / Ac = 0.0005236$
 $h2 = 250.00$
 $s2 = 100.00$
total area of hoops perpendicular to shear axis, $As2 = 157.0796$
(grid $ps3 = As3*b3/s3 = (As3*h3/s3) / Ac = 0.00$
 $h3 = 250.00$
 $s3 = 200.00$
total area of hoops perpendicular to shear axis, $As3 = 0.00$
total section area, $Ac = 750000.00$

Consequently:
New material of Secondary Member: Concrete Strength, $f_c = f_{c_lower_bound} = 25.00$
New material of Secondary Member: Steel Strength, $f_s = f_{s_lower_bound} = 500.00$
Concrete Elasticity, $E_c = 26999.444$
Steel Elasticity, $E_s = 200000.00$
Total Height, $H_{tot} = 3000.00$
Edges Width, $W_{edg} = 250.00$
Edges Height, $H_{edg} = 600.00$
Web Width, $W_{web} = 250.00$
Cover Thickness, $c = 25.00$
Element Length, $L = 3000.00$
Secondary 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
Lap Length $l_b = 300.00$
No FRP Wrapping

Stepwise Properties

Bending Moment, $M = -2.2306748E-010$
Shear Force, $V2 = -1.1969937E-013$
Shear Force, $V3 = -53656.852$
Axial Force, $F = -27994.722$
Longitudinal Reinforcement Area Distribution (in 2 divisions)
-Tension: $As_{lt} = 0.00$
-Compression: $As_{lc} = 7269.645$
Longitudinal Reinforcement Area Distribution (in 3 divisions)
-Tension: $As_{l,ten} = 2830.575$
-Compression: $As_{l,com} = 2830.575$
-Middle: $As_{l,mid} = 1608.495$
Mean Diameter of Tension Reinforcement, $Db_L = 16.46154$

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $u_R = 1.0^*$ $u = 0.00892944$
 $u = y + p = 0.00892944$

- Calculation of y -

$y = (M_y * I_p) / (EI)_{Eff} = 0.00092944 ((10-5), ASCE 41-17))$

$M_y = 1.4295E+008$
 $(EI)_{Eff} = 0.35 * E_c * I$ (table 10-5)
 $E_c * I = 1.0547E+014$
 $I_p = 0.5 * d = 0.5 * (0.8 * h) = 240.00$

Calculation of Yielding Moment M_y

Calculation of y and M_y according to Annex 7 -

 $y = \text{Min}(y_{ten}, y_{com})$
 $y_{ten} = 7.0162417E-006$
with ((10.1), ASCE 41-17) $f_y = \text{Min}(f_y, 1.25 * f_y * (I_b / I_d)^{2/3}) = 218.754$
 $d = 208.00$
 $y = 0.2505232$
 $A = 0.01185516$
 $B = 0.00720633$
with $p_t = 0.00453618$
 $p_c = 0.00453618$
 $p_v = 0.00257772$
 $N = 27994.722$
 $b = 3000.00$
 $" = 0.20192308$
 $y_{comp} = 3.2327896E-005$
with $f_c = 25.00$
 $E_c = 26999.444$
 $y = 0.24786597$
 $A = 0.01151549$
 $B = 0.00700125$
with $E_s = 200000.00$

Calculation of ratio I_b / I_d

Lap Length: $I_d / I_{d,min} = 0.20706852$
 $I_b = 300.00$
 $I_d = 1448.796$
Calculation of I according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 $I_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
 $= 1$
 $db = 16.35294$
Mean strength value of all re-bars: $f_y = 500.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

- Calculation of p -

Considering wall controlled by flexure (shear control ratio ≤ 1),
from table 10-19: $p = 0.008$
with:

- Condition i (shear wall and wall segments)
- $(A_s - A_s') * f_y + P) / (t_w * I_w * f_c') = -0.19236416$
 $A_s = 0.00$
 $A_s' = 7269.645$
 $f_y = 500.00$
 $P = 27994.722$
 $t_w = 3000.00$
 $I_w = 250.00$
 $f_c = 25.00$
- $V / (t_w * I_w * f_c'^{0.5}) = 3.8440039E-019$, NOTE: units in lb & in

- Confined Boundary: No
 Boundary hoops spacing does not exceed $8d_b$ ($s1 < 8*d_b$ and $s2 < 8*d_b$)
 Boundary Trans. Reinf. does not exceed 50% of ACI 318 provision ($V_{w1} + V_{w2} > 0.50*(V - V_c - V_{w3})$)
 With
 Boundary Element 1:
 $V_{w1} = 157079.633$
 $s1 = 100.00$
 Boundary Element 2:
 $V_{w2} = 157079.633$
 $s2 = 100.00$
 Grid Shear Force, $V_{w3} = 0.00$
 Concrete Shear Force, $V_c = 193783.13$
 (The variables above have already been given in Shear control ratio calculation)
 Mean diameter of all bars, $d_b = 17.33333$
 Design Shear Force, $V = 1.1969937E-013$

 End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
 At local axis: 3
 Integration Section: (a)

Calculation No. 13

wall W1, Floor 1
 Limit State: Life Safety (data interpolation between analysis steps 1 and 2)
 Analysis: Uniform +X
 Check: Shear capacity V_{Rd}
 Edge: End
 Local Axis: (2)



Start Of Calculation of Shear Capacity for element: wall W1 of floor 1
 At local axis: 2
 Integration Section: (b)
 Section Type: rcrrws

Constant Properties

Knowledge Factor, $\phi = 1.00$

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:

New material of Secondary Member: Concrete Strength, $f_c = f_{c_lower_bound} = 25.00$

New material of Secondary Member: Steel Strength, $f_s = f_{s_lower_bound} = 500.00$

Concrete Elasticity, $E_c = 26999.444$

Steel Elasticity, $E_s = 200000.00$

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_o = l_b = 300.00$

No FRP Wrapping

Stepwise Properties

EDGE -A-

Bending Moment, $M_a = -2.2306748E-010$

Shear Force, $V_a = -1.1969937E-013$

EDGE -B-

Bending Moment, $M_b = -1.3664558E-010$

Shear Force, $V_b = 1.1969937E-013$

BOTH EDGES

Axial Force, $F = -27994.722$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $As_t = 0.00$

-Compression: $As_c = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $As_{t,ten} = 2830.575$

-Compression: $As_{c,com} = 2830.575$

-Middle: $As_{mid} = 1608.495$

Mean Diameter of Tension Reinforcement, $Db_{L,ten} = 16.46154$

New component: From table 7-7, ASCE 41_17: Final Shear Capacity $V_R = 1.0 \cdot V_n = 539038.079$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_n < 0.83 \cdot f_c'^{0.5} \cdot h \cdot d = 539038.079$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 224878.814$

$\mu_u / V_u - l_w / 2 = 1016.573 > 0$

$= 1$ (normal-weight concrete)

$f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)

$h = 3000.00$

$d = 200.00$

$l_w = 250.00$

$\mu_u = 1.3664558E-010$

$V_u = 1.1969937E-013$

$N_u = 27994.722$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$

$V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:

$d = 200.00$

$A_v = 157079.633$

$$s = 100.00$$

$$f_y = 500.00$$

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

Vs2 = 157079.633 is calculated for pseudo-Column 2, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

$$d = 200.00$$

$$A_v = 0.00$$

$$s = 200.00$$

$$f_y = 500.00$$

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$$2(1-s/d) = 0.00$$

$$V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$$

$$\text{From } (11-11), \text{ACI } 440: V_s + V_f \leq 1.9929\text{E}+006$$

$$b_w = 3000.00$$

End Of Calculation of Shear Capacity for element: wall W1 of floor 1

At local axis: 2

Integration Section: (b)

Calculation No. 14

wall W1, Floor 1

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

Analysis: Uniform +X

Check: Chord rotation capacity (μ)

Edge: End

Local Axis: (2)



Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At Shear local axis: 3

(Bending local axis: 2)

Section Type: rcwrs

Constant Properties

Knowledge Factor, $\gamma = 1.00$

Mean strength values are used for both shear and moment calculations.

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 33.00$

New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 555.56$

Concrete Elasticity, $E_c = 26999.444$

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

New material: Steel Strength, $f_s = 1.25 \cdot f_{sm} = 694.45$

#####

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Mean Confinement Factor overall section = 1.00

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_o = 300.00$

No FRP Wrapping

Stepwise Properties

At local axis: 3

EDGE -A-

Shear Force, $V_a = 1.5016185E-058$

EDGE -B-

Shear Force, $V_b = -1.5016185E-058$

BOTH EDGES

Axial Force, $F = -27588.841$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $As_t = 0.00$

-Compression: $As_c = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $As_{l,ten} = 2865.133$

-Compression: $As_{l,com} = 2865.133$

-Middle: $As_{l,mid} = 0.00$

(According to 10.7.2.3 $As_{l,mid}$ is setted equal to zero)

Calculation of Shear Capacity ratio, $V_e/V_r = 0.69050088$

Member Controlled by Flexure ($V_e/V_r < 1$)

Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 $V_e = (M_{pr1} + M_{pr2})/l_n = 1.6587E+006$

with

$M_{pr1} = \max(\mu_{u1+}, \mu_{u1-}) = 2.4881E+009$

$\mu_{u1+} = 2.1705E+009$, 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

$\mu_{u1-} = 2.4881E+009$, 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

$M_{pr2} = \max(\mu_{u2+}, \mu_{u2-}) = 2.4881E+009$

$\mu_{u2+} = 2.1705E+009$, 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

$\mu_{u2-} = 2.4881E+009$, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

Calculation of Mu1+

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

$$\phi_u = 1.2902105E-006$$

$$M_u = 2.1705E+009$$

with full section properties:

$$b = 250.00$$

$$d = 2957.00$$

$$d' = 43.00$$

$$\nu = 0.00113091$$

$$N = 27588.841$$

$$f_c = 33.00$$

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

$$\text{Final value of } \phi_u: \phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } \phi_u = 0.0035$$

$$w_e(5.4c) = 0.00$$

$$a_{se}((5.4d), TBDY) = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$$

$$a_{se1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$a_{se2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$a_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$p_{sh,min} = \text{Min}(p_{sh,x}, p_{sh,y}) = 0.0010472$$

$$p_{sh,x} = p_{s1,x} + p_{s2,x} + p_{s3,x} = 0.00439823$$

$$p_{s1,x} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$p_{s2,x} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$p_{s3,x} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$p_{sh,y} = p_{s1,y} + p_{s2,y} + p_{s3,y} = 0.0010472$$

$$p_{s1,y} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$p_{s2,y} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$$

$$h_2 = 250.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$p_{s3,y} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00$$

$$h_3 = 250.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 157.0796$$

$$\text{No stirups, } n_{s3} = 0.00$$

$$A_{sec} = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$f_{ywe} = 694.45$$

```

fce = 33.00
From ((5A.5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00096384
sh1 = 0.00308428
ft1 = 321.2814
fy1 = 267.7345
su1 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.17128923
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
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 = 267.7345
with Es1 = Es = 200000.00
y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.17128923
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
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 = 267.7345
with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.17128923
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
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 = 267.7345
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)

```

```

--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.19157175
Mu = MRc (4.14) = 2.1705E+009
u = su (4.1) = 1.2902105E-006

```

Calculation of ratio lb/l_d

```

Lap Length: lb/ld = 0.17128923
lb = 300.00
ld = 1751.424
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 694.45
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 1.848
n = 34.00

```

Calculation of Mu1-

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

```

u = 1.2974768E-006
Mu = 2.4881E+009

```

with full section properties:

```

b = 250.00
d = 2957.00
d' = 43.00
v = 0.00113091
N = 27588.841
fc = 33.00
co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max( cu, cc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: cu = 0.0035
we (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
bi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
bi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472

```

```

psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796
No stirups, ns1 = 2.00
ps2,x (column 2) = (As2*h2/s_2)/Ac = 0.00125664

```

$h_2 = 600.00$
 $As_2 = Astir_2 * ns_2 = 157.0796$
 No stirups, $ns_2 = 2.00$
 $ps_{3,x} (web) = (As_3 * h_3 / s_3) / Ac = 0.00188496$
 $h_3 = 1800.00$
 $As_3 = Astir_3 * ns_3 = 0.00$
 No stirups, $ns_3 = 2.00$

$psh,y = ps_1,y + ps_2,y + ps_3,y = 0.0010472$
 $ps_{1,y} (column\ 1) = (As_1 * h_1 / s_1) / Ac = 0.0005236$
 $h_1 = 250.00$
 $As_1 = Astir_1 * ns_1 = 157.0796$
 No stirups, $ns_1 = 2.00$
 $ps_{2,y} (column\ 2) = (As_2 * h_2 / s_2) / Ac = 0.0005236$
 $h_2 = 250.00$
 $As_2 = Astir_2 * ns_2 = 157.0796$
 No stirups, $ns_2 = 2.00$
 $ps_{3,y} (web) = (As_3 * h_3 / s_3) / Ac = 0.00$
 $h_3 = 250.00$
 $As_3 = Astir_3 * ns_3 = 157.0796$
 No stirups, $ns_3 = 0.00$

$A_{sec} = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $fy_{we} = 694.45$
 $f_{ce} = 33.00$
 From ((5.A.5), TBDY), TBDY: $cc = 0.002$
 $c = \text{confinement factor} = 1.00$
 $y_1 = 0.00096384$
 $sh_1 = 0.00308428$
 $ft_1 = 321.2814$
 $fy_1 = 267.7345$
 $su_1 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/ld = 0.17128923$
 $su_1 = 0.4 * esu_{1,nominal} ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu_{1,nominal} = 0.08$,
 For calculation of $esu_{1,nominal}$ and y_1, sh_1, ft_1, fy_1 , it is considered
 characteristic value $fsy_1 = fs_1 / 1.2$, from table 5.1, TBDY.
 y_1, sh_1, ft_1, fy_1 , are also multiplied by $\text{Min}(1, 1.25 * (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs_1 = fs = 267.7345$
 with $Es_1 = Es = 200000.00$
 $y_2 = 0.00096384$
 $sh_2 = 0.00308428$
 $ft_2 = 321.2814$
 $fy_2 = 267.7345$
 $su_2 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/lb,min = 0.17128923$
 $su_2 = 0.4 * esu_{2,nominal} ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu_{2,nominal} = 0.08$,
 For calculation of $esu_{2,nominal}$ and y_2, sh_2, ft_2, fy_2 , it is considered
 characteristic value $fsy_2 = fs_2 / 1.2$, from table 5.1, TBDY.
 y_1, sh_1, ft_1, fy_1 , are also multiplied by $\text{Min}(1, 1.25 * (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs_2 = fs = 267.7345$
 with $Es_2 = Es = 200000.00$
 $y_v = 0.00096384$
 $sh_v = 0.00308428$
 $ft_v = 321.2814$
 $fy_v = 267.7345$
 $suv = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $l_o/l_{ou,min} = l_b/l_d = 0.17128923$
 $suv = 0.4 * esuv_{nominal} ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esuv_{nominal} = 0.08$,
 considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
 For calculation of $esuv_{nominal}$ and yv , shv , ftv , fyv , it is considered
 characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
 $y1$, $sh1$, $ft1$, $fy1$, are also multiplied by $\text{Min}(1, 1.25 * (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fsv = fs = 267.7345$
 with $Esv = Es = 200000.00$
 $1 = Asl_{ten}/(b*d) * (fs1/fc) = 0.03144444$
 $2 = Asl_{com}/(b*d) * (fs2/fc) = 0.03144444$
 $v = Asl_{mid}/(b*d) * (fsv/fc) = 0.01689449$
 and confined core properties:
 $b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $fcc (5A.2, TBDY) = 33.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = Asl_{ten}/(b*d) * (fs1/fc) = 0.04179832$
 $2 = Asl_{com}/(b*d) * (fs2/fc) = 0.04179832$
 $v = Asl_{mid}/(b*d) * (fsv/fc) = 0.02245743$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)
 --->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.19609924$
 $Mu = MRc (4.14) = 2.4881E+009$
 $u = su (4.1) = 1.2974768E-006$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$
 $l_b = 300.00$
 $l_d = 1751.424$
 Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 $l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $fy = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $Ktr = 1.848$
 $n = 34.00$

Calculation of Mu_{2+}

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 $u = 1.2902105E-006$
 $Mu = 2.1705E+009$

with full section properties:
 $b = 250.00$
 $d = 2957.00$
 $d' = 43.00$
 $v = 0.00113091$

$N = 27588.841$
 $fc = 33.00$
 $co \text{ (5A.5, TBDY)} = 0.002$
 Final value of cu : $cu^* = \text{shear_factor} * \text{Max}(cu, cc) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)
 From (5.4b), TBDY: $cu = 0.0035$
 $we \text{ (5.4c)} = 0.00$
 $ase \text{ ((5.4d), TBDY)} = (ase1 * Acol1 + ase2 * Acol2 + ase3 * Aweb) / Asec = 0.00$
 $ase1 = 0.00$
 $sh_1 = 100.00$
 $bo_1 = 190.00$
 $ho_1 = 540.00$
 $bi2_1 = 655400.00$
 $ase2 = 0.00$
 $sh_2 = 100.00$
 $bo_2 = 190.00$
 $ho_2 = 540.00$
 $bi2_2 = 655400.00$
 $ase3 = 0$ (grid does not provide confinement)
 $psh, \min = \text{Min}(psh, x, psh, y) = 0.0010472$

$psh, x = ps1, x + ps2, x + ps3, x = 0.00439823$
 $ps1, x \text{ (column 1)} = (As1 * h1 / s_1) / Ac = 0.00125664$
 $h1 = 600.00$
 $As1 = Astir1 * ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2, x \text{ (column 2)} = (As2 * h2 / s_2) / Ac = 0.00125664$
 $h2 = 600.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3, x \text{ (web)} = (As3 * h3 / s_3) / Ac = 0.00188496$
 $h3 = 1800.00$
 $As3 = Astir3 * ns3 = 0.00$
 No stirups, $ns3 = 2.00$

$psh, y = ps1, y + ps2, y + ps3, y = 0.0010472$
 $ps1, y \text{ (column 1)} = (As1 * h1 / s_1) / Ac = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 * ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2, y \text{ (column 2)} = (As2 * h2 / s_2) / Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3, y \text{ (web)} = (As3 * h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 * ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

$Asec = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $fywe = 694.45$
 $fce = 33.00$
 From ((5.A5), TBDY), TBDY: $cc = 0.002$
 $c = \text{confinement factor} = 1.00$
 $y1 = 0.00096384$
 $sh1 = 0.00308428$
 $ft1 = 321.2814$
 $fy1 = 267.7345$
 $su1 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $\text{Shear_factor} = 1.00$
 $lo/lou, \min = lb/ld = 0.17128923$
 $su1 = 0.4 * esu1_nominal \text{ ((5.5), TBDY)} = 0.032$

From table 5A.1, TBDY: $esu1_nominal = 0.08$,
For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered
characteristic value $fsy1 = fs1/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
with $fs1 = fs = 267.7345$
with $Es1 = Es = 200000.00$
 $y2 = 0.00096384$
 $sh2 = 0.00308428$
 $ft2 = 321.2814$
 $fy2 = 267.7345$
 $su2 = 0.00308428$
using (30) in Biskinis/Fardis (2013) multiplied with $shear_factor$
and also multiplied by the $shear_factor$ according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou, min = lb/lb, min = 0.17128923$
 $su2 = 0.4 \cdot esu2_nominal \cdot ((5.5), TBDY) = 0.032$
From table 5A.1, TBDY: $esu2_nominal = 0.08$,
For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered
characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
with $fs2 = fs = 267.7345$
with $Es2 = Es = 200000.00$
 $yv = 0.00096384$
 $shv = 0.00308428$
 $ftv = 321.2814$
 $fyv = 267.7345$
 $suv = 0.00308428$
using (30) in Biskinis/Fardis (2013) multiplied with $shear_factor$
and also multiplied by the $shear_factor$ according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou, min = lb/ld = 0.17128923$
 $suv = 0.4 \cdot esuv_nominal \cdot ((5.5), TBDY) = 0.032$
From table 5A.1, TBDY: $esuv_nominal = 0.08$,
considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
For calculation of $esuv_nominal$ and yv, shv, ftv, fyv , it is considered
characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
with $fsv = fs = 267.7345$
with $Esv = Es = 200000.00$
 $1 = Asl, ten / (b \cdot d) \cdot (fs1 / fc) = 0.03144444$
 $2 = Asl, com / (b \cdot d) \cdot (fs2 / fc) = 0.03144444$
 $v = Asl, mid / (b \cdot d) \cdot (fsv / fc) = 0.00$

and confined core properties:

$b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $fcc \text{ (5A.2, TBDY)} = 33.00$
 $cc \text{ (5A.5, TBDY)} = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = Asl, ten / (b \cdot d) \cdot (fs1 / fc) = 0.04179832$
 $2 = Asl, com / (b \cdot d) \cdot (fs2 / fc) = 0.04179832$
 $v = Asl, mid / (b \cdot d) \cdot (fsv / fc) = 0.00$

Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)

--->

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

--->

$su \text{ (4.9)} = 0.19157175$
 $Mu = MRc \text{ (4.14)} = 2.1705E+009$
 $u = su \text{ (4.1)} = 1.2902105E-006$

Calculation of ratio lb/ld

Lap Length: $lb/ld = 0.17128923$
 $lb = 300.00$
 $ld = 1751.424$

Calculation of l_b, \min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d, \min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
Mean strength value of all re-bars: $f_y = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of μ_2 -

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

$$\mu = 1.2974768E-006$$

$$\mu_u = 2.4881E+009$$

with full section properties:

$$b = 250.00$$

$$d = 2957.00$$

$$d' = 43.00$$

$$v = 0.00113091$$

$$N = 27588.841$$

$$f_c = 33.00$$

$$c_o \text{ (5A.5, TBDY)} = 0.002$$

$$\text{Final value of } \mu: \mu^* = \text{shear_factor} * \text{Max}(\mu, c_o) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } \mu = 0.0035$$

$$w_e \text{ (5.4c)} = 0.00$$

$$a_{se} \text{ ((5.4d), TBDY)} = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$$

$$a_{se1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$a_{se2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$a_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$psh, \min = \text{Min}(psh, x, psh, y) = 0.0010472$$

$$psh, x = ps1, x + ps2, x + ps3, x = 0.00439823$$

$$ps1, x \text{ (column 1)} = (As1 * h1 / s_1) / A_c = 0.00125664$$

$$h1 = 600.00$$

$$As1 = A_{stir1} * ns1 = 157.0796$$

$$\text{No stirups, } ns1 = 2.00$$

$$ps2, x \text{ (column 2)} = (As2 * h2 / s_2) / A_c = 0.00125664$$

$$h2 = 600.00$$

$$As2 = A_{stir2} * ns2 = 157.0796$$

$$\text{No stirups, } ns2 = 2.00$$

$$ps3, x \text{ (web)} = (As3 * h3 / s_3) / A_c = 0.00188496$$

$$h3 = 1800.00$$

$$As3 = A_{stir3} * ns3 = 0.00$$

$$\text{No stirups, } ns3 = 2.00$$

$$psh, y = ps1, y + ps2, y + ps3, y = 0.0010472$$

$$ps1, y \text{ (column 1)} = (As1 * h1 / s_1) / A_c = 0.0005236$$

$$h1 = 250.00$$

$$As1 = A_{stir1} * ns1 = 157.0796$$

$$\text{No stirups, } ns1 = 2.00$$

$$ps2,y \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.0005236$$

$$h2 = 250.00$$

$$As2 = Astir2 \cdot ns2 = 157.0796$$

$$\text{No stirups, } ns2 = 2.00$$

$$ps3,y \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00$$

$$h3 = 250.00$$

$$As3 = Astir3 \cdot ns3 = 157.0796$$

$$\text{No stirups, } ns3 = 0.00$$

$$Asec = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$fywe = 694.45$$

$$fce = 33.00$$

$$\text{From ((5.A5), TBDY), TBDY: } cc = 0.002$$

$$c = \text{confinement factor} = 1.00$$

$$y1 = 0.00096384$$

$$sh1 = 0.00308428$$

$$ft1 = 321.2814$$

$$fy1 = 267.7345$$

$$su1 = 0.00308428$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/ld = 0.17128923$$

$$su1 = 0.4 \cdot esu1_nominal \text{ ((5.5), TBDY)} = 0.032$$

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

For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

$$\text{with } fs1 = fs = 267.7345$$

$$\text{with } Es1 = Es = 200000.00$$

$$y2 = 0.00096384$$

$$sh2 = 0.00308428$$

$$ft2 = 321.2814$$

$$fy2 = 267.7345$$

$$su2 = 0.00308428$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/lb,min = 0.17128923$$

$$su2 = 0.4 \cdot esu2_nominal \text{ ((5.5), TBDY)} = 0.032$$

From table 5A.1, TBDY: esu2_nominal = 0.08,

For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

$$\text{with } fs2 = fs = 267.7345$$

$$\text{with } Es2 = Es = 200000.00$$

$$yv = 0.00096384$$

$$shv = 0.00308428$$

$$ftv = 321.2814$$

$$fyv = 267.7345$$

$$suv = 0.00308428$$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00

$$lo/lou,min = lb/ld = 0.17128923$$

$$suv = 0.4 \cdot esuv_nominal \text{ ((5.5), TBDY)} = 0.032$$

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

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

For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.

y1, sh1,ft1,fy1, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

$$\text{with } fsv = fs = 267.7345$$

$$\text{with } Esv = Es = 200000.00$$

$$1 = Asl,ten / (b \cdot d) \cdot (fs1 / fc) = 0.03144444$$

$$2 = A_{sl,com}/(b*d)*(f_s2/f_c) = 0.03144444$$

$$v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.01689449$$

and confined core properties:

$$b = 190.00$$

$$d = 2927.00$$

$$d' = 13.00$$

$$f_{cc} (5A.2, TBDY) = 33.00$$

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

$$c = \text{confinement factor} = 1.00$$

$$1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.04179832$$

$$2 = A_{sl,com}/(b*d)*(f_s2/f_c) = 0.04179832$$

$$v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02245743$$

Case/Assumption: Unconfined full section - Steel rupture

' satisfies Eq. (4.3)

--->

$v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

--->

$$s_u (4.9) = 0.19609924$$

$$M_u = M_{Rc} (4.14) = 2.4881E+009$$

$$u = s_u (4.1) = 1.2974768E-006$$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.17128923$

$$l_b = 300.00$$

$$l_d = 1751.424$$

Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

$l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$$= 1$$

$$d_b = 16.35294$$

Mean strength value of all re-bars: $f_y = 694.45$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

Calculation of Shear Strength $V_r = \text{Min}(V_{r1}, V_{r2}) = 2.4022E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 2.4022E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f_c'^{0.5}*h*d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f^*V_f$ '

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$

$$M_u/V_u - l_w/2 = 0.00 \leq 0$$

$$= 1 \text{ (normal-weight concrete)}$$

$$f_c' = 33.00, \text{ but } f_c'^{0.5} \leq 8.3 \text{ MPa (22.5.3.1, ACI 318-14)}$$

$$h = 250.00$$

$$d = 2400.00$$

$$l_w = 3000.00$$

$$M_u = 1.2001755E-010$$

$$V_u = 1.5016185E-058$$

$$N_u = 27588.841$$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$

$V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:

$$d = 480.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 555.56$$

V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)

Vs2 = 418882.372 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 555.56
Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
Vs3 = 628323.557 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 555.56
Vs3 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 2.2897E+006
bw = 250.00

Calculation of Shear Strength at edge 2, Vr2 = 2.4022E+006
From (22.5.1.1) and 11.5.4.3, ACI 318-14: Vr2 = Vn < 0.83*fc'^0.5*h*d

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 (11.5.4.6(d-e)), ACI 318-14: Vc = 936136.917
Mu/Vu-lw/2 = 0.00 <= 0
= 1 (normal-weight concrete)
fc' = 33.00, but fc'^0.5 <= 8.3 MPa (22.5.3.1, ACI 318-14)
h = 250.00
d = 2400.00
lw = 3000.00
Mu = 1.2001755E-010
Vu = 1.5016185E-058
Nu = 27588.841
From (11.5.4.8), ACI 318-14: Vs = Vs1 + Vs2 + Vs3 = 1.4661E+006
Vs1 = 418882.372 is calculated for pseudo-Column 1, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 555.56
Vs1 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
Vs2 = 418882.372 is calculated for pseudo-Column 2, with:
d = 480.00
Av = 157079.633
s = 100.00
fy = 555.56
Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
Vs3 = 628323.557 is calculated for web, with:
d = 1440.00
Av = 157079.633
s = 200.00
fy = 555.56
Vs3 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)
Vf ((11-3)-(11.4), ACI 440) = 0.00
From (11-11), ACI 440: Vs + Vf <= 2.2897E+006
bw = 250.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1
At Shear local axis: 2
(Bending local axis: 3)
Section Type: rcrrws

Constant Properties

Knowledge Factor, $\phi = 1.00$
 Mean strength values are used for both shear and moment calculations.
 Consequently:
 New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 25.00$
 New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 500.00$
 Concrete Elasticity, $E_c = 26999.444$
 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
 New material: Steel Strength, $f_s = 1.25 \cdot f_{sm} = 625.00$
 #####
 Total Height, $H_{tot} = 3000.00$
 Edges Width, $W_{edg} = 250.00$
 Edges Height, $H_{edg} = 600.00$
 Web Width, $W_{web} = 250.00$
 Cover Thickness, $c = 25.00$
 Mean Confinement Factor overall section = 1.00
 Element Length, $L = 3000.00$
 Secondary 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
 Lap Length $l_o = 300.00$
 No FRP Wrapping

Stepwise Properties

At local axis: 2
 EDGE -A-
 Shear Force, $V_a = 0.00$
 EDGE -B-
 Shear Force, $V_b = 0.00$
 BOTH EDGES
 Axial Force, $F = -27588.841$
 Longitudinal Reinforcement Area Distribution (in 2 divisions)
 -Tension: $As_t = 0.00$
 -Compression: $As_c = 7269.645$
 Longitudinal Reinforcement Area Distribution (in 3 divisions)
 -Tension: $As_{t,ten} = 2830.575$
 -Compression: $As_{c,com} = 2830.575$
 -Middle: $As_{l,mid} = 0.00$
 (According to 10.7.2.3 $As_{l,mid}$ is setted equal to zero)

Calculation of Shear Capacity ratio, $V_e/V_r = 0.08521711$
 Member Controlled by Flexure ($V_e/V_r < 1$)
 Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 $V_e = (M_{pr1} + M_{pr2})/l_n = 96267.817$
 with
 $M_{pr1} = \max(\mu_{u1+}, \mu_{u1-}) = 1.4440E+008$
 $\mu_{u1+} = 1.2341E+008$, 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
 $\mu_{u1-} = 1.4440E+008$, 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
 $M_{pr2} = \max(\mu_{u2+}, \mu_{u2-}) = 1.4440E+008$
 $\mu_{u2+} = 1.2341E+008$, 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
 $\mu_{u2-} = 1.4440E+008$, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the the static loading combination

Calculation of μ_{u1+}

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

$$\phi_u = 1.8630672E-005$$

$$\mu = 1.2341E+008$$

with full section properties:

$$b = 3000.00$$

$$d = 208.00$$

$$d' = 42.00$$

$$\nu = 0.00176852$$

$$N = 27588.841$$

$$f_c = 25.00$$

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

$$\text{Final value of } \phi_u: \phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_{co}) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } \phi_u = 0.0035$$

$$\phi_{we} (5.4c) = 0.00$$

$$\phi_{ase} ((5.4d), TBDY) = (\phi_{ase1} * A_{col1} + \phi_{ase2} * A_{col2} + \phi_{ase3} * A_{web}) / A_{sec} = 0.00$$

$$\phi_{ase1} = 0.00$$

$$s_{h1} = 100.00$$

$$b_{o1} = 190.00$$

$$h_{o1} = 540.00$$

$$b_{i21} = 655400.00$$

$$\phi_{ase2} = 0.00$$

$$s_{h2} = 100.00$$

$$b_{o2} = 190.00$$

$$h_{o2} = 540.00$$

$$b_{i22} = 655400.00$$

$$\phi_{ase3} = 0 \text{ (grid does not provide confinement)}$$

$$\phi_{psh,min} = \text{Min}(\phi_{psh,x}, \phi_{psh,y}) = 0.0010472$$

$$\phi_{psh,x} = \phi_{ps1,x} + \phi_{ps2,x} + \phi_{ps3,x} = 0.00439823$$

$$\phi_{ps1,x} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{ps2,x} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{ps3,x} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$\phi_{psh,y} = \phi_{ps1,y} + \phi_{ps2,y} + \phi_{ps3,y} = 0.0010472$$

$$\phi_{ps1,y} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{ps2,y} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$$

$$h_2 = 250.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{ps3,y} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00$$

$$h_3 = 250.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 157.0796$$

$$\text{No stirups, } n_{s3} = 0.00$$

$$A_{sec} = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

$$f_{ywe} = 625.00$$

$$f_{ce} = 25.00$$

```

From ((5.A.5), TBDY), TBDY:  $cc = 0.002$ 
 $c = \text{confinement factor} = 1.00$ 
 $y1 = 0.00094258$ 
 $sh1 = 0.00301626$ 
 $ft1 = 282.7748$ 
 $fy1 = 235.6456$ 
 $su1 = 0.00301626$ 
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
 $lo/lou,min = lb/ld = 0.16565482$ 
 $su1 = 0.4*esu1\_nominal ((5.5), TBDY) = 0.032$ 
From table 5A.1, TBDY:  $esu1\_nominal = 0.08$ ,
For calculation of  $esu1\_nominal$  and  $y1, sh1, ft1, fy1$ , it is considered
characteristic value  $fsy1 = fs1/1.2$ , from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$ , are also multiplied by  $Min(1, 1.25*(lb/ld)^{2/3})$ , from 10.3.5, ASCE 41-17.
with  $fs1 = fs = 235.6456$ 
with  $Es1 = Es = 200000.00$ 
 $y2 = 0.00094258$ 
 $sh2 = 0.00301626$ 
 $ft2 = 282.7748$ 
 $fy2 = 235.6456$ 
 $su2 = 0.00301626$ 
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
 $lo/lou,min = lb/lb,min = 0.16565482$ 
 $su2 = 0.4*esu2\_nominal ((5.5), TBDY) = 0.032$ 
From table 5A.1, TBDY:  $esu2\_nominal = 0.08$ ,
For calculation of  $esu2\_nominal$  and  $y2, sh2, ft2, fy2$ , it is considered
characteristic value  $fsy2 = fs2/1.2$ , from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$ , are also multiplied by  $Min(1, 1.25*(lb/ld)^{2/3})$ , from 10.3.5, ASCE 41-17.
with  $fs2 = fs = 235.6456$ 
with  $Es2 = Es = 200000.00$ 
 $yv = 0.00094258$ 
 $shv = 0.00301626$ 
 $ftv = 282.7748$ 
 $fyv = 235.6456$ 
 $suv = 0.00301626$ 
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
 $lo/lou,min = lb/ld = 0.16565482$ 
 $suv = 0.4*esuv\_nominal ((5.5), TBDY) = 0.032$ 
From table 5A.1, TBDY:  $esuv\_nominal = 0.08$ ,
considering characteristic value  $fsyv = fsv/1.2$ , from table 5.1, TBDY
For calculation of  $esuv\_nominal$  and  $yv, shv, ftv, fyv$ , it is considered
characteristic value  $fsyv = fsv/1.2$ , from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$ , are also multiplied by  $Min(1, 1.25*(lb/ld)^{2/3})$ , from 10.3.5, ASCE 41-17.
with  $fsv = fs = 235.6456$ 
with  $Esv = Es = 200000.00$ 
 $1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722$ 
 $2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722$ 
 $v = Asl,mid/(b*d)*(fsv/fc) = 0.00$ 
and confined core properties:
 $b = 2940.00$ 
 $d = 178.00$ 
 $d' = 12.00$ 
 $fcc (5A.2, TBDY) = 25.00$ 
 $cc (5A.5, TBDY) = 0.002$ 
 $c = \text{confinement factor} = 1.00$ 
 $1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316$ 
 $2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316$ 
 $v = Asl,mid/(b*d)*(fsv/fc) = 0.00$ 
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
--->

```


$v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

---->

$$su(4.9) = 0.22164534$$

$$\mu = MRc(4.14) = 1.2341E+008$$

$$u = su(4.1) = 1.8630672E-005$$

Calculation of ratio l_b/l_d

$$\text{Lap Length: } l_b/l_d = 0.16565482$$

$$l_b = 300.00$$

$$l_d = 1810.995$$

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

l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$$= 1$$

$$d_b = 16.35294$$

$$\text{Mean strength value of all re-bars: } f_y = 625.00$$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

Calculation of μ_1 -

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

$$u = 1.8844503E-005$$

$$\mu = 1.4440E+008$$

with full section properties:

$$b = 3000.00$$

$$d = 208.00$$

$$d' = 42.00$$

$$v = 0.00176852$$

$$N = 27588.841$$

$$f_c = 25.00$$

$$c_o(5A.5, \text{TB DY}) = 0.002$$

$$\text{Final value of } c_u: c_u^* = \text{shear_factor} * \text{Max}(c_u, c_c) = 0.0035$$

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

$$\text{From (5.4b), TB DY: } c_u = 0.0035$$

$$w_e(5.4c) = 0.00$$

$$a_{se}((5.4d), \text{TB DY}) = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$$

$$a_{se1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$a_{se2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$a_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$p_{sh,min} = \text{Min}(p_{sh,x}, p_{sh,y}) = 0.0010472$$

$$p_{sh,x} = p_{s1,x} + p_{s2,x} + p_{s3,x} = 0.00439823$$

$$p_{s1,x}(\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$p_{s2,x}(\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$As_2 = Astir_2 * ns_2 = 157.0796$
 No stirups, $ns_2 = 2.00$
 $ps_{3,x} (web) = (As_3 * h_3 / s_3) / Ac = 0.00188496$
 $h_3 = 1800.00$
 $As_3 = Astir_3 * ns_3 = 0.00$
 No stirups, $ns_3 = 2.00$

$psh_y = ps_1_y + ps_2_y + ps_3_y = 0.0010472$
 $ps_{1,y} (column\ 1) = (As_1 * h_1 / s_1) / Ac = 0.0005236$
 $h_1 = 250.00$
 $As_1 = Astir_1 * ns_1 = 157.0796$
 No stirups, $ns_1 = 2.00$
 $ps_{2,y} (column\ 2) = (As_2 * h_2 / s_2) / Ac = 0.0005236$
 $h_2 = 250.00$
 $As_2 = Astir_2 * ns_2 = 157.0796$
 No stirups, $ns_2 = 2.00$
 $ps_{3,y} (web) = (As_3 * h_3 / s_3) / Ac = 0.00$
 $h_3 = 250.00$
 $As_3 = Astir_3 * ns_3 = 157.0796$
 No stirups, $ns_3 = 0.00$

$A_{sec} = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $fy_{we} = 625.00$
 $f_{ce} = 25.00$
 From ((5.A.5), TBDY), TBDY: $cc = 0.002$
 $c = \text{confinement factor} = 1.00$
 $y_1 = 0.00094258$
 $sh_1 = 0.00301626$
 $ft_1 = 282.7748$
 $fy_1 = 235.6456$
 $su_1 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou, min = lb/l_d = 0.16565482$
 $su_1 = 0.4 * esu_{1_nominal} ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu_{1_nominal} = 0.08$,
 For calculation of $esu_{1_nominal}$ and y_1, sh_1, ft_1, fy_1 , it is considered
 characteristic value $fsy_1 = fs_1 / 1.2$, from table 5.1, TBDY.
 y_1, sh_1, ft_1, fy_1 , are also multiplied by $\text{Min}(1, 1.25 * (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs_1 = fs = 235.6456$
 with $Es_1 = Es = 200000.00$
 $y_2 = 0.00094258$
 $sh_2 = 0.00301626$
 $ft_2 = 282.7748$
 $fy_2 = 235.6456$
 $su_2 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou, min = lb/l_b, min = 0.16565482$
 $su_2 = 0.4 * esu_{2_nominal} ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu_{2_nominal} = 0.08$,
 For calculation of $esu_{2_nominal}$ and y_2, sh_2, ft_2, fy_2 , it is considered
 characteristic value $fsy_2 = fs_2 / 1.2$, from table 5.1, TBDY.
 y_1, sh_1, ft_1, fy_1 , are also multiplied by $\text{Min}(1, 1.25 * (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs_2 = fs = 235.6456$
 with $Es_2 = Es = 200000.00$
 $y_v = 0.00094258$
 $sh_v = 0.00301626$
 $ft_v = 282.7748$
 $fy_v = 235.6456$
 $suv = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor

and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
 $l_o/l_{o,min} = l_b/l_d = 0.16565482$
 $suv = 0.4 * esuv_{nominal} ((5.5), TBDY) = 0.032$
From table 5A.1, TBDY: $esuv_{nominal} = 0.08$,
considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
For calculation of $esuv_{nominal}$ and yv, shv, ftv, fyv , it is considered
characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 * (l_b/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
with $fsv = fs = 235.6456$
with $Esv = Es = 200000.00$
 $1 = Asl_{ten}/(b*d) * (fs1/fc) = 0.04275722$
 $2 = Asl_{com}/(b*d) * (fs2/fc) = 0.04275722$
 $v = Asl_{mid}/(b*d) * (fsv/fc) = 0.02429711$
and confined core properties:
 $b = 2940.00$
 $d = 178.00$
 $d' = 12.00$
 $fcc (5A.2, TBDY) = 25.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = Asl_{ten}/(b*d) * (fs1/fc) = 0.05098316$
 $2 = Asl_{com}/(b*d) * (fs2/fc) = 0.05098316$
 $v = Asl_{mid}/(b*d) * (fsv/fc) = 0.02897156$
Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)
--->
 $v < vsy2$ - LHS eq.(4.5) is satisfied
--->
 $su (4.9) = 0.23047746$
 $Mu = MRc (4.14) = 1.4440E+008$
 $u = su (4.1) = 1.8844503E-005$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$
 $l_b = 300.00$
 $l_d = 1810.995$
Calculation of l_b,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
Mean strength value of all re-bars: $fy = 625.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $Ktr = 1.848$
 $n = 34.00$

Calculation of $Mu2+$

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
 $u = 1.8630672E-005$
 $Mu = 1.2341E+008$

with full section properties:
 $b = 3000.00$
 $d = 208.00$
 $d' = 42.00$
 $v = 0.00176852$
 $N = 27588.841$

$f_c = 25.00$
 $c_o (5A.5, TBDY) = 0.002$
 Final value of c_u : $c_u^* = \text{shear_factor} * \text{Max}(c_u, c_c) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)
 From (5.4b), TBDY: $c_u = 0.0035$
 $w_e (5.4c) = 0.00$
 $a_{se} ((5.4d), TBDY) = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$
 $a_{se1} = 0.00$
 $sh_1 = 100.00$
 $bo_1 = 190.00$
 $ho_1 = 540.00$
 $bi2_1 = 655400.00$
 $a_{se2} = 0.00$
 $sh_2 = 100.00$
 $bo_2 = 190.00$
 $ho_2 = 540.00$
 $bi2_2 = 655400.00$
 $a_{se3} = 0$ (grid does not provide confinement)
 $psh, \min = \text{Min}(psh, x, psh, y) = 0.0010472$

$psh, x = ps1, x + ps2, x + ps3, x = 0.00439823$
 $ps1, x \text{ (column 1)} = (As1 * h1 / s_1) / A_c = 0.00125664$
 $h1 = 600.00$
 $As1 = Astir1 * ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2, x \text{ (column 2)} = (As2 * h2 / s_2) / A_c = 0.00125664$
 $h2 = 600.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3, x \text{ (web)} = (As3 * h3 / s_3) / A_c = 0.00188496$
 $h3 = 1800.00$
 $As3 = Astir3 * ns3 = 0.00$
 No stirups, $ns3 = 2.00$

$psh, y = ps1, y + ps2, y + ps3, y = 0.0010472$
 $ps1, y \text{ (column 1)} = (As1 * h1 / s_1) / A_c = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 * ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2, y \text{ (column 2)} = (As2 * h2 / s_2) / A_c = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3, y \text{ (web)} = (As3 * h3 / s_3) / A_c = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 * ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

$A_{sec} = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $fy_{we} = 625.00$
 $f_{ce} = 25.00$

From ((5.A5), TBDY), TBDY: $c_c = 0.002$
 $c = \text{confinement factor} = 1.00$
 $y1 = 0.00094258$
 $sh1 = 0.00301626$
 $ft1 = 282.7748$
 $fy1 = 235.6456$
 $su1 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $lo/lou, \min = lb/ld = 0.16565482$
 $su1 = 0.4 * esu1_nominal ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu1_nominal = 0.08$,

For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered characteristic value $fsy1 = fs1/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs1 = fs = 235.6456$
 with $Es1 = Es = 200000.00$
 $y2 = 0.00094258$
 $sh2 = 0.00301626$
 $ft2 = 282.7748$
 $fy2 = 235.6456$
 $su2 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $lo/lo_{u,min} = lb/lb_{u,min} = 0.16565482$
 $su2 = 0.4 \cdot esu2_nominal \cdot ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esu2_nominal = 0.08$,
 For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs2 = fs = 235.6456$
 with $Es2 = Es = 200000.00$
 $yv = 0.00094258$
 $shv = 0.00301626$
 $ftv = 282.7748$
 $fyv = 235.6456$
 $suv = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $lo/lo_{u,min} = lb/ld = 0.16565482$
 $suv = 0.4 \cdot esuv_nominal \cdot ((5.5), TBDY) = 0.032$
 From table 5A.1, TBDY: $esuv_nominal = 0.08$,
 considering characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY
 For calculation of $esuv_nominal$ and yv, shv, ftv, fyv , it is considered characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fsv = fs = 235.6456$
 with $Es_v = Es = 200000.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (fs1/fc) = 0.04275722$
 $2 = A_{sl,com}/(b \cdot d) \cdot (fs2/fc) = 0.04275722$
 $v = A_{sl,mid}/(b \cdot d) \cdot (fsv/fc) = 0.00$

and confined core properties:

$b = 2940.00$
 $d = 178.00$
 $d' = 12.00$
 $f_{cc} \text{ (5A.2, TBDY)} = 25.00$
 $cc \text{ (5A.5, TBDY)} = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b \cdot d) \cdot (fs1/fc) = 0.05098316$
 $2 = A_{sl,com}/(b \cdot d) \cdot (fs2/fc) = 0.05098316$
 $v = A_{sl,mid}/(b \cdot d) \cdot (fsv/fc) = 0.00$

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

--->
 $su \text{ (4.9)} = 0.22164534$
 $\mu = M_{Rc} \text{ (4.14)} = 1.2341E+008$
 $u = su \text{ (4.1)} = 1.8630672E-005$

Calculation of ratio lb/ld

Lap Length: $lb/ld = 0.16565482$
 $lb = 300.00$
 $ld = 1810.995$

Calculation of $lb_{u,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$$= 1$$

$$db = 16.35294$$

Mean strength value of all re-bars: $f_y = 625.00$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$cb = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

Calculation of μ_2 -

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

$$\mu = 1.8844503E-005$$

$$\mu = 1.4440E+008$$

with full section properties:

$$b = 3000.00$$

$$d = 208.00$$

$$d' = 42.00$$

$$v = 0.00176852$$

$$N = 27588.841$$

$$f_c = 25.00$$

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

$$\text{Final value of } \mu: \mu^* = \text{shear_factor} * \text{Max}(\mu, c_o) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } \mu = 0.0035$$

$$w_e(5.4c) = 0.00$$

$$a_{se}((5.4d), TBDY) = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$$

$$a_{se1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$a_{se2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$a_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$p_{sh,min} = \text{Min}(p_{sh,x}, p_{sh,y}) = 0.0010472$$

$$p_{sh,x} = p_{s1,x} + p_{s2,x} + p_{s3,x} = 0.00439823$$

$$p_{s1,x} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$p_{s2,x} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$p_{s3,x} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$p_{sh,y} = p_{s1,y} + p_{s2,y} + p_{s3,y} = 0.0010472$$

$$p_{s1,y} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$p_{s2,y} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$$

$h2 = 250.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,y (web) = (As3 * h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 * ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

 $Asec = 750000.00$

$s_1 = 100.00$

$s_2 = 100.00$

$s_3 = 200.00$

$fywe = 625.00$

$fce = 25.00$

From ((5.A5), TBDY), TBDY: $cc = 0.002$

$c =$ confinement factor $= 1.00$

$y1 = 0.00094258$

$sh1 = 0.00301626$

$ft1 = 282.7748$

$fy1 = 235.6456$

$su1 = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor $= 1.00$

$lo/lou,min = lb/d = 0.16565482$

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

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

For calculation of $esu1_nominal$ and $y1$, $sh1$, $ft1$, $fy1$, it is considered
 characteristic value $fsy1 = fs1/1.2$, from table 5.1, TBDY.

$y1$, $sh1$, $ft1$, $fy1$, are also multiplied by $Min(1, 1.25 * (lb/d)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs1 = fs = 235.6456$

with $Es1 = Es = 200000.00$

$y2 = 0.00094258$

$sh2 = 0.00301626$

$ft2 = 282.7748$

$fy2 = 235.6456$

$su2 = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor $= 1.00$

$lo/lou,min = lb/lb,min = 0.16565482$

$su2 = 0.4 * esu2_nominal ((5.5), TBDY) = 0.032$

From table 5A.1, TBDY: $esu2_nominal = 0.08$,

For calculation of $esu2_nominal$ and $y2$, $sh2$, $ft2$, $fy2$, it is considered
 characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.

$y1$, $sh1$, $ft1$, $fy1$, are also multiplied by $Min(1, 1.25 * (lb/d)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs2 = fs = 235.6456$

with $Es2 = Es = 200000.00$

$yv = 0.00094258$

$shv = 0.00301626$

$ftv = 282.7748$

$fyv = 235.6456$

$suv = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor $= 1.00$

$lo/lou,min = lb/d = 0.16565482$

$suv = 0.4 * esuv_nominal ((5.5), TBDY) = 0.032$

From table 5A.1, TBDY: $esuv_nominal = 0.08$,

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

For calculation of $esuv_nominal$ and yv , shv , ftv , fyv , it is considered
 characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.

$y1$, $sh1$, $ft1$, $fy1$, are also multiplied by $Min(1, 1.25 * (lb/d)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fsv = fs = 235.6456$

with $Esv = Es = 200000.00$

1 = $Asl,ten / (b * d) * (fs1 / fc) = 0.04275722$

2 = $Asl,com / (b * d) * (fs2 / fc) = 0.04275722$

$v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02429711$
 and confined core properties:
 $b = 2940.00$
 $d = 178.00$
 $d' = 12.00$
 $f_{cc} (5A.2, TBDY) = 25.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.05098316$
 $2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.05098316$
 $v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02897156$
 Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)
 --->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
 --->
 $su (4.9) = 0.23047746$
 $Mu = MRc (4.14) = 1.4440E+008$
 $u = su (4.1) = 1.8844503E-005$

Calculation of ratio l_b/l_d

Lap Length: $l_b/l_d = 0.16565482$
 $l_b = 300.00$
 $l_d = 1810.995$
 Calculation of l_b,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 625.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Shear Strength $V_r = \text{Min}(V_{r1}, V_{r2}) = 1.1297E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 1.1297E+006$
 From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f_c^{0.5}*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$
 $Mu/V_u - l_w/2 = 0.00 \leq 0$
 $= 1$ (normal-weight concrete)
 $f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 3000.00$
 $d = 200.00$
 $l_w = 250.00$
 $Mu = 2.5788780E-012$
 $V_u = 0.00$
 $Nu = 27588.841$
 From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$
 $V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:
 $d = 200.00$
 $A_v = 157079.633$
 $s = 100.00$
 $f_y = 500.00$
 V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17, 10.3.4)
 $V_{s2} = 157079.633$ is calculated for pseudo-Column 2, with:

d = 200.00

Av = 157079.633

s = 100.00

fy = 500.00

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

d = 200.00

Av = 0.00

s = 200.00

fy = 500.00

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$2(1-s/d) = 0.00$

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

From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$

bw = 3000.00

Calculation of Shear Strength at edge 2, Vr2 = 1.1297E+006

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_r2 = V_n < 0.83 \cdot f_c' \cdot 0.5 \cdot h \cdot d$

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 (11.5.4.6(d-e)), ACI 318-14: Vc = 815517.768

$\mu_u/V_u - l_w/2 = 0.00 \leq 0$

= 1 (normal-weight concrete)

$f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)

h = 3000.00

d = 200.00

lw = 250.00

$\mu_u = 2.5788780E-012$

Vu = 0.00

Nu = 27588.841

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$

Vs1 = 157079.633 is calculated for pseudo-Column 1, with:

d = 200.00

Av = 157079.633

s = 100.00

fy = 500.00

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

Vs2 = 157079.633 is calculated for pseudo-Column 2, with:

d = 200.00

Av = 157079.633

s = 100.00

fy = 500.00

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

d = 200.00

Av = 0.00

s = 200.00

fy = 500.00

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$2(1-s/d) = 0.00$

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

From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$

bw = 3000.00

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1

At local axis: 2

Integration Section: (b)

Section Type: rcrrws

Constant Properties

Knowledge Factor, $\phi = 1.00$

According to 10.7.2.3, ASCE 41-17, shear walls with transverse reinforcement percentage, $\rho_n < 0.0015$

are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17
 $\rho_n = 0.0010472$

with $\rho_n = \rho_{s1} + \rho_{s2} + \rho_{s3}$, being the shear reinf. ratio in a plane perpendicular to the shear axis 3

(pseudo-col.1 $\rho_{s1} = A_{s1} \cdot b_1 / s_1 = (A_{s1} \cdot h_1 / s_1) / A_c = 0.0005236$

$h_1 = 250.00$

$s_1 = 100.00$

total area of hoops perpendicular to shear axis, $A_{s1} = 157.0796$

(pseudo-col.2 $\rho_{s2} = A_{s2} \cdot b_2 / s_2 = (A_{s2} \cdot h_2 / s_2) / A_c = 0.0005236$

$h_2 = 250.00$

$s_2 = 100.00$

total area of hoops perpendicular to shear axis, $A_{s2} = 157.0796$

(grid $\rho_{s3} = A_{s3} \cdot b_3 / s_3 = (A_{s3} \cdot h_3 / s_3) / A_c = 0.00$

$h_3 = 250.00$

$s_3 = 200.00$

total area of hoops perpendicular to shear axis, $A_{s3} = 0.00$

total section area, $A_c = 750000.00$

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{c_lower_bound} = 25.00$

New material of Secondary Member: Steel Strength, $f_s = f_{s_lower_bound} = 500.00$

Concrete Elasticity, $E_c = 26999.444$

Steel Elasticity, $E_s = 200000.00$

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_b = 300.00$

No FRP Wrapping

Stepwise Properties

Bending Moment, $M = 59475.088$

Shear Force, $V_2 = 1.1969937E-013$

Shear Force, $V_3 = 53656.852$

Axial Force, $F = -27994.722$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $A_{st} = 0.00$

-Compression: $A_{sc} = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $A_{st,ten} = 2865.133$

-Compression: $A_{st,com} = 2865.133$

-Middle: $A_{st,mid} = 1539.38$

Mean Diameter of Tension Reinforcement, $D_bL = 17.33333$

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $u_R = 1.0^*$ $u = 0.01246271$

$u = \gamma + \rho = 0.01246271$

- Calculation of γ -

$y = (M_y * I_p) / (EI)_{\text{Eff}} = 0.00046271$ ((10-5), ASCE 41-17))
 $M_y = 2.0496 \text{E}+009$
 $(EI)_{\text{Eff}} = 0.35 * E_c * I$ (table 10-5)
 $E_c * I = 1.5187 \text{E}+016$
 $I_p = 0.5 * d = 0.5 * (0.8 * h) = 1200.00$

Calculation of Yielding Moment M_y

Calculation of y and M_y according to Annex 7 -

$y = \text{Min}(y_{\text{ten}}, y_{\text{com}})$
 $y_{\text{ten}} = 4.6950448 \text{E}-007$
 with ((10.1), ASCE 41-17) $f_y = \text{Min}(f_y, 1.25 * f_y * (l_b / d)^{2/3}) = 218.754$
 $d = 2957.00$
 $y = 0.21216547$
 $A = 0.01000692$
 $B = 0.00516152$
 with $p_t = 0.00387573$
 $p_c = 0.00387573$
 $p_v = 0.00208235$
 $N = 27994.722$
 $b = 250.00$
 $" = 0.01454177$
 $y_{\text{comp}} = 2.6939913 \text{E}-006$
 with $f_c = 25.00$
 $E_c = 26999.444$
 $y = 0.20922336$
 $A = 0.00972021$
 $B = 0.00498841$
 with $E_s = 200000.00$

Calculation of ratio l_b / d

Lap Length: $l_d / d, \text{min} = 0.20706852$
 $l_b = 300.00$
 $l_d = 1448.796$
 Calculation of l according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d, min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 500.00$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

- Calculation of p -

Considering wall controlled by flexure (shear control ratio ≤ 1),
 from table 10-19: $p = 0.012$
 with:

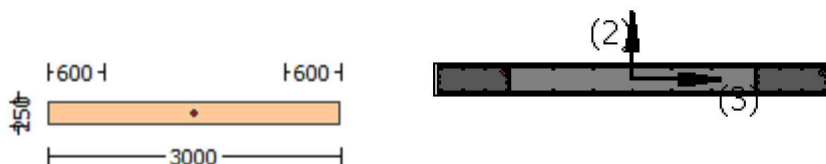
- Condition i (shear wall and wall segments)
 $-(A_s - A_s') * f_y + P) / (t_w * l_w * f_c') = -0.19236416$
 $A_s = 0.00$
 $A_s' = 7269.645$
 $f_y = 500.00$
 $P = 27994.722$
 $t_w = 250.00$
 $l_w = 3000.00$
 $f_c = 25.00$

- $V/(t_w \cdot l_w \cdot f_c^{0.5}) = 0.17231265$, NOTE: units in lb & in
 - Confined Boundary: Yes
 Table values have been multiplied by 0.8 according to subnote b
 Boundary Trans. Reinf. exceeds 75% of ACI 318 provision ($V_{w1} + V_{w2} > 0.50 \cdot (V - V_c - V_{w3})$)
 Boundary hoops spacing does not exceed $8d_b$ ($s_1 < 8 \cdot d_b$ and $s_2 < 8 \cdot d_b$)
 With
 Boundary Element 1:
 $V_{w1} = 376991.118$
 $s_1 = 100.00$
 Boundary Element 2:
 $V_{w2} = 376991.118$
 $s_2 = 100.00$
 Grid Shear Force, $V_{w3} = 0.00$
 Concrete Shear Force, $V_c = 815598.944$
 (The variables above have already been given in Shear control ratio calculation)
 Mean diameter of all bars, $d_b = 17.33333$
 Design Shear Force, $V = 53656.852$

 End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
 At local axis: 2
 Integration Section: (b)

Calculation No. 15

wall W1, Floor 1
 Limit State: Life Safety (data interpolation between analysis steps 1 and 2)
 Analysis: Uniform +X
 Check: Shear capacity VR_d
 Edge: End
 Local Axis: (3)



Start Of Calculation of Shear Capacity for element: wall W1 of floor 1
 At local axis: 3
 Integration Section: (b)

Section Type: rcrws

Constant Properties

Knowledge Factor, $\phi = 1.00$

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:

New material of Secondary Member: Concrete Strength, $f_c = f_{c_lower_bound} = 25.00$

New material of Secondary Member: Steel Strength, $f_s = f_{s_lower_bound} = 500.00$

Concrete Elasticity, $E_c = 26999.444$

Steel Elasticity, $E_s = 200000.00$

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_o = l_b = 300.00$

No FRP Wrapping

Stepwise Properties

EDGE -A-

Bending Moment, $M_a = 1.6093E+008$

Shear Force, $V_a = -53656.852$

EDGE -B-

Bending Moment, $M_b = 59475.088$

Shear Force, $V_b = 53656.852$

BOTH EDGES

Axial Force, $F = -27994.722$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $A_{sl,t} = 0.00$

-Compression: $A_{sl,c} = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $A_{sl,ten} = 2865.133$

-Compression: $A_{sl,com} = 2865.133$

-Middle: $A_{sl,mid} = 1539.38$

Mean Diameter of Tension Reinforcement, $Db_{L,ten} = 17.33333$

New component: From table 7-7, ASCE 41_17: Final Shear Capacity $V_R = 1.0 \cdot V_n = 2.1351E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_n < 0.83 \cdot f_c'^{0.5} \cdot h \cdot d = 2.1351E+006$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815598.944$

$\mu_u / \mu_l w / 2 = -1498.892 \leq 0$

$= 1$ (normal-weight concrete)

$f_c' = 25.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)

$h = 250.00$

$d = 2400.00$

$l_w = 3000.00$

$\mu_u = 59475.088$

$V_u = 53656.852$

$\mu_u = 27994.722$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.3195E+006$

$V_{s1} = 376991.118$ is calculated for pseudo-Column 1, with:

$d = 480.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 500.00$

V_{s1} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s2} = 376991.118$ is calculated for pseudo-Column 2, with:

$d = 480.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 500.00$

V_{s2} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_{s3} = 565486.678$ is calculated for web, with:

$d = 1440.00$

$A_v = 157079.633$

$s = 200.00$

$f_y = 500.00$

V_{s3} has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_f ((11-3)-(11.4), \text{ACI 440}) = 0.00$

From (11-11), ACI 440: $V_s + V_f \leq 1.9929E+006$

$b_w = 250.00$

End Of Calculation of Shear Capacity for element: wall W1 of floor 1

At local axis: 3

Integration Section: (b)

Calculation No. 16

wall W1, Floor 1

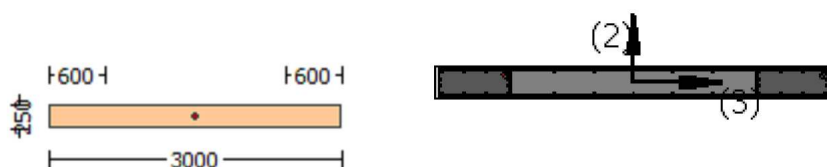
Limit State: Life Safety (data interpolation between analysis steps 1 and 2)

Analysis: Uniform +X

Check: Chord rotation capacity (μ)

Edge: End

Local Axis: (3)



Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At Shear local axis: 3

(Bending local axis: 2)

Section Type: rcrws

Constant Properties

Knowledge Factor, $\gamma = 1.00$

Mean strength values are used for both shear and moment calculations.

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 33.00$

New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 555.56$

Concrete Elasticity, $E_c = 26999.444$

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

New material: Steel Strength, $f_s = 1.25 \cdot f_{sm} = 694.45$

#####

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Mean Confinement Factor overall section = 1.00

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_o = 300.00$

No FRP Wrapping

Stepwise Properties

At local axis: 3

EDGE -A-

Shear Force, $V_a = 1.5016185E-058$

EDGE -B-

Shear Force, $V_b = -1.5016185E-058$

BOTH EDGES

Axial Force, $F = -27588.841$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $As_t = 0.00$

-Compression: $As_c = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $As_{t,ten} = 2865.133$

-Compression: $As_{l,com} = 2865.133$

-Middle: $As_{l,mid} = 0.00$

(According to 10.7.2.3 $As_{l,mid}$ is setted equal to zero)

Calculation of Shear Capacity ratio, $V_e/V_r = 0.69050088$

Member Controlled by Flexure ($V_e/V_r < 1$)

Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 $V_e = (M_{pr1} + M_{pr2})/l_n = 1.6587E+006$

with

$M_{pr1} = \max(\mu_{u1+}, \mu_{u1-}) = 2.4881E+009$

$\mu_{u1+} = 2.1705E+009$, 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

$\mu_{u1-} = 2.4881E+009$, 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

$M_{pr2} = \max(\mu_{u2+}, \mu_{u2-}) = 2.4881E+009$

$\mu_{u2+} = 2.1705E+009$, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the static loading combination

$\mu_{u2-} = 2.4881E+009$, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the static loading combination

Calculation of Mu1+

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

$$\phi_u = 1.2902105E-006$$

$$M_u = 2.1705E+009$$

with full section properties:

$$b = 250.00$$

$$d = 2957.00$$

$$d' = 43.00$$

$$v = 0.00113091$$

$$N = 27588.841$$

$$f_c = 33.00$$

$$\phi_c \text{ (5A.5, TBDY)} = 0.002$$

$$\text{Final value of } \phi_u: \phi_u = \text{shear_factor} * \text{Max}(\phi_c, \phi_c) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } \phi_u = 0.0035$$

$$\phi_{we} \text{ (5.4c)} = 0.00$$

$$\phi_{ase} \text{ ((5.4d), TBDY)} = (\phi_{ase1} * A_{col1} + \phi_{ase2} * A_{col2} + \phi_{ase3} * A_{web}) / A_{sec} = 0.00$$

$$\phi_{ase1} = 0.00$$

$$s_{h1} = 100.00$$

$$b_{o1} = 190.00$$

$$h_{o1} = 540.00$$

$$b_{i2,1} = 655400.00$$

$$\phi_{ase2} = 0.00$$

$$s_{h2} = 100.00$$

$$b_{o2} = 190.00$$

$$h_{o2} = 540.00$$

$$b_{i2,2} = 655400.00$$

$$\phi_{ase3} = 0 \text{ (grid does not provide confinement)}$$

$$\phi_{psh,min} = \text{Min}(\phi_{psh,x}, \phi_{psh,y}) = 0.0010472$$

$$\phi_{psh,x} = \phi_{ps1,x} + \phi_{ps2,x} + \phi_{ps3,x} = 0.00439823$$

$$\phi_{ps1,x} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{ps2,x} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{ps3,x} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$\phi_{psh,y} = \phi_{ps1,y} + \phi_{ps2,y} + \phi_{ps3,y} = 0.0010472$$

$$\phi_{ps1,y} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$\phi_{ps2,y} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$$

$$h_2 = 250.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$\phi_{ps3,y} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00$$

$$h_3 = 250.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 157.0796$$

$$\text{No stirups, } n_{s3} = 0.00$$

$$A_{sec} = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$


```

s_3 = 200.00
fywe = 694.45
fce = 33.00
From ((5A.5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00096384
sh1 = 0.00308428
ft1 = 321.2814
fy1 = 267.7345
su1 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.17128923
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 267.7345
with Es1 = Es = 200000.00
y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.17128923
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 267.7345
with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb = 0.17128923
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/lb)^ 2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 267.7345
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
v = Asl,mid/(b*d)*(fsv/fc) = 0.00

```

Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)

--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.19157175
Mu = MRc (4.14) = 2.1705E+009
u = su (4.1) = 1.2902105E-006

Calculation of ratio lb/l_d

Lap Length: lb/l_d = 0.17128923
lb = 300.00
ld = 1751.424
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 694.45
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 1.848
n = 34.00

Calculation of Mu1-

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
u = 1.2974768E-006
Mu = 2.4881E+009

with full section properties:

b = 250.00
d = 2957.00
d' = 43.00
v = 0.00113091
N = 27588.841
fc = 33.00
co (5A.5, TBDY) = 0.002
Final value of cu: cu* = shear_factor * Max(cu, cc) = 0.0035
The Shear_factor is considered equal to 1 (pure moment strength)
From (5.4b), TBDY: cu = 0.0035
we (5.4c) = 0.00
ase ((5.4d), TBDY) = (ase1*Acol1+ase2*Acol2+ase3*Aweb)/Asec = 0.00
ase1 = 0.00
sh_1 = 100.00
bo_1 = 190.00
ho_1 = 540.00
bi2_1 = 655400.00
ase2 = 0.00
sh_2 = 100.00
bo_2 = 190.00
ho_2 = 540.00
bi2_2 = 655400.00
ase3 = 0 (grid does not provide confinement)
psh,min = Min(psh,x , psh,y) = 0.0010472
psh,x = ps1,x+ps2,x+ps3,x = 0.00439823
ps1,x (column 1) = (As1*h1/s_1)/Ac = 0.00125664
h1 = 600.00
As1 = Astir1*ns1 = 157.0796

No stirups, ns1 = 2.00
 $ps2,x$ (column 2) = $(As2 \cdot h2 / s_2) / Ac = 0.00125664$
 $h2 = 600.00$
 $As2 = Astir2 \cdot ns2 = 157.0796$
 No stirups, ns2 = 2.00
 $ps3,x$ (web) = $(As3 \cdot h3 / s_3) / Ac = 0.00188496$
 $h3 = 1800.00$
 $As3 = Astir3 \cdot ns3 = 0.00$
 No stirups, ns3 = 2.00

 $psh,y = ps1,y + ps2,y + ps3,y = 0.0010472$
 $ps1,y$ (column 1) = $(As1 \cdot h1 / s_1) / Ac = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 \cdot ns1 = 157.0796$
 No stirups, ns1 = 2.00
 $ps2,y$ (column 2) = $(As2 \cdot h2 / s_2) / Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 \cdot ns2 = 157.0796$
 No stirups, ns2 = 2.00
 $ps3,y$ (web) = $(As3 \cdot h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 \cdot ns3 = 157.0796$
 No stirups, ns3 = 0.00

 $Asec = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $fywe = 694.45$
 $fce = 33.00$
 From ((5.A5), TBDY), TBDY: $cc = 0.002$
 $c = \text{confinement factor} = 1.00$
 $y1 = 0.00096384$
 $sh1 = 0.00308428$
 $ft1 = 321.2814$
 $fy1 = 267.7345$
 $su1 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/l_d = 0.17128923$
 $su1 = 0.4 \cdot esu1_nominal$ ((5.5), TBDY) = 0.032
 From table 5A.1, TBDY: $esu1_nominal = 0.08$,
 For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered
 characteristic value $fsy1 = fs1 / 1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs1 = fs = 267.7345$
 with $Es1 = Es = 200000.00$
 $y2 = 0.00096384$
 $sh2 = 0.00308428$
 $ft2 = 321.2814$
 $fy2 = 267.7345$
 $su2 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/l_b,min = 0.17128923$
 $su2 = 0.4 \cdot esu2_nominal$ ((5.5), TBDY) = 0.032
 From table 5A.1, TBDY: $esu2_nominal = 0.08$,
 For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered
 characteristic value $fsy2 = fs2 / 1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs2 = fs = 267.7345$
 with $Es2 = Es = 200000.00$
 $yv = 0.00096384$
 $shv = 0.00308428$
 $ftv = 321.2814$

```

fyv = 267.7345
suv = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lo,min = lb/ld = 0.17128923
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
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 = 267.7345
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.01689449
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
v = Asl,mid/(b*d)*(fsv/fc) = 0.02245743
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.19609924
Mu = MRc (4.14) = 2.4881E+009
u = su (4.1) = 1.2974768E-006

```

Calculation of ratio lb/ld

```

Lap Length: lb/ld = 0.17128923
lb = 300.00
ld = 1751.424
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 694.45
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 1.848
n = 34.00

```

Calculation of Mu2+

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

```

u = 1.2902105E-006
Mu = 2.1705E+009

```

with full section properties:

```

b = 250.00
d = 2957.00

```

$d' = 43.00$
 $v = 0.00113091$
 $N = 27588.841$
 $fc = 33.00$
 $co (5A.5, TBDY) = 0.002$
 Final value of cu : $cu^* = shear_factor * Max(cu, cc) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)
 From (5.4b), TBDY: $cu = 0.0035$
 $w_e (5.4c) = 0.00$
 $ase ((5.4d), TBDY) = (ase1 * Acol1 + ase2 * Acol2 + ase3 * Aweb) / Asec = 0.00$
 $ase1 = 0.00$
 $sh_1 = 100.00$
 $bo_1 = 190.00$
 $ho_1 = 540.00$
 $bi2_1 = 655400.00$
 $ase2 = 0.00$
 $sh_2 = 100.00$
 $bo_2 = 190.00$
 $ho_2 = 540.00$
 $bi2_2 = 655400.00$
 $ase3 = 0$ (grid does not provide confinement)
 $psh, min = Min(psh, x, psh, y) = 0.0010472$

$psh, x = ps1, x + ps2, x + ps3, x = 0.00439823$
 $ps1, x (column 1) = (As1 * h1 / s_1) / Ac = 0.00125664$
 $h1 = 600.00$
 $As1 = Astir1 * ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2, x (column 2) = (As2 * h2 / s_2) / Ac = 0.00125664$
 $h2 = 600.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3, x (web) = (As3 * h3 / s_3) / Ac = 0.00188496$
 $h3 = 1800.00$
 $As3 = Astir3 * ns3 = 0.00$
 No stirups, $ns3 = 2.00$

$psh, y = ps1, y + ps2, y + ps3, y = 0.0010472$
 $ps1, y (column 1) = (As1 * h1 / s_1) / Ac = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 * ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2, y (column 2) = (As2 * h2 / s_2) / Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3, y (web) = (As3 * h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 * ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

$Asec = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$

$fywe = 694.45$
 $fce = 33.00$

From ((5.A5), TBDY), TBDY: $cc = 0.002$
 $c =$ confinement factor $= 1.00$

$y1 = 0.00096384$
 $sh1 = 0.00308428$
 $ft1 = 321.2814$
 $fy1 = 267.7345$
 $su1 = 0.00308428$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

```

lo/lou,min = lb/d = 0.17128923
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/d)^ 2/3), from 10.3.5, ASCE 41-17.
with fs1 = fs = 267.7345
with Es1 = Es = 200000.00
y2 = 0.00096384
sh2 = 0.00308428
ft2 = 321.2814
fy2 = 267.7345
su2 = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.17128923
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/d)^ 2/3), from 10.3.5, ASCE 41-17.
with fs2 = fs = 267.7345
with Es2 = Es = 200000.00
yv = 0.00096384
shv = 0.00308428
ftv = 321.2814
fyv = 267.7345
suv = 0.00308428
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/d = 0.17128923
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
y1, sh1,ft1,fy1, are also multiplied by Min(1,1.25*(lb/d)^ 2/3), from 10.3.5, ASCE 41-17.
with fsv = fs = 267.7345
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.03144444
2 = Asl,com/(b*d)*(fs2/fc) = 0.03144444
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 190.00
d = 2927.00
d' = 13.00
fcc (5A.2, TBDY) = 33.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04179832
2 = Asl,com/(b*d)*(fs2/fc) = 0.04179832
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfined full section - Steel rupture
' satisfies Eq. (4.3)
---->
v < vs,y2 - LHS eq.(4.5) is satisfied
---->
su (4.9) = 0.19157175
Mu = MRc (4.14) = 2.1705E+009
u = su (4.1) = 1.2902105E-006

```

Calculation of ratio lb/d

Lap Length: lb/d = 0.17128923

$l_b = 300.00$
 $l_d = 1751.424$
 Calculation of l_b ,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d ,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
 Mean strength value of all re-bars: $f_y = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of μ_2 -

Calculation of ultimate curvature μ according to 4.1, Biskinis/Fardis 2013:
 $\mu = 1.2974768E-006$
 $\mu = 2.4881E+009$

with full section properties:

$b = 250.00$
 $d = 2957.00$
 $d' = 43.00$
 $v = 0.00113091$
 $N = 27588.841$
 $f_c = 33.00$
 ϕ (5A.5, TBDY) = 0.002
 Final value of ϕ : $\phi^* = \text{shear_factor} * \text{Max}(\phi_c, \phi_s) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)
 From (5.4b), TBDY: $\phi_c = 0.0035$
 ϕ_s (5.4c) = 0.00
 $\phi_{se} ((5.4d), \text{TBDY}) = (\phi_{se1} * A_{col1} + \phi_{se2} * A_{col2} + \phi_{se3} * A_{web}) / A_{sec} = 0.00$
 $\phi_{se1} = 0.00$
 $sh_1 = 100.00$
 $bo_1 = 190.00$
 $ho_1 = 540.00$
 $bi2_1 = 655400.00$
 $\phi_{se2} = 0.00$
 $sh_2 = 100.00$
 $bo_2 = 190.00$
 $ho_2 = 540.00$
 $bi2_2 = 655400.00$
 $\phi_{se3} = 0$ (grid does not provide confinement)
 $\phi_{sh,min} = \text{Min}(\phi_{sh,x}, \phi_{sh,y}) = 0.0010472$

$\phi_{sh,x} = \phi_{s1,x} + \phi_{s2,x} + \phi_{s3,x} = 0.00439823$
 $\phi_{s1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$
 $h_1 = 600.00$
 $A_{s1} = A_{stir1} * n_{s1} = 157.0796$
 No stirups, $n_{s1} = 2.00$
 $\phi_{s2,x}$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$
 $h_2 = 600.00$
 $A_{s2} = A_{stir2} * n_{s2} = 157.0796$
 No stirups, $n_{s2} = 2.00$
 $\phi_{s3,x}$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$
 $h_3 = 1800.00$
 $A_{s3} = A_{stir3} * n_{s3} = 0.00$
 No stirups, $n_{s3} = 2.00$

$\phi_{sh,y} = \phi_{s1,y} + \phi_{s2,y} + \phi_{s3,y} = 0.0010472$
 $\phi_{s1,y}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.0005236$
 $h_1 = 250.00$

$As1 = Astir1 * ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2,y \text{ (column 2)} = (As2 * h2 / s_2) / Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 * ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,y \text{ (web)} = (As3 * h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 * ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

$Asec = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $fywe = 694.45$
 $fce = 33.00$
 From ((5.A5), TBDY), TBDY: $cc = 0.002$
 $c = \text{confinement factor} = 1.00$
 $y1 = 0.00096384$
 $sh1 = 0.00308428$
 $ft1 = 321.2814$
 $fy1 = 267.7345$
 $su1 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/l_d = 0.17128923$
 $su1 = 0.4 * esu1_nominal \text{ ((5.5), TBDY)} = 0.032$
 From table 5A.1, TBDY: $esu1_nominal = 0.08$,
 For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered
 characteristic value $fsy1 = fs1 / 1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 * (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs1 = fs = 267.7345$
 with $Es1 = Es = 200000.00$
 $y2 = 0.00096384$
 $sh2 = 0.00308428$
 $ft2 = 321.2814$
 $fy2 = 267.7345$
 $su2 = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/l_b,min = 0.17128923$
 $su2 = 0.4 * esu2_nominal \text{ ((5.5), TBDY)} = 0.032$
 From table 5A.1, TBDY: $esu2_nominal = 0.08$,
 For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered
 characteristic value $fsy2 = fs2 / 1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 * (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs2 = fs = 267.7345$
 with $Es2 = Es = 200000.00$
 $yv = 0.00096384$
 $shv = 0.00308428$
 $ftv = 321.2814$
 $fyv = 267.7345$
 $suv = 0.00308428$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/l_d = 0.17128923$
 $suv = 0.4 * esuv_nominal \text{ ((5.5), TBDY)} = 0.032$
 From table 5A.1, TBDY: $esuv_nominal = 0.08$,
 considering characteristic value $fsyv = fsv / 1.2$, from table 5.1, TBDY
 For calculation of $esuv_nominal$ and yv, shv, ftv, fyv , it is considered
 characteristic value $fsyv = fsv / 1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 * (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fsv = fs = 267.7345$

with $E_s = E_s = 200000.00$
 $1 = A_{s,ten}/(b*d)*(f_{s1}/f_c) = 0.03144444$
 $2 = A_{s,com}/(b*d)*(f_{s2}/f_c) = 0.03144444$
 $v = A_{s,mid}/(b*d)*(f_{sv}/f_c) = 0.01689449$
and confined core properties:
 $b = 190.00$
 $d = 2927.00$
 $d' = 13.00$
 $f_{cc} (5A.2, TBDY) = 33.00$
 $cc (5A.5, TBDY) = 0.002$
 $c = \text{confinement factor} = 1.00$
 $1 = A_{s,ten}/(b*d)*(f_{s1}/f_c) = 0.04179832$
 $2 = A_{s,com}/(b*d)*(f_{s2}/f_c) = 0.04179832$
 $v = A_{s,mid}/(b*d)*(f_{sv}/f_c) = 0.02245743$
Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)

--->
 $v < v_{s,y2}$ - LHS eq.(4.5) is satisfied
--->
 $su (4.9) = 0.19609924$
 $\mu_u = M_{Rc} (4.14) = 2.4881E+009$
 $u = su (4.1) = 1.2974768E-006$

Calculation of ratio l_b/d

Lap Length: $l_b/d = 0.17128923$
 $l_b = 300.00$
 $l_d = 1751.424$
Calculation of l_b, \min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
 l_d, \min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
 $= 1$
 $db = 16.35294$
Mean strength value of all re-bars: $f_y = 694.45$
 $t = 1.00$
 $s = 0.80$
 $e = 1.00$
 $cb = 25.00$
 $K_{tr} = 1.848$
 $n = 34.00$

Calculation of Shear Strength $V_r = \min(V_{r1}, V_{r2}) = 2.4022E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 2.4022E+006$
From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f_c'^{0.5}*h*d$

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

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$
 $\mu_u/V_u - l_w/2 = 0.00 \leq 0$
 $= 1$ (normal-weight concrete)
 $f_c' = 33.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)
 $h = 250.00$
 $d = 2400.00$
 $l_w = 3000.00$
 $\mu_u = 1.2001755E-010$
 $V_u = 1.5016185E-058$
 $N_u = 27588.841$
From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$
 $V_{s1} = 418882.372$ is calculated for pseudo-Column 1, with:
 $d = 480.00$
 $A_v = 157079.633$
 $s = 100.00$

$f_y = 555.56$

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

Vs2 = 418882.372 is calculated for pseudo-Column 2, with:

$d = 480.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 555.56$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 628323.557 is calculated for web, with:

$d = 1440.00$

$A_v = 157079.633$

$s = 200.00$

$f_y = 555.56$

Vs3 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$

From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$

$b_w = 250.00$

Calculation of Shear Strength at edge 2, $V_{r2} = 2.4022E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c' \cdot h \cdot d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 936136.917$

$\mu_u / \mu_l - l_w / 2 = 0.00 \leq 0$

= 1 (normal-weight concrete)

$f_c' = 33.00$, but $f_c'^{0.5} \leq 8.3$ MPa (22.5.3.1, ACI 318-14)

$h = 250.00$

$d = 2400.00$

$l_w = 3000.00$

$\mu_u = 1.2001755E-010$

$V_u = 1.5016185E-058$

$N_u = 27588.841$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 1.4661E+006$

Vs1 = 418882.372 is calculated for pseudo-Column 1, with:

$d = 480.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 555.56$

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

Vs2 = 418882.372 is calculated for pseudo-Column 2, with:

$d = 480.00$

$A_v = 157079.633$

$s = 100.00$

$f_y = 555.56$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 628323.557 is calculated for web, with:

$d = 1440.00$

$A_v = 157079.633$

$s = 200.00$

$f_y = 555.56$

Vs3 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

$V_f ((11-3)-(11.4), \text{ACI } 440) = 0.00$

From (11-11), ACI 440: $V_s + V_f \leq 2.2897E+006$

$b_w = 250.00$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At local axis: 3

Start Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At Shear local axis: 2

(Bending local axis: 3)

Section Type: rcrcws

Constant Properties

Knowledge Factor, $\phi = 1.00$

Mean strength values are used for both shear and moment calculations.

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{cm} = 25.00$

New material of Secondary Member: Steel Strength, $f_s = f_{sm} = 500.00$

Concrete Elasticity, $E_c = 26999.444$

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

New material: Steel Strength, $f_s = 1.25 \cdot f_{sm} = 625.00$

#####

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Mean Confinement Factor overall section = 1.00

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_o = 300.00$

No FRP Wrapping

Stepwise Properties

At local axis: 2

EDGE -A-

Shear Force, $V_a = 0.00$

EDGE -B-

Shear Force, $V_b = 0.00$

BOTH EDGES

Axial Force, $F = -27588.841$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $A_{sl,t} = 0.00$

-Compression: $A_{sl,c} = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $A_{sl,ten} = 2830.575$

-Compression: $A_{sl,com} = 2830.575$

-Middle: $A_{sl,mid} = 0.00$

(According to 10.7.2.3 $A_{sl,mid}$ is setted equal to zero)

Calculation of Shear Capacity ratio, $V_e/V_r = 0.08521711$

Member Controlled by Flexure ($V_e/V_r < 1$)

Calculation of Shear Demand from fig. R18.6.5, ACI 318-14 $V_e = (M_{pr1} + M_{pr2})/l_n = 96267.817$

with

$M_{pr1} = \max(\mu_{u1+}, \mu_{u1-}) = 1.4440E+008$

$\mu_{u1+} = 1.2341E+008$, 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

$\mu_{u1-} = 1.4440E+008$, 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

$M_{pr2} = \max(\mu_{u2+}, \mu_{u2-}) = 1.4440E+008$

$\mu_{u2+} = 1.2341E+008$, is the ultimate moment strength at the edge 2 of the member in the actual moment direction which is defined for the static loading combination

$\mu_{u2-} = 1.4440E+008$, is the ultimate moment strength at the edge 2 of the member in the opposite moment direction which is defined for the static loading combination

Calculation of Mu1+

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

$$\phi_u = 1.8630672E-005$$

$$M_u = 1.2341E+008$$

with full section properties:

$$b = 3000.00$$

$$d = 208.00$$

$$d' = 42.00$$

$$v = 0.00176852$$

$$N = 27588.841$$

$$f_c = 25.00$$

$$c_o \text{ (5A.5, TBDY)} = 0.002$$

$$\text{Final value of } \phi_u: \phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$$

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

$$\text{From (5.4b), TBDY: } \phi_u = 0.0035$$

$$w_e \text{ (5.4c)} = 0.00$$

$$a_{se} \text{ ((5.4d), TBDY)} = (a_{se1} * A_{col1} + a_{se2} * A_{col2} + a_{se3} * A_{web}) / A_{sec} = 0.00$$

$$a_{se1} = 0.00$$

$$sh_1 = 100.00$$

$$bo_1 = 190.00$$

$$ho_1 = 540.00$$

$$bi2_1 = 655400.00$$

$$a_{se2} = 0.00$$

$$sh_2 = 100.00$$

$$bo_2 = 190.00$$

$$ho_2 = 540.00$$

$$bi2_2 = 655400.00$$

$$a_{se3} = 0 \text{ (grid does not provide confinement)}$$

$$p_{sh,min} = \text{Min}(p_{sh,x}, p_{sh,y}) = 0.0010472$$

$$p_{sh,x} = p_{s1,x} + p_{s2,x} + p_{s3,x} = 0.00439823$$

$$p_{s1,x} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$$

$$h_1 = 600.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$p_{s2,x} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$$

$$h_2 = 600.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$p_{s3,x} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$$

$$h_3 = 1800.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 0.00$$

$$\text{No stirups, } n_{s3} = 2.00$$

$$p_{sh,y} = p_{s1,y} + p_{s2,y} + p_{s3,y} = 0.0010472$$

$$p_{s1,y} \text{ (column 1)} = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$$

$$h_1 = 250.00$$

$$A_{s1} = A_{stir1} * n_{s1} = 157.0796$$

$$\text{No stirups, } n_{s1} = 2.00$$

$$p_{s2,y} \text{ (column 2)} = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$$

$$h_2 = 250.00$$

$$A_{s2} = A_{stir2} * n_{s2} = 157.0796$$

$$\text{No stirups, } n_{s2} = 2.00$$

$$p_{s3,y} \text{ (web)} = (A_{s3} * h_3 / s_3) / A_c = 0.00$$

$$h_3 = 250.00$$

$$A_{s3} = A_{stir3} * n_{s3} = 157.0796$$

$$\text{No stirups, } n_{s3} = 0.00$$

$$A_{sec} = 750000.00$$

$$s_1 = 100.00$$

$$s_2 = 100.00$$

$$s_3 = 200.00$$

```

fywe = 625.00
fce = 25.00
From ((5A.5), TBDY), TBDY: cc = 0.002
c = confinement factor = 1.00
y1 = 0.00094258
sh1 = 0.00301626
ft1 = 282.7748
fy1 = 235.6456
su1 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16565482
su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
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 = 235.6456
with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.16565482
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
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 = 235.6456
with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16565482
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
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 = 235.6456
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
v = Asl,mid/(b*d)*(fsv/fc) = 0.00
Case/Assumption: Unconfinedsd full section - Steel rupture

```

satisfies Eq. (4.3)

--->

$v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

--->

μ_u (4.9) = 0.22164534

$\mu_u = M_{Rc}$ (4.14) = 1.2341E+008

$u = \mu_u$ (4.1) = 1.8630672E-005

Calculation of ratio I_b/I_d

Lap Length: $I_b/I_d = 0.16565482$

$I_b = 300.00$

$I_d = 1810.995$

Calculation of $I_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

$I_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

= 1

$d_b = 16.35294$

Mean strength value of all re-bars: $f_y = 625.00$

$t = 1.00$

$s = 0.80$

$e = 1.00$

$c_b = 25.00$

$K_{tr} = 1.848$

$n = 34.00$

Calculation of μ_{u1} -

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

$u = 1.8844503E-005$

$\mu_u = 1.4440E+008$

with full section properties:

$b = 3000.00$

$d = 208.00$

$d' = 42.00$

$v = 0.00176852$

$N = 27588.841$

$f_c = 25.00$

ϕ (5A.5, TBDY) = 0.002

Final value of μ_u : $\mu_u^* = \text{shear_factor} * \text{Max}(\mu_u, \mu_c) = 0.0035$

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

From (5.4b), TBDY: $\mu_u = 0.0035$

μ_w (5.4c) = 0.00

μ_{ase} ((5.4d), TBDY) = $(\mu_{ase1} * A_{col1} + \mu_{ase2} * A_{col2} + \mu_{ase3} * A_{web}) / A_{sec} = 0.00$

$\mu_{ase1} = 0.00$

$\mu_{sh_1} = 100.00$

$\mu_{bo_1} = 190.00$

$\mu_{ho_1} = 540.00$

$\mu_{bi2_1} = 655400.00$

$\mu_{ase2} = 0.00$

$\mu_{sh_2} = 100.00$

$\mu_{bo_2} = 190.00$

$\mu_{ho_2} = 540.00$

$\mu_{bi2_2} = 655400.00$

$\mu_{ase3} = 0$ (grid does not provide confinement)

$\mu_{psh,min} = \text{Min}(\mu_{psh,x}, \mu_{psh,y}) = 0.0010472$

$\mu_{psh,x} = \mu_{ps1,x} + \mu_{ps2,x} + \mu_{ps3,x} = 0.00439823$

$\mu_{ps1,x}$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

$h_1 = 600.00$

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirrups, $n_{s1} = 2.00$

$ps2,x \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.00125664$
 $h2 = 600.00$
 $As2 = Astir2 \cdot ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,x \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00188496$
 $h3 = 1800.00$
 $As3 = Astir3 \cdot ns3 = 0.00$
 No stirups, $ns3 = 2.00$

$psh,y = ps1,y + ps2,y + ps3,y = 0.0010472$
 $ps1,y \text{ (column 1)} = (As1 \cdot h1 / s_1) / Ac = 0.0005236$
 $h1 = 250.00$
 $As1 = Astir1 \cdot ns1 = 157.0796$
 No stirups, $ns1 = 2.00$
 $ps2,y \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 \cdot ns2 = 157.0796$
 No stirups, $ns2 = 2.00$
 $ps3,y \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 \cdot ns3 = 157.0796$
 No stirups, $ns3 = 0.00$

$Asec = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $fywe = 625.00$
 $fce = 25.00$
 From ((5.A5), TBDY), TBDY: $cc = 0.002$
 $c = \text{confinement factor} = 1.00$
 $y1 = 0.00094258$
 $sh1 = 0.00301626$
 $ft1 = 282.7748$
 $fy1 = 235.6456$
 $su1 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/l_d = 0.16565482$
 $su1 = 0.4 \cdot esu1_nominal \text{ ((5.5), TBDY)} = 0.032$
 From table 5A.1, TBDY: $esu1_nominal = 0.08$,
 For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered
 characteristic value $fsy1 = fs1 / 1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs1 = fs = 235.6456$
 with $Es1 = Es = 200000.00$
 $y2 = 0.00094258$
 $sh2 = 0.00301626$
 $ft2 = 282.7748$
 $fy2 = 235.6456$
 $su2 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 $Shear_factor = 1.00$
 $lo/lou,min = lb/l_b,min = 0.16565482$
 $su2 = 0.4 \cdot esu2_nominal \text{ ((5.5), TBDY)} = 0.032$
 From table 5A.1, TBDY: $esu2_nominal = 0.08$,
 For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered
 characteristic value $fsy2 = fs2 / 1.2$, from table 5.1, TBDY.
 $y1, sh1, ft1, fy1$, are also multiplied by $\text{Min}(1, 1.25 \cdot (lb/l_d)^{2/3})$, from 10.3.5, ASCE 41-17.
 with $fs2 = fs = 235.6456$
 with $Es2 = Es = 200000.00$
 $yv = 0.00094258$
 $shv = 0.00301626$
 $ftv = 282.7748$
 $fyv = 235.6456$

```

suv = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lo,min = lb/ld = 0.16565482
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
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 = 235.6456
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.02429711
and confined core properties:
b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
v = Asl,mid/(b*d)*(fsv/fc) = 0.02897156
Case/Assumption: Unconfined full section - Steel rupture
'satisfies Eq. (4.3)
--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.23047746
Mu = MRc (4.14) = 1.4440E+008
u = su (4.1) = 1.8844503E-005
-----

Calculation of ratio lb/ld
-----
Lap Length: lb/ld = 0.16565482
lb = 300.00
ld = 1810.995
Calculation of lb,min according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.
ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)
= 1
db = 16.35294
Mean strength value of all re-bars: fy = 625.00
t = 1.00
s = 0.80
e = 1.00
cb = 25.00
Ktr = 1.848
n = 34.00
-----

Calculation of Mu2+
-----

Calculation of ultimate curvature u according to 4.1, Biskinis/Fardis 2013:
u = 1.8630672E-005
Mu = 1.2341E+008
-----
with full section properties:
b = 3000.00
d = 208.00
d' = 42.00

```


$v = 0.00176852$
 $N = 27588.841$
 $f_c = 25.00$
 $\phi_c (5A.5, TBDY) = 0.002$
 Final value of ϕ_{cu} : $\phi_{cu}^* = \text{shear_factor} * \text{Max}(\phi_{cu}, \phi_{cc}) = 0.0035$
 The Shear_factor is considered equal to 1 (pure moment strength)
 From (5.4b), TBDY: $\phi_{cu} = 0.0035$
 $\phi_{we} (5.4c) = 0.00$
 $\phi_{ase} ((5.4d), TBDY) = (\phi_{ase1} * A_{col1} + \phi_{ase2} * A_{col2} + \phi_{ase3} * A_{web}) / A_{sec} = 0.00$
 $\phi_{ase1} = 0.00$
 $sh_1 = 100.00$
 $bo_1 = 190.00$
 $ho_1 = 540.00$
 $bi2_1 = 655400.00$
 $\phi_{ase2} = 0.00$
 $sh_2 = 100.00$
 $bo_2 = 190.00$
 $ho_2 = 540.00$
 $bi2_2 = 655400.00$
 $\phi_{ase3} = 0$ (grid does not provide confinement)
 $\phi_{psh,min} = \text{Min}(\phi_{psh,x}, \phi_{psh,y}) = 0.0010472$

$\phi_{psh,x} = \phi_{ps1,x} + \phi_{ps2,x} + \phi_{ps3,x} = 0.00439823$
 $\phi_{ps1,x} (\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.00125664$
 $h_1 = 600.00$
 $A_{s1} = A_{stir1} * n_{s1} = 157.0796$
 No stirups, $n_{s1} = 2.00$
 $\phi_{ps2,x} (\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.00125664$
 $h_2 = 600.00$
 $A_{s2} = A_{stir2} * n_{s2} = 157.0796$
 No stirups, $n_{s2} = 2.00$
 $\phi_{ps3,x} (\text{web}) = (A_{s3} * h_3 / s_3) / A_c = 0.00188496$
 $h_3 = 1800.00$
 $A_{s3} = A_{stir3} * n_{s3} = 0.00$
 No stirups, $n_{s3} = 2.00$

$\phi_{psh,y} = \phi_{ps1,y} + \phi_{ps2,y} + \phi_{ps3,y} = 0.0010472$
 $\phi_{ps1,y} (\text{column 1}) = (A_{s1} * h_1 / s_1) / A_c = 0.0005236$
 $h_1 = 250.00$
 $A_{s1} = A_{stir1} * n_{s1} = 157.0796$
 No stirups, $n_{s1} = 2.00$
 $\phi_{ps2,y} (\text{column 2}) = (A_{s2} * h_2 / s_2) / A_c = 0.0005236$
 $h_2 = 250.00$
 $A_{s2} = A_{stir2} * n_{s2} = 157.0796$
 No stirups, $n_{s2} = 2.00$
 $\phi_{ps3,y} (\text{web}) = (A_{s3} * h_3 / s_3) / A_c = 0.00$
 $h_3 = 250.00$
 $A_{s3} = A_{stir3} * n_{s3} = 157.0796$
 No stirups, $n_{s3} = 0.00$

$A_{sec} = 750000.00$
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$
 $f_{ywe} = 625.00$
 $f_{ce} = 25.00$
 From ((5.A5), TBDY), TBDY: $\phi_{cc} = 0.002$
 $\phi_c = \text{confinement factor} = 1.00$
 $y_1 = 0.00094258$
 $sh_1 = 0.00301626$
 $ft_1 = 282.7748$
 $fy_1 = 235.6456$
 $su_1 = 0.00301626$
 using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00
 $l_o / l_{ou,min} = l_b / l_d = 0.16565482$

```

su1 = 0.4*esu1_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu1_nominal = 0.08,
For calculation of esu1_nominal and y1, sh1,ft1,fy1, it is considered
characteristic value fsy1 = fs1/1.2, from table 5.1, TBDY.
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 = 235.6456
with Es1 = Es = 200000.00
y2 = 0.00094258
sh2 = 0.00301626
ft2 = 282.7748
fy2 = 235.6456
su2 = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/lb,min = 0.16565482
su2 = 0.4*esu2_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esu2_nominal = 0.08,
For calculation of esu2_nominal and y2, sh2,ft2,fy2, it is considered
characteristic value fsy2 = fs2/1.2, from table 5.1, TBDY.
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 = 235.6456
with Es2 = Es = 200000.00
yv = 0.00094258
shv = 0.00301626
ftv = 282.7748
fyv = 235.6456
suv = 0.00301626
using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
and also multiplied by the shear_factor according to 15.7.1.4, with
Shear_factor = 1.00
lo/lou,min = lb/ld = 0.16565482
suv = 0.4*esuv_nominal ((5.5), TBDY) = 0.032
From table 5A.1, TBDY: esuv_nominal = 0.08,
considering characteristic value fsyv = fsv/1.2, from table 5.1, TBDY
For calculation of esuv_nominal and yv, shv,ftv,fyv, it is considered
characteristic value fsyv = fsv/1.2, from table 5.1, TBDY.
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 = 235.6456
with Esv = Es = 200000.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.04275722
2 = Asl,com/(b*d)*(fs2/fc) = 0.04275722
v = Asl,mid/(b*d)*(fsv/fc) = 0.00

```

and confined core properties:

```

b = 2940.00
d = 178.00
d' = 12.00
fcc (5A.2, TBDY) = 25.00
cc (5A.5, TBDY) = 0.002
c = confinement factor = 1.00
1 = Asl,ten/(b*d)*(fs1/fc) = 0.05098316
2 = Asl,com/(b*d)*(fs2/fc) = 0.05098316
v = Asl,mid/(b*d)*(fsv/fc) = 0.00

```

Case/Assumption: Unconfined full section - Steel rupture
 ' satisfies Eq. (4.3)

```

--->
v < vs,y2 - LHS eq.(4.5) is satisfied
--->
su (4.9) = 0.22164534
Mu = MRc (4.14) = 1.2341E+008
u = su (4.1) = 1.8630672E-005

```

Calculation of ratio lb/ld

```

Lap Length: lb/ld = 0.16565482
lb = 300.00

```

ld = 1810.995

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

ld,min from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

= 1

db = 16.35294

Mean strength value of all re-bars: fy = 625.00

t = 1.00

s = 0.80

e = 1.00

cb = 25.00

Ktr = 1.848

n = 34.00

Calculation of Mu2-

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

$\phi_u = 1.8844503E-005$

Mu = 1.4440E+008

with full section properties:

b = 3000.00

d = 208.00

d' = 42.00

v = 0.00176852

N = 27588.841

fc = 25.00

co (5A.5, TBDY) = 0.002

Final value of ϕ_u : $\phi_u^* = \text{shear_factor} * \text{Max}(\phi_u, \phi_c) = 0.0035$

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

From (5.4b), TBDY: $\phi_u = 0.0035$

we (5.4c) = 0.00

ase ((5.4d), TBDY) = $(\text{ase1} * A_{col1} + \text{ase2} * A_{col2} + \text{ase3} * A_{web}) / A_{sec} = 0.00$

ase1 = 0.00

sh_1 = 100.00

bo_1 = 190.00

ho_1 = 540.00

bi2_1 = 655400.00

ase2 = 0.00

sh_2 = 100.00

bo_2 = 190.00

ho_2 = 540.00

bi2_2 = 655400.00

ase3 = 0 (grid does not provide confinement)

psh,min = $\text{Min}(\text{psh},x, \text{psh},y) = 0.0010472$

$\text{psh},x = \text{ps1},x + \text{ps2},x + \text{ps3},x = 0.00439823$

$\text{ps1},x$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.00125664$

h1 = 600.00

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, $n_{s1} = 2.00$

$\text{ps2},x$ (column 2) = $(A_{s2} * h_2 / s_2) / A_c = 0.00125664$

h2 = 600.00

$A_{s2} = A_{stir2} * n_{s2} = 157.0796$

No stirups, $n_{s2} = 2.00$

$\text{ps3},x$ (web) = $(A_{s3} * h_3 / s_3) / A_c = 0.00188496$

h3 = 1800.00

$A_{s3} = A_{stir3} * n_{s3} = 0.00$

No stirups, $n_{s3} = 2.00$

$\text{psh},y = \text{ps1},y + \text{ps2},y + \text{ps3},y = 0.0010472$

$\text{ps1},y$ (column 1) = $(A_{s1} * h_1 / s_1) / A_c = 0.0005236$

h1 = 250.00

$A_{s1} = A_{stir1} * n_{s1} = 157.0796$

No stirups, ns1 = 2.00
 $ps2,y \text{ (column 2)} = (As2 \cdot h2 / s_2) / Ac = 0.0005236$
 $h2 = 250.00$
 $As2 = Astir2 \cdot ns2 = 157.0796$
 No stirups, ns2 = 2.00
 $ps3,y \text{ (web)} = (As3 \cdot h3 / s_3) / Ac = 0.00$
 $h3 = 250.00$
 $As3 = Astir3 \cdot ns3 = 157.0796$
 No stirups, ns3 = 0.00

Asec = 750000.00
 $s_1 = 100.00$
 $s_2 = 100.00$
 $s_3 = 200.00$

$fywe = 625.00$
 $fce = 25.00$

From ((5.A.5), TBDY), TBDY: cc = 0.002
 c = confinement factor = 1.00

$y1 = 0.00094258$
 $sh1 = 0.00301626$
 $ft1 = 282.7748$
 $fy1 = 235.6456$
 $su1 = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

$lo/lou,min = lb/ld = 0.16565482$

$su1 = 0.4 \cdot esu1_nominal \text{ ((5.5), TBDY)} = 0.032$

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

For calculation of $esu1_nominal$ and $y1, sh1, ft1, fy1$, it is considered
 characteristic value $fsy1 = fs1/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs1 = fs = 235.6456$

with $Es1 = Es = 200000.00$

$y2 = 0.00094258$
 $sh2 = 0.00301626$
 $ft2 = 282.7748$
 $fy2 = 235.6456$
 $su2 = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

$lo/lou,min = lb/lb,min = 0.16565482$

$su2 = 0.4 \cdot esu2_nominal \text{ ((5.5), TBDY)} = 0.032$

From table 5A.1, TBDY: $esu2_nominal = 0.08$,

For calculation of $esu2_nominal$ and $y2, sh2, ft2, fy2$, it is considered
 characteristic value $fsy2 = fs2/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fs2 = fs = 235.6456$

with $Es2 = Es = 200000.00$

$yv = 0.00094258$
 $shv = 0.00301626$
 $ftv = 282.7748$
 $fyv = 235.6456$
 $suv = 0.00301626$

using (30) in Biskinis/Fardis (2013) multiplied with shear_factor
 and also multiplied by the shear_factor according to 15.7.1.4, with
 Shear_factor = 1.00

$lo/lou,min = lb/ld = 0.16565482$

$suv = 0.4 \cdot esuv_nominal \text{ ((5.5), TBDY)} = 0.032$

From table 5A.1, TBDY: $esuv_nominal = 0.08$,

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

For calculation of $esuv_nominal$ and yv, shv, ftv, fyv , it is considered
 characteristic value $fsyv = fsv/1.2$, from table 5.1, TBDY.

$y1, sh1, ft1, fy1$, are also multiplied by $Min(1, 1.25 \cdot (lb/ld)^{2/3})$, from 10.3.5, ASCE 41-17.

with $fsv = fs = 235.6456$

with $Esv = Es = 200000.00$

$$1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.04275722$$

$$2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.04275722$$

$$v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02429711$$

and confined core properties:

$$b = 2940.00$$

$$d = 178.00$$

$$d' = 12.00$$

$$f_{cc} (5A.2, TBDY) = 25.00$$

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

$$c = \text{confinement factor} = 1.00$$

$$1 = A_{sl,ten}/(b*d)*(f_{s1}/f_c) = 0.05098316$$

$$2 = A_{sl,com}/(b*d)*(f_{s2}/f_c) = 0.05098316$$

$$v = A_{sl,mid}/(b*d)*(f_{sv}/f_c) = 0.02897156$$

Case/Assumption: Unconfined full section - Steel rupture

' satisfies Eq. (4.3)

--->

$v < v_{s,y2}$ - LHS eq.(4.5) is satisfied

--->

$$su (4.9) = 0.23047746$$

$$\mu_u = M_{Rc} (4.14) = 1.4440E+008$$

$$u = su (4.1) = 1.8844503E-005$$

Calculation of ratio l_b/d

$$\text{Lap Length: } l_b/d = 0.16565482$$

$$l_b = 300.00$$

$$l_d = 1810.995$$

Calculation of $l_{b,min}$ according to (25.4.3.2), ACI 318-14, using mean values for all the section re-bars.

$l_{d,min}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (9.1.2, TS500 - No provision in ACI 318)

$$= 1$$

$$d_b = 16.35294$$

$$\text{Mean strength value of all re-bars: } f_y = 625.00$$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

Calculation of Shear Strength $V_r = \text{Min}(V_{r1}, V_{r2}) = 1.1297E+006$

Calculation of Shear Strength at edge 1, $V_{r1} = 1.1297E+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r1} = V_n < 0.83*f_c'^{0.5}*h*d$

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

$$\text{From Table (11.5.4.6(d-e)), ACI 318-14: } V_c = 815517.768$$

$$\mu_u/V_u - l_w/2 = 0.00 \leq 0$$

$$= 1 \text{ (normal-weight concrete)}$$

$$f_c' = 25.00, \text{ but } f_c'^{0.5} \leq 8.3 \text{ MPa (22.5.3.1, ACI 318-14)}$$

$$h = 3000.00$$

$$d = 200.00$$

$$l_w = 250.00$$

$$\mu_u = 2.5788780E-012$$

$$V_u = 0.00$$

$$N_u = 27588.841$$

$$\text{From (11.5.4.8), ACI 318-14: } V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$$

$V_{s1} = 157079.633$ is calculated for pseudo-Column 1, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

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

Vs2 = 157079.633 is calculated for pseudo-Column 2, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

$$d = 200.00$$

$$A_v = 0.00$$

$$s = 200.00$$

$$f_y = 500.00$$

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$$2(1-s/d) = 0.00$$

$$V_f((11-3)-(11.4), \text{ACI } 440) = 0.00$$

$$\text{From } (11-11), \text{ACI } 440: V_s + V_f \leq 1.9929\text{E}+006$$

$$b_w = 3000.00$$

Calculation of Shear Strength at edge 2, $V_{r2} = 1.1297\text{E}+006$

From (22.5.1.1) and 11.5.4.3, ACI 318-14: $V_{r2} = V_n < 0.83 \cdot f_c' \cdot h \cdot d$

NOTE: In expression (22.5.1.1) ' V_w ' is replaced by ' $V_w + f \cdot V_f$ '
where V_f is the contribution of FRPs (11.3), ACI 440).

From Table (11.5.4.6(d-e)), ACI 318-14: $V_c = 815517.768$

$$\mu_u / \nu_u - l_w / 2 = 0.00 \leq 0$$

$$= 1 \text{ (normal-weight concrete)}$$

$$f_c' = 25.00, \text{ but } f_c'^{0.5} \leq 8.3 \text{ MPa (22.5.3.1, ACI 318-14)}$$

$$h = 3000.00$$

$$d = 200.00$$

$$l_w = 250.00$$

$$\mu_u = 2.5788780\text{E}-012$$

$$\nu_u = 0.00$$

$$N_u = 27588.841$$

From (11.5.4.8), ACI 318-14: $V_s = V_{s1} + V_{s2} + V_{s3} = 314159.265$

Vs1 = 157079.633 is calculated for pseudo-Column 1, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

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

Vs2 = 157079.633 is calculated for pseudo-Column 2, with:

$$d = 200.00$$

$$A_v = 157079.633$$

$$s = 100.00$$

$$f_y = 500.00$$

Vs2 has been multiplied by 1 ($s < d/2$, according to ASCE 41-17,10.3.4)

Vs3 = 0.00 is calculated for web, with:

$$d = 200.00$$

$$A_v = 0.00$$

$$s = 200.00$$

$$f_y = 500.00$$

Vs3 has been multiplied by $2(1-s/d)$ ($s > d/2$, according to ASCE 41-17,10.3.4)

$$2(1-s/d) = 0.00$$

$$V_f((11-3)-(11.4), \text{ACI } 440) = 0.00$$

$$\text{From } (11-11), \text{ACI } 440: V_s + V_f \leq 1.9929\text{E}+006$$

$$b_w = 3000.00$$

End Of Calculation of Shear Capacity ratio for element: wall W1 of floor 1

At local axis: 2

Start Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1

At local axis: 3

Integration Section: (b)

Section Type: rcrws

Constant Properties

Knowledge Factor, $\gamma = 1.00$

According to 10.7.2.3, ASCE 41-17, shear walls with

transverse reinforcement percentage, $\rho < 0.0015$

are considered Force-Controlled and lower-bound strengths are used according to 7.5.1.3, ASCE 41-17

$\rho = 0.0010472$

with $\rho = \rho_1 + \rho_2 + \rho_3$, being the shear reinf. ratio in a plane perpendicular to the shear axis 2

(pseudo-col.1 $\rho_1 = A_{s1} \cdot b_1 / s_1 = (A_{s1} \cdot h_1 / s_1) / A_c = 0.0005236$

$h_1 = 250.00$

$s_1 = 100.00$

total area of hoops perpendicular to shear axis, $A_{s1} = 157.0796$

(pseudo-col.2 $\rho_2 = A_{s2} \cdot b_2 / s_2 = (A_{s2} \cdot h_2 / s_2) / A_c = 0.0005236$

$h_2 = 250.00$

$s_2 = 100.00$

total area of hoops perpendicular to shear axis, $A_{s2} = 157.0796$

(grid $\rho_3 = A_{s3} \cdot b_3 / s_3 = (A_{s3} \cdot h_3 / s_3) / A_c = 0.00$

$h_3 = 250.00$

$s_3 = 200.00$

total area of hoops perpendicular to shear axis, $A_{s3} = 0.00$

total section area, $A_c = 750000.00$

Consequently:

New material of Secondary Member: Concrete Strength, $f_c = f_{c_lower_bound} = 25.00$

New material of Secondary Member: Steel Strength, $f_s = f_{s_lower_bound} = 500.00$

Concrete Elasticity, $E_c = 26999.444$

Steel Elasticity, $E_s = 200000.00$

Total Height, $H_{tot} = 3000.00$

Edges Width, $W_{edg} = 250.00$

Edges Height, $H_{edg} = 600.00$

Web Width, $W_{web} = 250.00$

Cover Thickness, $c = 25.00$

Element Length, $L = 3000.00$

Secondary 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

Lap Length $l_b = 300.00$

No FRP Wrapping

Stepwise Properties

Bending Moment, $M = -1.3664558E-010$

Shear Force, $V_2 = 1.1969937E-013$

Shear Force, $V_3 = 53656.852$

Axial Force, $F = -27994.722$

Longitudinal Reinforcement Area Distribution (in 2 divisions)

-Tension: $A_{st} = 0.00$

-Compression: $A_{sc} = 7269.645$

Longitudinal Reinforcement Area Distribution (in 3 divisions)

-Tension: $A_{st,ten} = 2830.575$

-Compression: $A_{st,com} = 2830.575$

-Middle: $A_{st,mid} = 1608.495$

Mean Diameter of Tension Reinforcement, $D_bL = 16.46154$

New component: From table 7-7, ASCE 41_17: Final chord rotation Capacity $u_R = 1.0^*$ $u = 0.00892944$

$u = \gamma + \rho = 0.00892944$

- Calculation of y -

$$y = (M_y \cdot I_p) / (EI)_{\text{Eff}} = 0.00092944 \text{ ((10-5), ASCE 41-17)}$$

$$M_y = 1.4295 \text{E}+008$$

$$(EI)_{\text{Eff}} = 0.35 \cdot E_c \cdot I \text{ (table 10-5)}$$

$$E_c \cdot I = 1.0547 \text{E}+014$$

$$I_p = 0.5 \cdot d = 0.5 \cdot (0.8 \cdot h) = 240.00$$

Calculation of Yielding Moment M_y

Calculation of y and M_y according to Annex 7 -

$$y = \text{Min}(y_{\text{ten}}, y_{\text{com}})$$

$$y_{\text{ten}} = 7.0162417 \text{E}-006$$

$$\text{with ((10.1), ASCE 41-17)} \quad f_y = \text{Min}(f_y, 1.25 \cdot f_y \cdot (I_b / I_d)^{2/3}) = 218.754$$

$$d = 208.00$$

$$y = 0.2505232$$

$$A = 0.01185516$$

$$B = 0.00720633$$

$$\text{with } p_t = 0.00453618$$

$$p_c = 0.00453618$$

$$p_v = 0.00257772$$

$$N = 27994.722$$

$$b = 3000.00$$

$$" = 0.20192308$$

$$y_{\text{comp}} = 3.2327896 \text{E}-005$$

$$\text{with } f_c = 25.00$$

$$E_c = 26999.444$$

$$y = 0.24786597$$

$$A = 0.01151549$$

$$B = 0.00700125$$

$$\text{with } E_s = 200000.00$$

Calculation of ratio I_b / I_d

$$\text{Lap Length: } I_d / I_{d,\text{min}} = 0.20706852$$

$$I_b = 300.00$$

$$I_d = 1448.796$$

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

$I_{d,\text{min}}$ from (25.4.3.2) is multiplied 2 times to account for smooth re-bars (10.3.5, ASCE 41-17)

$$= 1$$

$$d_b = 16.35294$$

$$\text{Mean strength value of all re-bars: } f_y = 500.00$$

$$t = 1.00$$

$$s = 0.80$$

$$e = 1.00$$

$$c_b = 25.00$$

$$K_{tr} = 1.848$$

$$n = 34.00$$

- Calculation of p -

Considering wall controlled by flexure (shear control ratio ≤ 1),

from table 10-19: $p = 0.008$

with:

- Condition i (shear wall and wall segments)

$$-(A_s - A_s') \cdot f_y + P / (t_w \cdot I_w \cdot f_c') = -0.19236416$$

$$A_s = 0.00$$

$$A_s' = 7269.645$$

$$f_y = 500.00$$

$$P = 27994.722$$

$$t_w = 3000.00$$

$l_w = 250.00$
 $f_c = 25.00$
- $V/(t_w l_w f_c^{0.5}) = 3.8440039E-019$, NOTE: units in lb & in
- Confined Boundary: No
Boundary hoops spacing does not exceed $8d_b$ ($s_1 < 8d_b$ and $s_2 < 8d_b$)
Boundary Trans. Reinf. does not exceed 50% of ACI 318 provision ($V_{w1} + V_{w2} > 0.50(V - V_c - V_{w3})$)
With
Boundary Element 1:
 $V_{w1} = 157079.633$
 $s_1 = 100.00$
Boundary Element 2:
 $V_{w2} = 157079.633$
 $s_2 = 100.00$
Grid Shear Force, $V_{w3} = 0.00$
Concrete Shear Force, $V_c = 224878.814$
(The variables above have already been given in Shear control ratio calculation)
Mean diameter of all bars, $d_b = 17.33333$
Design Shear Force, $V = 1.1969937E-013$

End Of Calculation of Chord Rotation Capacity for element: wall W1 of floor 1
At local axis: 3
Integration Section: (b)
