COLUMN DESIGN FOR SHEAR AND LINKS (NON DUCTILE)

DESIGN CODE ACI 318M-2014

Input / Defaults

$ColumnNo$: C22

$Location$: Bottom Joint

$TypeOfColumn := 1$	----------	1- for Non-Ductile, 2 for Intermediate, 3 for Special
$B := 600\ mm$	----------	Width of the Column
$D := 900\ mm$	----------	Depth of the Column
$Pu\_D := 4112.05\ kN$	----------	factored axial force occurring simultaneously with Vu along D
$Pu\_B := 2604.49\ kN$	----------	factored axial force occurring simultaneously with Vu along B
$Mshear\_D := 100.96\ kN{\cdot}m$	----------	factored Bending Moment occurring simultaneously with Vu along D
$Mshear\_B := 100.96\ kN{\cdot}m$	----------	factored Bending Moment occurring simultaneously with Vu along D
$Vuy3 := 981.8\ kN$	----------	Ultimate Shear force at section considered along D
$Vux3 := 59.93\ kN$	----------	Ultimate Shear force at section considered along B
$f'c := 20\ MPa$	----------	Grade of Concrete (Cylindrical Strength)
$fy := 420\ MPa$	----------	Grade of Reinforcement for Main Reinforcement
$fyt := 420\ MPa$	----------	Grade of Reinforcement for Secondary Reinforcement
$Cc := 50\ mm$	----------	Nominal Cover to Beam Tension Reinforcement
$Es := 200000\ MPa$	----------	Modulus of elasticity of reinforcement
$LuD := 3400\ mm$	----------	Clear Floor Height @ lux
$LuB := 3400\ mm$	----------	Clear Floor Height @ luy
$\lambda := 1$	----------	Modification factor for compressive strength

Reinforcement Provided

$\phi 1 := 19.1\ mm$	----------	Diameter of Reinforcement
$N1 := 18$	----------	No of Rebar
$\phi 2 := 15.9\ mm$	----------	Diameter of Reinforcement
$N2 := 2$	----------	No of Rebar

$$Ast := \frac{\pi \cdot \phi 1^2}{4} \cdot N1 + \frac{\pi \cdot \phi 2^2}{4} \cdot N2 = 5554.493\ mm^2$$ ---------- Area of Reinforcement Provided

Shear reinforcement Provided

$\phi 3 := 9.5\ mm$	----------	Diameter of Link
$Bundled\_1 := 1$		
$Legs1 := 5$	----------	Number of shear Legs along D
$Legs2 := 7$	----------	Number of shear Legs along B
$Spc := 250\ mm$	----------	Spacing of Non-ductile links provided

$$Asvprv\_D := \left(\frac{\pi \cdot \phi 3^2}{4} \cdot Legs1\right) \cdot \frac{1}{Spc} \cdot Bundled\_1 = 1417.644\ \frac{mm^2}{m}$$

---------- Area of Links Provided along D

$$Asvprv\_B := \left(\frac{\pi \cdot \phi 3^2}{4} \cdot Legs2\right) \cdot \frac{1}{Spc} \cdot Bundled\_1 = 1984.701\ \frac{mm^2}{m}$$

---------- Area of Links Provided along B

$$fy\_s := \left\| \begin{array}{l} \text{if } fy > 420\ MPa \\ \quad \| 420\ MPa \\ \text{else} \\ \quad \| fy \end{array} \right| = 420\ MPa$$

Permissible yield strength of transverse reinforcement
Table 20.2.2.4a

Shear Force Calculation

Shear as per Column Flexural Capacity (Fig. R18.3.3)

18.3.3 Columns having unsupported length $\ell_u \le 5c_1$ shall have ϕV_n at least the lesser of (a) and (b):

(a) The shear associated with development of nominal moment strengths of the column at each restrained end of the unsupported length due to reverse curvature bending. Column flexural strength shall be calculated for the factored axial force, consistent with the direction of the lateral forces considered, resulting in the highest flexural strength.
(b) The maximum shear obtained from design load combinations that include E, with $\Omega_o E$ substituted for E.

Along D

$LuD = 3400\ mm$

$D = 900\ mm$

$$Check := \left\| \begin{array}{l} \text{if } LuD < 5 \cdot D \\ \quad \| \text{“ShortColumn”} \\ \text{else} \\ \quad \| \text{“LongColumn”} \end{array} \right| = \text{“ShortColumn”}$$

Shear from Moment Capacity

$Pu\_top := 2574.39\ kN$

$Mnt\_top := 1156.03\ kN \cdot m$

$Pu\_bot := 2625.44\ kN$

$Mnt\_bot := 1140.57\ kN \cdot m$

$$Vuy1 := \frac{(Mnt\_top + Mnt\_bot)}{LuD} = 675.471\ kN$$

Along B

$LuB = 3400\ mm$

$$Check := \left\| \begin{array}{l} \text{if } LuB < 5 \cdot B \\ \quad \| \text{“ShortColumn”} \\ \text{else} \\ \quad \| \text{“LongColumn”} \end{array} \right| = \text{“LongColumn”}$$

$Vux1 := 0\ kN$

Note:
The column moment capacity (Mnt_top and Mnt_bot) is calculated for axial force (Pu) which gives the maximum moment capacity. The PM curve is generated and the capacity is calculated.

Shear from Load combinations with Enhanced Eq factor

Shear Design along D

Critical Load Combination 1.2 (LOAD 1: LOAD CASE 1) +0.5 (LOAD 2: LOAD CASE 2) +3 (LOAD 3: LOAD CASE 3 EQ-X)

$Vuy2 := 1086.09\ kN$

Shear Design along B

$Vux2 := 0\ kN$

$Vu'y := min(Vuy1, Vuy2) = 675.471\ kN$

$Vu'x := min(Vux1, Vux2) = 0\ kN$

Shear Design along D

Critical Load Combination [1] : 1.4 (LOAD 1: LOAD CASE 1)

$Pu\_D = 4112.05\ kN$

$Mshear\_D = 100.96\ kN \cdot m$

$Vuy3 = 981.8\ kN$

$Vuy := \max(Vu'y, Vuy3) = 981.8\ kN$

$\phi := \left\| \begin{array}{l} \text{if } TypeOfColumn > 2 \\ \quad \| 0.6 \\ \text{else} \\ \quad \| 0.75 \end{array} \right\| = 0.75$ ---------- Strength Reduction Factor

$deff := D - Cc - \frac{\phi 1}{2} = 840.45\ mm$

$pt := \frac{Ast}{2 \cdot B \cdot deff} = 0.00551$ ---------- 50% of total reinforcement assumed as Tension Reinforcement

$Ag := D \cdot B = 540000\ mm^2$

$Aeff\_y := deff \cdot B = 504270\ mm^2$

$Mm\_y := Mshear\_D - Pu\_D \cdot \frac{(4 \cdot D - deff)}{8} = -1317.466\ kN \cdot m$

$Vcy1 := 0.17 \cdot \left(1 \cdot MPa + \left(\frac{Pu\_D}{3.5 \cdot Ag}\right)\right) \cdot \lambda \cdot \sqrt{f'c \cdot MPa} \cdot B \cdot \frac{deff}{MPa} = 1217.488\ kN$

---------- Clause 22.5.7.1

$Vcy2 := \left(0.16 \cdot \sqrt{f'c \cdot MPa} + 17 \cdot pt \cdot MPa \cdot \left(\frac{Vuy \cdot deff}{Mm\_y}\right)\right) \cdot B \cdot deff = 331.256\ kN$

---------- Table 22.5.6.1 (a)

$Vcy3 := \left(0.29 \cdot \sqrt{f'c} \cdot \sqrt{1 \cdot MPa + \left(0.29 \cdot \frac{Pu\_D}{Ag}\right)}\right) \cdot B \cdot deff = 1171.427\ kN$

---------- Table 22.5.6.1 (b)

$$\phi Vcy := \begin{cases} \text{if } Pu\_D < 0 \\ \quad Vcy1 \cdot \phi \\ \text{else if } Mm\_y < 0 \\ \quad Vcy3 \cdot \phi \\ \text{else} \\ \quad \phi \cdot min(Vcy2, Vcy3) \end{cases} = 878.57\ kN$$

$$Check1 := \begin{cases} \text{if } \phi Vcy \geq Vuy \\ \quad \text{“ShearReinfNotRequired”} \\ \text{else} \\ \quad \text{“ShearReinfRequired”} \end{cases} = \text{“ShearReinfRequired”}$$

---------- Clause 7.1.1

$$fy\_s = 420\ MPa$$

$$Vsy := \begin{cases} \text{if } \phi Vcy \geq Vuy \\ \quad 0\ kN \\ \text{else} \\ \quad \dfrac{(Vuy - \phi Vcy)}{\phi} \end{cases} = 137.64\ kN$$

---------- Clause 7.1.1

$$Vsy\_perm := 0.66 \cdot \sqrt{f'c \cdot MPa} \cdot B \cdot deff = 1488.408\ kN$$

$$Check2 := \begin{cases} \text{if } Vsy\_perm \geq Vsy \\ \quad \text{“Ok”} \\ \text{else} \\ \quad \text{“Revise”} \end{cases} = \text{“Ok”}$$

$$Check3 := \begin{cases} \text{if } Vuy > 0.5 \cdot \phi Vcy \\ \quad \text{“Check for Min. Shear Reinf”} \\ \text{else} \\ \quad \text{“Check for Min. Shear Reinf Not Req”} \end{cases} = \text{“Check for Min. Shear Reinf”}$$

$$Asv\_min1 := \max\left(0.062 \cdot \sqrt{f'c \cdot MPa} \cdot \frac{B}{fy\_s} \cdot 1000 \cdot mm,\ 0.35 \cdot \frac{B}{fy\_s} \cdot 1000 \cdot MPa \cdot mm\right) = 500\ mm^2$$

$$Asv\_min := \begin{cases} \text{if } Vuy > 0.5 \cdot \phi Vcy \\ \quad Asv\_min1 \\ \text{else} \\ \quad 0\ mm^2 \end{cases} = 500\ mm^2$$

---------- Clause 15.4.2

$$Asv\_shear\_y := \begin{cases} \text{if } \phi Vcy \geq Vuy \\ \quad 0\ mm^2 \\ \text{else} \\ \quad \dfrac{Vsy \cdot m}{fy\_s \cdot deff} \end{cases} = 389.927\ mm^2$$

$$Asv\_req\_y := \frac{\max(Asv\_min, Asv\_shear\_y)}{m} = 500\ \frac{mm^2}{m}$$

$$Check := \left\| \begin{array}{l} \text{if } Asvprv\_D > Asv\_req\_y \\ \quad \| \text{“Ok”} \\ \text{else} \\ \quad \| \text{“Increase Reinforcement”} \end{array} \right\| = \text{“Ok”}$$

Shear Design along B

Critical Load Combination [13] : 0.9 (LOAD 1: LOAD CASE 1) -(LOAD 4: LOAD CASE 4 EQ-Y)

$Pu\_B = 2604.49\ kN$

$Mshear\_B := 109.65\ kN \cdot m$

$Vux3 = 59.93\ kN$

$Vux := \max(Vu'x, Vux3) = 59.93\ kN$

$$\phi := \left\| \begin{array}{l} \text{if } TypeOfColumn > 2 \\ \quad \| 0.6 \\ \text{else} \\ \quad \| 0.75 \end{array} \right\| = 0.75$$

---------- Strength Reduction Factor

$$beff := B - Cc - \frac{\phi 1}{2} = 540.45\ mm$$

$$pt := \frac{Ast}{2 \cdot D \cdot beff} = 0.00571$$

---------- 50% of total reinforcement assumed as Tension Reinforcement

$Ag := D \cdot B = 540000\ mm^2$

$Aeff\_x := beff \cdot D = 486405\ mm^2$

$$Mm\_x := Mshear\_B - Pu\_B \cdot \frac{(4 \cdot B - beff)}{8} = -495.747\ kN \cdot m$$

$$Vcx1 := 0.17 \cdot \left(1 \cdot MPa + \left(\frac{Pu\_B}{3.5 \cdot Ag}\right)\right) \cdot \lambda \cdot \sqrt{f'c \cdot MPa} \cdot D \cdot \frac{beff}{MPa} = 879.388\ kN$$

---------- Clause 22.5.7.1

$$Vcx2 := \left(0.16 \cdot \sqrt{f'c \cdot MPa} + 17 \cdot pt \cdot MPa \cdot \left(\frac{Vux \cdot beff}{Mm\_x}\right)\right) \cdot D \cdot beff = 344.958\ kN$$

---------- Table 22.5.6.1 (a)

$$Vcx3 := \left(0.29 \cdot \sqrt{f'c} \cdot \sqrt{1 \cdot MPa + \left(0.29 \cdot \frac{Pu\_B}{Ag}\right)}\right) \cdot D \cdot beff = 977.012\ kN$$

---------- Table 22.5.6.1 (b)

$$\phi Vcx := \left\| \begin{array}{l} \text{if } Pu\_B < 0 \\ \quad \| Vcx1 \cdot \phi \\ \text{else if } Mm\_x < 0 \\ \quad \| Vcx3 \cdot \phi \\ \text{else} \\ \quad \| \phi \cdot min(Vcx2, Vcx3) \end{array} \right\| = 732.76\ kN$$

$$Check1 := \begin{cases} \text{if } \phi Vcx \geq Vux \\ \quad \text{“ShearReinfNotRequired”} \\ \text{else} \\ \quad \text{“ShearReinfRequired”} \end{cases} = \text{“ShearReinfNotRequired”}$$

$$fy\_s = 420\ MPa$$

$$Vsx := \begin{cases} \text{if } \phi Vcx \geq Vux \\ \quad 0\ kN \\ \text{else} \\ \quad \dfrac{(Vux - \phi Vcx)}{\phi} \end{cases} = 0\ kN$$

---------- Clause 7.1.1

$$Vsx\_perm := 0.66 \cdot \sqrt{f'c \cdot MPa} \cdot D \cdot beff = 1435.678\ kN$$

$$Check2 := \begin{cases} \text{if } Vsx\_perm \geq Vsx \\ \quad \text{“Ok”} \\ \text{else} \\ \quad \text{“Revise”} \end{cases} = \text{“Ok”}$$

$$Check3 := \begin{cases} \text{if } Vux > 0.5 \cdot \phi Vcx \\ \quad \text{“Check for Min. Shear Reinf”} \\ \text{else} \\ \quad \text{“Check for Min. Shear Reinf Not Req”} \end{cases} = \text{“Check for Min. Shear Reinf Not Req”}$$

$$Asv\_min1 := \max\left(0.062 \cdot \sqrt{f'c \cdot MPa} \cdot \frac{D}{fy\_s} \cdot 1000 \cdot mm,\ 0.35 \cdot \frac{D}{fy\_s} \cdot 1000 \cdot MPa \cdot mm\right) = 750\ mm^2$$

$$Asv\_min := \begin{cases} \text{if } Vux > 0.5 \cdot \phi Vcx \\ \quad Asv\_min1 \\ \text{else} \\ \quad 0\ mm^2 \end{cases} = 0\ mm^2$$

$$Asv\_shear\_x := \begin{cases} \text{if } \phi Vcx \geq Vux \\ \quad 0\ mm^2 \\ \text{else} \\ \quad \dfrac{Vsx \cdot m}{fy\_s \cdot beff} \end{cases} = 0\ mm^2$$

$$Asv\_req\_x := \frac{\max(Asv\_min,\ Asv\_shear\_x)}{m} = 0\ \frac{mm^2}{m}$$

$$Check := \begin{cases} \text{if } Asvprv\_D > Asv\_req\_x \\ \quad \text{“Ok”} \\ \text{else} \\ \quad \text{“Increase Reinforcement”} \end{cases} = \text{“Ok”}$$

Detailing of Links

Check for Minimum Area of Shear Reinforcement (Clause 7.10.5.1)

Along D

$$Asv\_minD := \max\left(0.062 \cdot \sqrt{f'c \cdot MPa} \cdot \frac{B}{fy\_s} \cdot 1000 \cdot mm,\ 0.35 \cdot \frac{B}{fy\_s} \cdot 1000 \cdot MPa \cdot mm\right) = 500\ mm^2$$

$$Check := \left\| \begin{array}{l} \text{if } Asvprv\_D \geq \frac{Asv\_minD}{m} \\ \quad \| \text{“Ok”} \\ \text{else} \\ \quad \| \text{“Increase Shear Reinf”} \end{array} \right. = \text{“Ok”}$$

Along B

$$Asv\_minB := \max\left(0.062 \cdot \sqrt{f'c \cdot MPa} \cdot \frac{D}{fy\_s} \cdot 1000 \cdot mm,\ 0.35 \cdot \frac{D}{fy\_s} \cdot 1000 \cdot MPa \cdot mm\right) = 750\ mm^2$$

$$Check := \left\| \begin{array}{l} \text{if } Asvprv\_B \geq \frac{Asv\_minB}{m} \\ \quad \| \text{“Ok”} \\ \text{else} \\ \quad \| \text{“Increase Shear Reinf”} \end{array} \right. = \text{“Ok”}$$

Check for Minimum Diameter (Clause 25.7.2.2)

$$maxDia := \max(\phi 1, \phi 2) = 19.1\ mm$$

$$Bundled := 1$$

$$Effective\_Area := \frac{\pi}{4} \cdot maxDia^2 \cdot Bundled = 286.521\ mm^2$$

$$Effective\_Dia := \sqrt{\frac{Effective\_Area \cdot 4}{\pi}} = 19.1\ mm$$

$$Min\_Dia := \left\| \begin{array}{l} \text{if } Effective\_Dia > 35.8\ mm \\ \quad \| 12.7\ mm \\ \text{else if } Bundled > 1 \\ \quad \| 12.7\ mm \\ \text{else} \\ \quad \| 9.5\ mm \end{array} \right. = 9.5\ mm$$

$$Check := \left\| \begin{array}{l} \text{if } \phi 3 \geq Min\_Dia \\ \quad \| \text{“Ok”} \\ \text{else} \\ \quad \| \text{“Increase Diameter”} \end{array} \right. = \text{“Ok”}$$

Check for Minimum Spacing (Clause 25.7.2.1)

$$Spc1 := 16 \cdot min(\phi 1, \phi 2) = 254.4\ mm$$

$$Spc2 := 48 \cdot \phi 3 = 456\ mm$$

$$Spc3 := B = 600\ mm$$

Criterion for spacing for shear reinforcement (Clause 10.7.6.2)

Along D

$$Vsy := \begin{cases} \text{if } \phi Vcy \geq Vuy \\ \quad 0\ kN \\ \text{else} \\ \quad \dfrac{(Vuy - \phi Vcy)}{\phi} \end{cases} = 137.64\ kN$$

$$Vsy\_1 := 0.33 \cdot \sqrt{f'c \cdot MPa} \cdot Aeff\_y = 744.204\ kN$$

$$Spc4 := \begin{cases} \text{if } Vsy \leq Vsy\_1 \\ \quad \dfrac{deff}{2} \\ \text{else} \\ \quad \dfrac{deff}{4} \end{cases} = 420.225\ mm$$

$$Spc5 := \begin{cases} \text{if } Vsy \leq Vsy\_1 \\ \quad 600\ mm \\ \text{else} \\ \quad 300\ mm \end{cases} = 600\ mm$$

Along B

$$Vsx := \begin{cases} \text{if } \phi Vcx \geq Vux \\ \quad 0\ kN \\ \text{else} \\ \quad \dfrac{(Vuy - \phi Vcy)}{\phi} \end{cases} = 0\ kN$$

$$Vsx\_1 := 0.33 \cdot \sqrt{f'c \cdot MPa} \cdot Aeff\_y = 744.204\ kN$$

$$Spc6 := \begin{cases} \text{if } Vsx \leq Vsx\_1 \\ \quad \dfrac{beff}{2} \\ \text{else} \\ \quad \dfrac{beff}{4} \end{cases} = 270.225\ mm$$

$$Spc7 := \begin{cases} \text{if } Vsx \leq Vsx\_1 \\ \quad 600\ mm \\ \text{else} \\ \quad 300\ mm \end{cases} = 600\ mm$$

$$SpcReq := min(Spc1, Spc2, Spc3, Spc4, Spc5, Spc6, Spc7) = 254.4\ mm$$

$$Check := \begin{cases} \text{if } Spc \leq SpcReq \\ \quad \text{“Ok”} \\ \text{else} \\ \quad \text{“Reduce spacing”} \end{cases} = \text{“Ok”}$$

Check for Minimum Area of Shear Reinforcement (Clause 7.10.5.1)

Along D

$$Asv\_minD := \max\left(0.062 \cdot \sqrt{f'c \cdot MPa} \cdot \frac{B}{fy\_s} \cdot 1000 \cdot mm,\ 0.35 \cdot \frac{B}{fy\_s} \cdot 1000 \cdot MPa \cdot mm\right) = 500\ mm^2$$

$$Check := \left\| \begin{array}{l} \text{if } Asvprv\_D \geq \frac{Asv\_minD}{m} \\ \quad \| \text{“Ok”} \\ \text{else} \\ \quad \| \text{“Increase Shear Reinf”} \end{array} \right. = \text{“Ok”}$$

Along B

$$Asv\_minB := \max\left(0.062 \cdot \sqrt{f'c \cdot MPa} \cdot \frac{D}{fy\_s} \cdot 1000 \cdot mm,\ 0.35 \cdot \frac{D}{fy\_s} \cdot 1000 \cdot MPa \cdot mm\right) = 750\ mm^2$$

$$Check := \left\| \begin{array}{l} \text{if } Asvprv\_B \geq \frac{Asv\_minB}{m} \\ \quad \| \text{“Ok”} \\ \text{else} \\ \quad \| \text{“Increase Shear Reinf”} \end{array} \right. = \text{“Ok”}$$

Table For Links

Note: Ductile Design of Links is Applicable Only For Boundary Elements

	Required			Provided	
	Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Rebar Number	10	---	---	10	---
Spacing	250	---	---	250	---

RCDC Output - Design Calculation Report

General Data

Column No.	:	C22
Level	:	0 m To 4.2 m
Frame Type	=	Non-Ductile
Response Modification Coefficient	=	3
Design Code	=	ACI 318M - 14
Grade Of Concrete (f'c)	=	C20 N/sqmm
Grade Of Steel (Main)	=	Fy420 N/sqmm
Grade Of Steel (Shear)	=	Fy420 N/sqmm
Grade Of Steel - Flexural Design	=	Fy420 N/sqmm
Grade Of Steel - Shear Design	=	Fy420 N/sqmm
Consider Ductile	=	No
Column B	=	600 mm
Column D	=	900 mm
Clear Cover, Cc	=	50 mm
Clear Floor Height @ lux	=	3400 mm
Clear Floor Height @ luy	=	3400 mm
No Of Floors	=	1
No Of Columns In Group	=	1

Shear Calculation (Analysis Forces)	Along D	Along B
lu (mm)	3400	3400
Column Dimension (D , B) (mm)	900	600
Check	lu <= 5 x D	lu > 5 x B
Shear from Moment Capacity		
Lu (mm)	3400	-
Pu Top (kN)	2574.39	-
Mnt (kNm)	1156.03	-
Pu Bottom (kN)	2625.44	-
Mnb (kNm)	1140.57	-
Vu1 (kN)	675.47	-
Shear from Load combinations with Enhanced Eq factor		
Load Combination	1.2 (LOAD 1: LOAD CASE 1) +0.5 (LOAD 2: LOAD CASE 2) +3 (LOAD 3: LOAD CASE 3 EQ-X)	-
Vu2 (kN)	1086.09	-
Critical Analysis Load Combination	5	17
Critical Load Combination	[1] : 1.4 (LOAD 1: LOAD CASE 1)	[13] : 0.9 (LOAD 1: LOAD CASE 1) - (LOAD 4: LOAD CASE 4 EQ-Y)
Nu (kN)	4112.05	2604.49
Mu (kNm)	100.96	109.65
Vu3 (kN)	981.8	59.93
Vu' (kN)	Minimum(Vu1, Vu2)	
	675.47	-
Design Shear, Vu (kN)	Maximum(Vu', Vu3)	
	981.8	59.93
λ	1	1
ϕ	0.75	0.75
Deff (mm)	840.45	540.45
ρw (50% of As provided)	0.006	0.006
Mm (kNm)	-1317.47	-495.75
ϕVc (kN)	878.57	732.76
Check	Vu > ϕVc	Vu < ϕVc
Link For Shear Design	Required	Not Required
Shear Links Design		
Vs (kN)	(Vu - ϕVc) / ϕVc	
	137.63	-
Vs Permissible (kN)	0.66 x sqrt(f'c) x b x deff	
	1488.41	-
Vs Permissible Check	Vs < Vs permissible; Hence, OK	-
Check for Minimum Shear Reinforcement		-
0.5 x ϕVc (kN)	439.29	-
Minimum Shear Reinforcement Check	ϕVc; Hence, Minimum Shear reinforceme	-
Av/s minimum (sqmm/m)	500	-
Av/s shear (sqmm/m)	389.91	-
Av/s required (sqmm/m)	max (Av/s minimum , Av/s shear)	
	500	-
Link Rebar Number	10	-
Diameter of link (mm)	9.5	-
Numbers of legs provided	5	-
Spacing of Link Provided (mm)	250	-
Av/s provided (sqmm/m)	1417.6	-
Av/s provided check	Av/s required < Av/s provided; Hence, OK	-