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# PART-A

# Definition: - Bar Bending Schedule (BBS)

In Civil Engineering Bar Bending Schedule is the important part of Estimation chart. In the Bar Bending schedule provides the reinforcement (steel) calculation for reinforcement of concrete column, beam and slab cutting length and also use to find the types of bends of length which we provide in steel structures.

This process of listing the location, type and size, number of and all other details is called "Scheduling". In context of Reinforcement bars, it is called bar scheduling. In short, Bar Bending Schedule is a way of organizing rebars for each structural unit, giving detailed reinforcement requirements.

BBS is used in finding cutting length of steel and total weight of steel per unit area. and we can make the bar bending schedule in MS-Excel.

## General Procedure to be followed in Preparing BBS

- The bars should be grouped together for each structural unit, e.g. beam, column, Footing etc.
- In a building structure, the bars should be listed floor by floor or according to need.
- For cutting and bending purposes schedules should be provided as separate A4 sheets and not as part of the detailed reinforcement drawings.
- It is preferable that bars should be listed in the schedule in numerical order.
- It is essential that bundle of bars refers uniquely to a particular group or set of bars of defined length, size, shape and type used on the job.

## Advantages of Bar Bending Schedule

- Cutting Length & Bending of Reinforcement Bar can be done.
- Bar Bending Schedule avoids wastage of steel reinforcement (5% to 10%) & thus saves project cost.
- Bar Bending Schedule provides Better Estimation of reinforcement Steel requirement for each and every Structure Member
- it is very much useful during Auditing of Reinforcement & provides check or Theft & misappropriation.
- It enables easy and fast preparation of Bills of construction work for clients & contractors.

## **Why Steel is Used in Concrete**

Reinforced concrete is a composite material made up of Plain Concrete reinforced with rebars i.e. Reinforcing Bars. Plain Concrete possesses very good compressive strength but is weak in tensile strength. As a result, a plain concrete beam fails suddenly as soon as the tension cracks start to develop due to load.

Hence in order to avoid failure of plain concrete it should be provided with tensile strength. This is possible by inducing rebars into plain concrete. Hence, it is reinforced (i.e. embedded) with rebars.

The reinforcement bars transfers load between the concrete and rebar. The direct stress (tensile/pull or compressive/push) transfer takes place from concrete to rebar interface by means of bond between them i.e. due to friction

As rebars imparts tensile strength to concrete, metals used for rebars should possess good tensile strength. This will avoid cracking of concrete in tension. Though there are many metals like Aluminum, Cast Iron, copper available for reinforcing concrete, Steel is most widely used as reinforcing material in reinforced concrete. It is because the thermal Expansion coefficient of both materials are approximately same so the bonding between concrete and steel is more.

# What is TMT BAR

**TMT bars or Thermo-Mechanically Treated bars are high-Strength Reinforcement bars** having a tough outer core and a soft inner core. The very first step of the manufacturing process involves passing the steel wires through a rolling mill stand. Thereafter, these rolled steel wires are again passed through the Temp core water cooling system. While passing the wires through the water-cooling system, the water pressure is optimized. The sudden quenching and drastic change in temperature toughen the outer layer of the steel bar, thus making it super tough and durable. Once this process is over, the TMT bars are subject to atmospheric cooling. This is done in order to equalize the temperature difference between the soft inner core and the tough exterior. Once the TMT bar cools down, it slowly turns into a ferrite-pearlite mass. The inner core remains soft giving the TMT bar great tensile strength and elongation point.


This design is unique to the TMT bars and gives superior ductility to the bars. Also, this unique manufacturing technique and the absence of Cold stress make this bar corrosion- resistant and boost its weld ability

# ADVANTAGES OF TMT BARS

- Higher strength with better elongation
- Excellent Weld-ability
- Resistance to fire hazards
- Excellent Ductility
- Higher Fatigue Strength
- Easy workability at site
- Better Bonding Strength
- Better Corrosion Resistance
- Achieves better results than BIS Standards

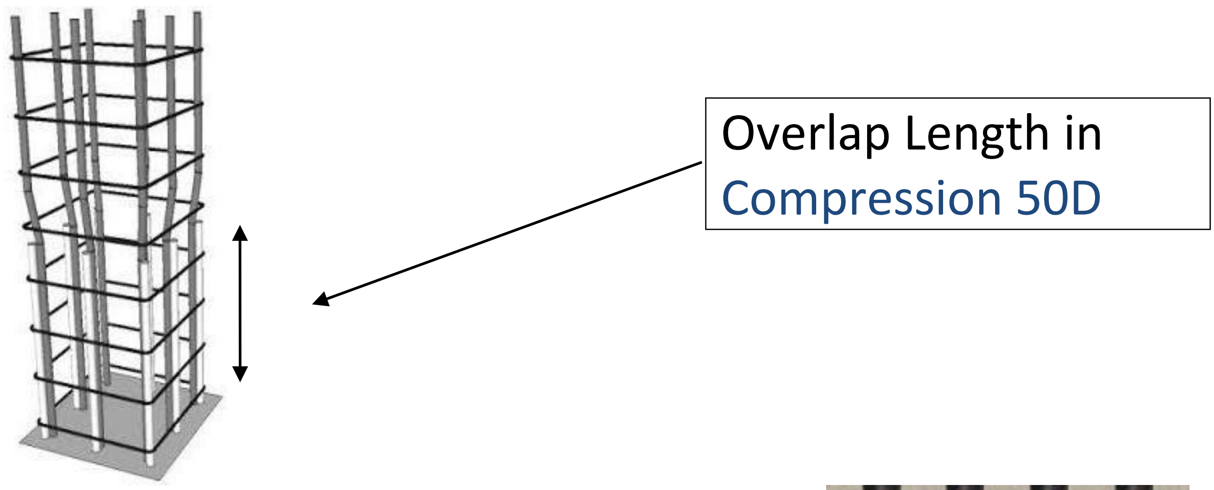
# Overlap Length / Lap Length in Reinforcement

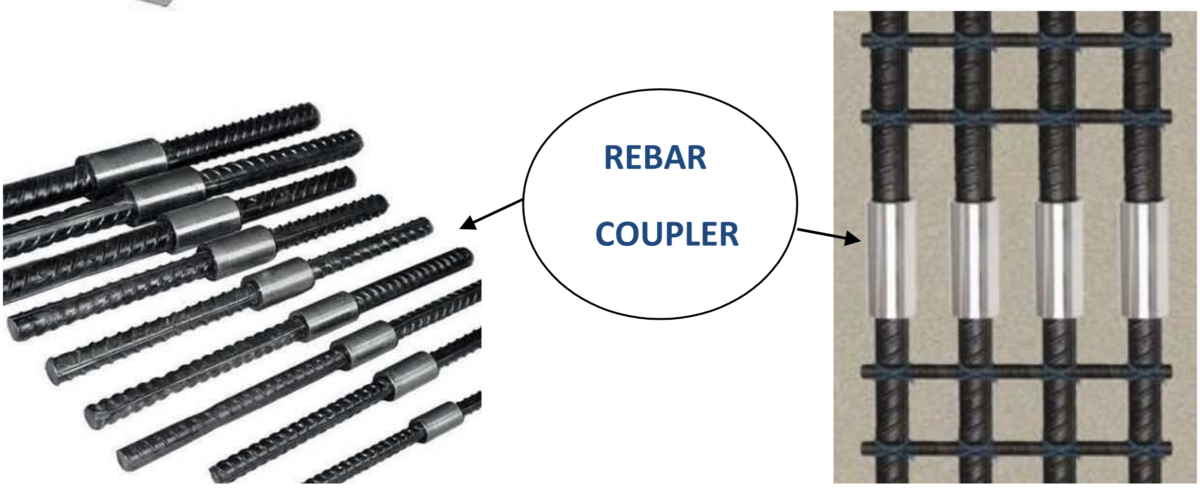
The standard length of Rebar is 12m. Suppose the height of the column is 20 m. To purvey this requirement, two bars of length 12m and 8m are overlapped (joined) with overlap length.

**Overlap Length for compression members (columns) = 50d**

**The Overlap Length for tension members (beams) = 40d**

**[d is the Diameter of the bar]**




Results of the study reveal that the use of **rebar couplers** in place of **lapping** is considerably cost effective for larger diameter bars such as 32 or 40 mm bars. Other than the cost, the other obvious advantage of **couplers** is avoiding congestion of **rebars** which may occur at a lap zone, now a day moistly use coupler in construction.

# What is clear cover in concrete

The Clear Cover is the Distance measured From the Exposed concrete Surface (without Plaster and Other Finishes) to the nearest Surface of reinforced bar.

They were made up of 1:3 ratio of cement mortar. Cover block should be immersed in water for 14 days to get the maximum strength. All the beams, column, slab, were checked to ensure adequate cover blocks are provided to the bottom and sides of the reinforcement**.** Main bars of the columns were adjusted to ensure the covering requirements before concreting. Chair of correct height were used to maintain the require gap between top and bottom reinforcement nets and cover blocks were also provided to bottom reinforcement

## Clear Cover to Main Reinforcement

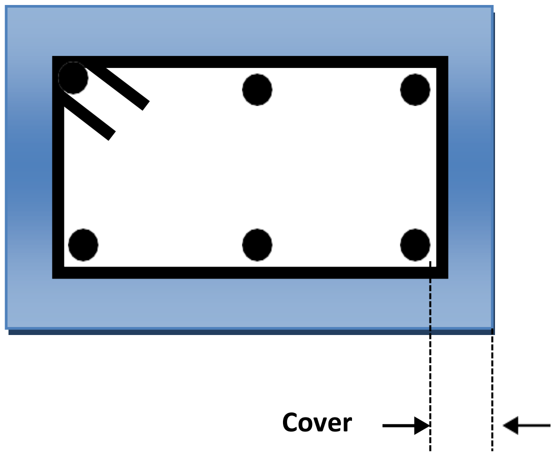
| | |
|---|---|
| **Footing** | **50mm** |
| **Raft Foundation Top** | **50mm** |
| **Raft Foundation Bottom/Side** | **75mm** |
| **Strap Beam** | **50mm** |
| **Grade Slab** | **20mm** |
| **Column** | **40mm** |
| **Shear Wall** | **25mm** |
| **Beams** | **25mm** |
| **Slabs** | **15mm** |
| **Flat Slabs** | **20mm** |
| **Staircase** | **15mm** |
| **Retaining Walls** | **20/30mm** |
| **Water Retaining Structures** | **20/30mm** |

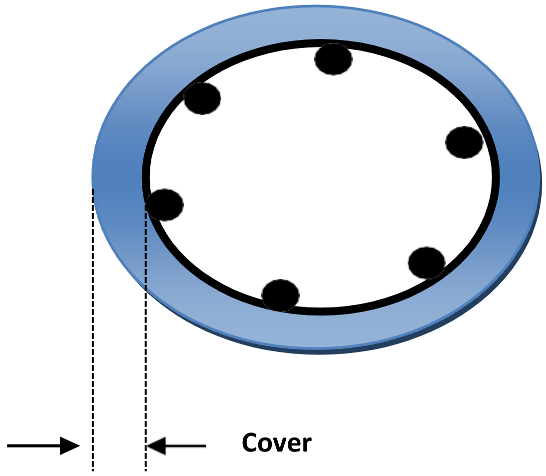
In the design of reinforced concrete structures, the reinforcement provided is embedded in the concrete up to a particular distance from the face of the member because of the following main reasons:

- To provide protection to reinforcement from corrosion.
- To provide fire resistance to reinforcement.
- To provide sufficient embedded depth so that reinforcement develops the requisite stress.

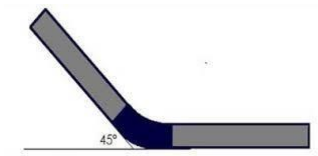
This distance is measured in different ways and known by different names:

1. **Clear cover:** This is the distance from the face of the member to the outermost face of the reinforcement including shear or torsion Stirrups or links.
2. **Nominal cover:** This is the same thing as clear cover albeit with a different name. This term is used by the code. It is the distance measured from the face of the member to the outermost face of the reinforcement including Stirrups or links. It is the dimension shown in drawings and detailing.
3. **Effective cover:** This is the distance measured from the face of the member to the center of area of the main reinforcement, that is tension or compression reinforcement. This is the dimension usually used for design calculations

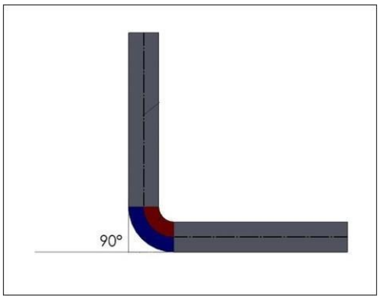


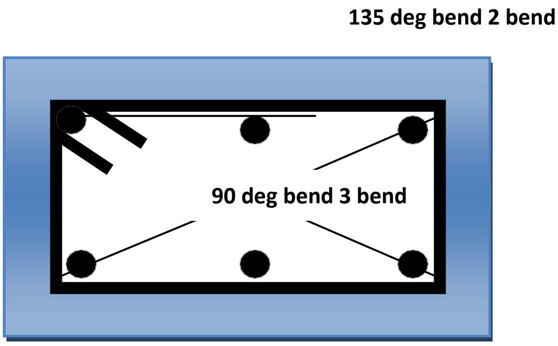



# How much bend deduction we take on turning of reinforced bar at 45° 90° 135° & 180°

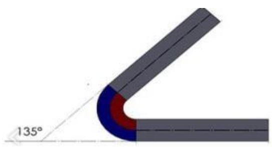



At 45 Degree, Bend Elongation is 1d. Where “d” is Dia. Of Bar

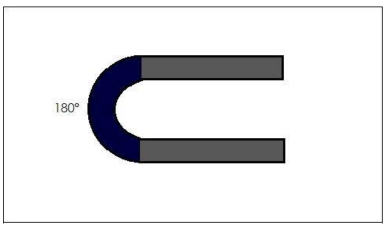



At 90 Degree, Bend Elongation is 2d. Where “d” is Dia. Of Bar

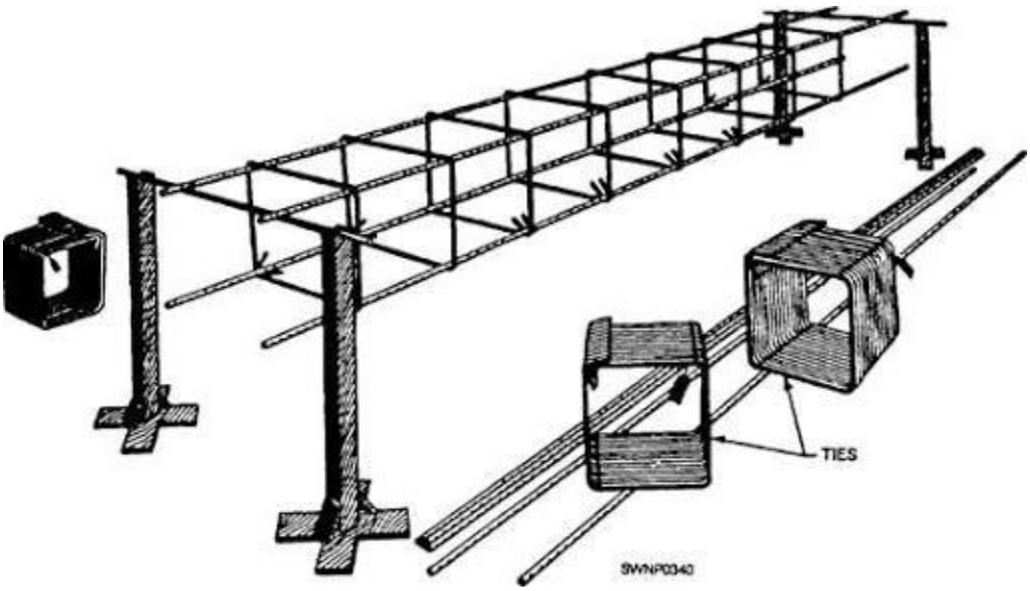



At 135 Degree, Bend Elongation is 3d. Where d is Dia. of Bar




At 180 Degree, Bend Elongation is 4d. Where d is Dia of bar

# How much does hook length take in a Ring




Remember,

The transverse reinforcement provided in Column is called **Ties** and the transverse reinforcement provided in Beam is called **Stirrups**. But on-site, we usually call both transverse reinforcements as Stirrups.

**In General Hook Length Varies According to IS CODE is 9d to 12d**

**HOOK 9d to 12d**

# Bar Bending Schedule
# Part - B

# Diameter of Reinforcement Bar Availability

Steel bars does not vary according to the structure. They vary according to loading conditions imposed on the structure. What-ever the structure it is Footing, Raft, Columns, Beam and Slab The most commonly used bars and available in shelf at all times are **6mm, 8mm, 10mm,12mm,16mm,20mm,25mm** are available easily outside also. In most of the buildings we use max 25mm. only in some places 32mm also available. greater dia. like 64mm and 128mm has to be ordered specially from steel plant for manufacturing unit.

| Diameter of Reinforcement bar in mm<br>For MKS Measurement | Diameter of Reinforcement bar in inch<br>For FPS Measurement |
|---|---|
| • 6 mm<br>• 8mm<br>• 10mm<br>• 12mm<br>• 16mm<br>• 20mm<br>• 25mm<br>• 28mm<br>• 30mm<br>• 32mm<br>• 36mm | • #3(3/8”)<br>• #4(1/2”)<br>• #5(5/8”)<br>• #6(3/4”)<br>• #7(7/8”)<br>• #8(1”)<br>• #9(9/8”)<br>• #10(10/8”) |

| Standard Length of the Steel Bar In Meter (MKS)<br>(Bars are sold at standard Length) | Standard Length of the Steel Bar In Feet (FPS)<br>(Bars are sold at standard Length) |
|---|---|
| 12M OR 12.19M | 39’4” or 40’ |

| Formula to Find Weight of Bar in Meter | Formula to Find Weight of Bar in Feet |
|---|---|
| Weight Per Meter = D2/162<br>(Note Dia Should be in mm)<br><br>For Example<br><br>If Diameter of bar=D=8mm<br><br>Weight Per Meter =<br>W= (8x8)/162=.395Kg/M<br><br>If Diameter of bar=D=10mm<br>Weight Per Meter<br>W= (10x10)/162=.617Kg/M | Weight Per Feet = D2/24/2.204<br>(Note Dia Should be in #)<br><br>For Example<br><br>If Diameter of bar=D= #4<br><br>Weight Per Feet<br>W =4X4/24/2.204=.302KG/FT<br><br>If Diameter of bar=D= #6<br>Weight Per Feet<br>W =6X6/24/2.204=.680 KG/FT |

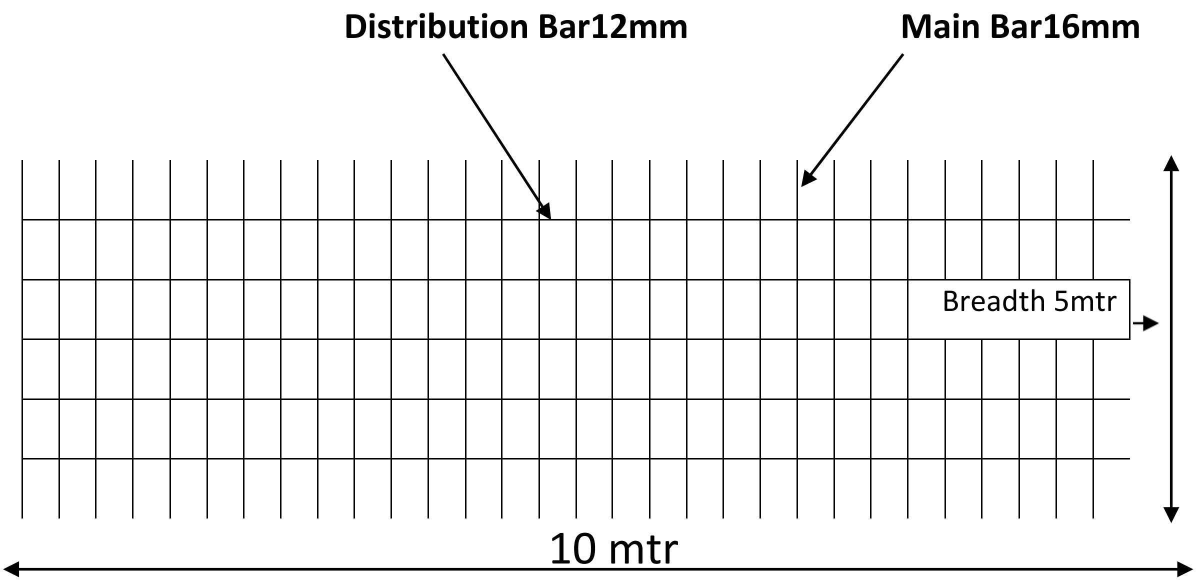
| Formula to Find Weight of Per Bar in Meter | Formula to Find Weight of Per Bar in Feet |
|---|---|
| For Example<br><br>If Diameter of bar=D=8mm<br><br>Weight per Bar=<br>w=(8x8)/162 x 12M/rod =4.74kg/Bar | For Example<br><br>If Diameter of bar=D= #4<br><br>Weight Per Feet<br>W =4X4/24/2.204 x 40=12.10KG/Bar |

**Mostly we Calculate in all process in MKS System because More Accuracy is found in the MKS System.**

# Procedure to Find Cutting Length of Main Bar or Distribution Bar in mesh :-

**Main Bar:** The Main Bar in Reinforced Concrete Structures is the Reinforcement Provided in the direction in which Moment is very high or dominates.

- Main Reinforcement Bar is normally used at the bottom of the slab.
- Higher Dimension Bar is used as Main Reinforcement. (12/16 mm)
- Main Reinforcement Bar is used to transfer the bending moment to beam.




**Cutting Length Of Distribution Bar With Hook:**


Length of hook =9d where d is the diameter of bar. if both side Providing then

**Total Length of Distribution Bar = L+9d(one side)+9d(another side)-(2 90°bend)**

Now for example. Dia of bar "d"=12mm

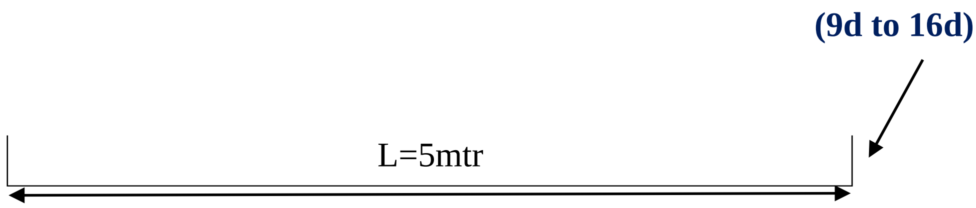
So 9d=9x12=108mm we Convert into Meter (108/1000)=.108 mtr

For bend ( 2 x 2 x d) = (2 No. x 2 x 12) = 48mm = (48/1000) = .048 mtr

Total Length of Distribution Bar = 10+(9d)+(9d)-bend

= 10+.108+.108 - .048 = 10.168 mtr

**Cutting Length Of Main Bar With Bend :** if Bend Providing Both Side




**Length of Bend = 9 d to 16 d**

Where d is the Diameter of bar.

**Total Length of Main Bar = L+10d+10d –(2 x 2d)**

Now For Example, d= 16mm then

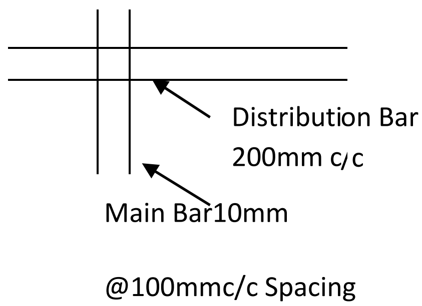
So 10d = 10x 12=120mm We convert into meter (120/1000)=.120 mtr

For bend ( 2 x 2 x d) = (2 No. x 2 x 16) = 64mm = (48/1000) = .064 mtr

**Total Length of Main Bar = 5 + .120 + .120 - .064**

**= 5.176 mtr**

## Number of Distribution Bar (12 mm) in mesh.




**Number of Dist. Bar =** $\frac{\text{Width of mesh}}{\text{Spacing of Dist.bar}} + 1$

= $\frac{5000}{200} + 1$

= $\frac{2900}{200} + 1$

= 25 + 1 = **26 Nos.**

## Number of Distribution Bar(12 mm ) in mesh.

**Number of Main Bar =** $\frac{\text{Length of mesh}}{\text{Spacing of Dist.bar}} + 1$

= $\frac{10000}{100} + 1$

= $\frac{10000}{100} + 1$

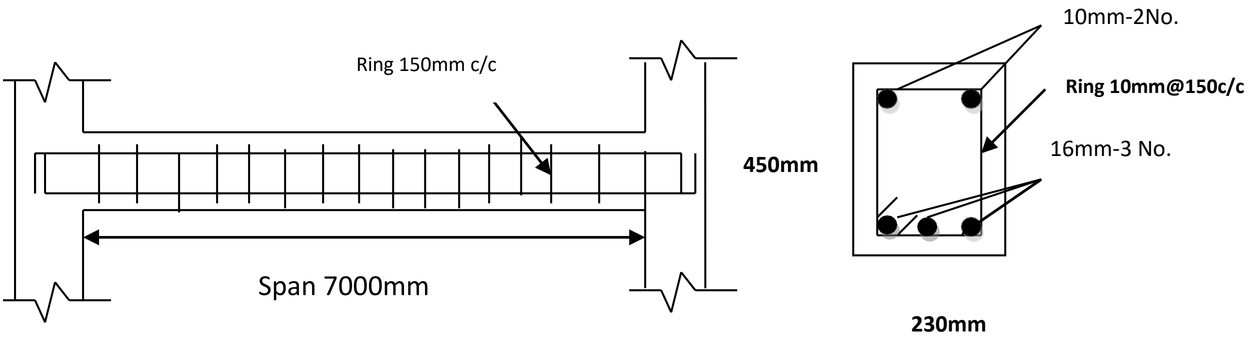
= 100 + 1 = **101 Nos.**

**Note – In this Calculation We learn only how to find cut length of main or dist. bar in mesh and How to find number of main bar or dist. bar without Clear Cover**

# Procedure to find out cut length of "2L" Rectangular Stirrups

Suppose we have a beam having a Width **230 mm** and having a Depth **450 mm.** The diameter of the stirrup bar is 10 mm. The clear cover in the beam is **35 mm.**

1. So calculate the cutting length of the rectangular stirrup is going to use the beam?




**GIVEN DATA:**

Width of beam = 230 mm.

Depth of beam = 450 mm.

Clear cover = 35 mm.

Hook Length = 10d

Diameter of the stirrup bar = 10 mm.

Calculate cutting length of stirrup = ?

**Procedure to be followed for calculating cutting length of rectangular/square stirrup:**

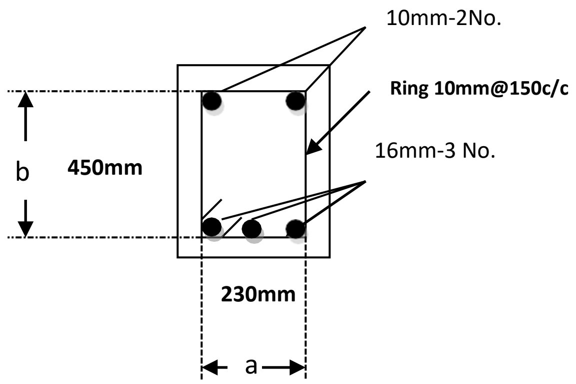
**Step 1:** Mark c/c distance of stirrup along base as 'a' as per the given structural drawing of stirrup.

**Step 2:** Mark c/c distance of stirrup along depth stirrup as 'b' as per the given structural drawing of stirrup.

**Step 3:** Calculate a & b separately from the given structural drawing of stirrup.

**Step 4:** See hook Detail in DWG and Count No. of bend for 90degree or 135degree.

**Step 5:** Now, calculate the cutting length of stirrup.




**Length of a** = Width – 2(Clear cover) **-** 2(Half the diameter of the bar)

= 230 – 2(35) – 2(5)

= **150 mm**

**Length of b** = Depth– 2(Clear cover) – 2(Half the diameter of the bar)

= 450– 2(35) – 2(5)

= **370 mm**

**Cutting length of stirrup......**

**Formula = 2(a + b)+ 2(10d) – 3(2d) – 2(3d)**

#where

d = Diameter of the stirrup bar.

10d = is the length of the hook

2d = 90* Bends in stirrup(2x10)

3d = 135* Bends from gook sides(3x10)

By putting the given values in the formula we get the length of the stirrup.

Length of the bar = 2(150 + 370) + 2(10 x 10) – 3(2 x 10) – 2(3 x 10)

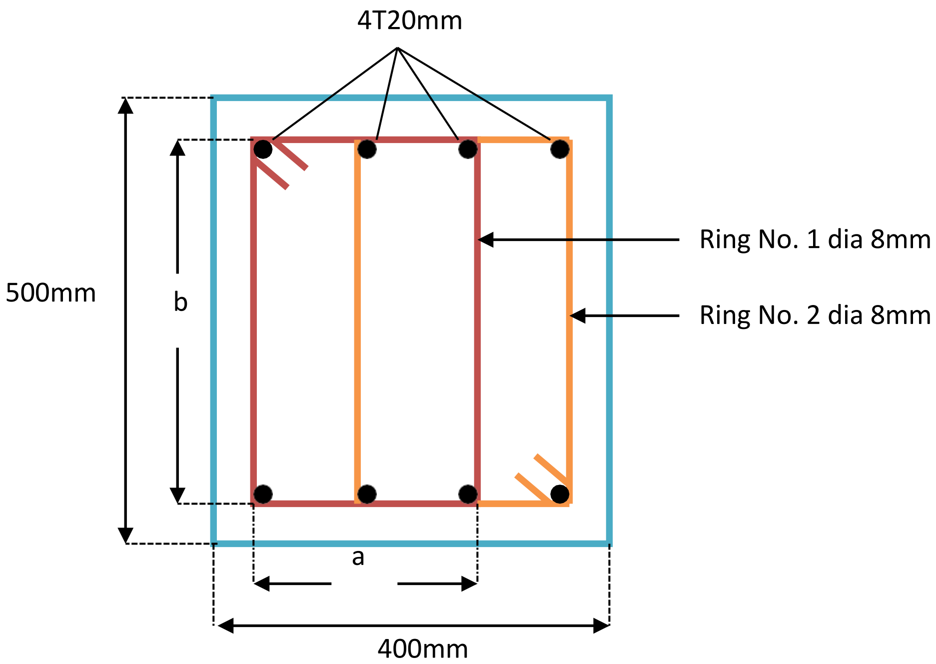
= 1040 + 200 – 60 – 60

= 1040 – 120

= **1120 mm or 1.120 m.**

# Procedure to find out cut length of "4L" Rectangular Stirrups

Suppose we have a Beam having a Depth **500 mm** and having a Width **400mm.** The diameter of the stirrup bar is 8 mm. The clear cover in the Column is **30 mm**




**GIVEN DATA:**

Width of beam = 400 mm.
Depth of beam = 500 mm.
Clear cover = 30 mm.
Diameter of the stirrup bar = 8 mm.
Calculate cutting length of stirrup 1/2 = ?

**Procedure to be followed for calculating cutting length of rectangular/square stirrup:**

**Step 1:** Mark c/c distance of stirrup 1 along width base as 'a' as per the given structural drawing of stirrup.

**Step 2:** Mark c/c distance of stirrup 1 along depth side as 'b' as per the given structural drawing of stirrup.

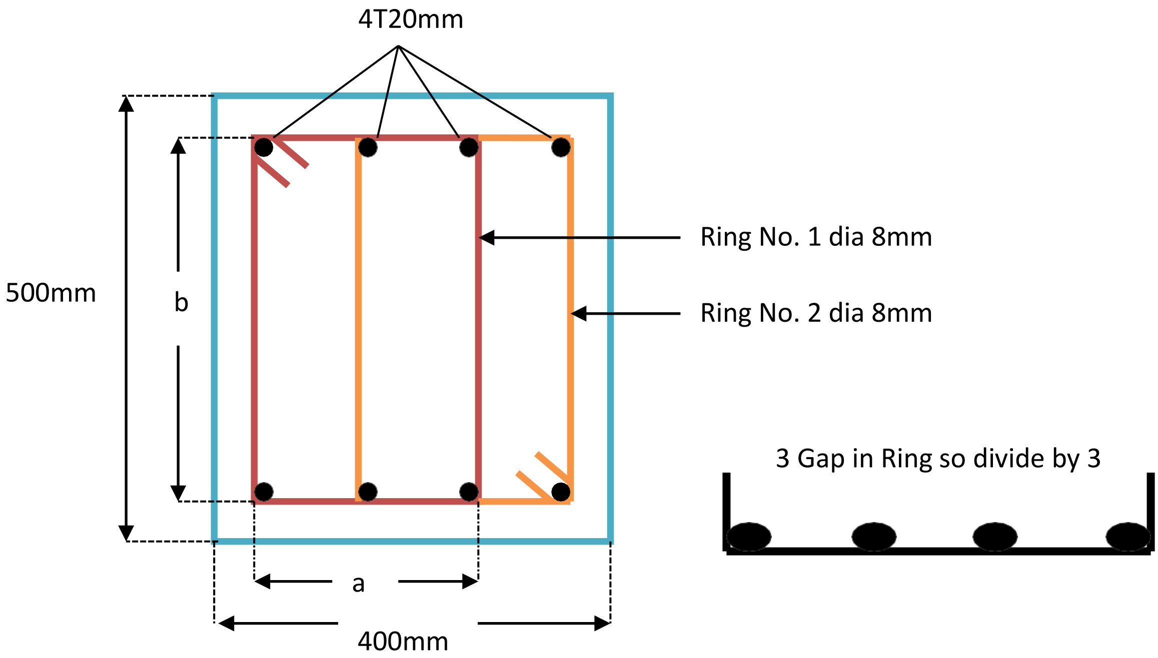
**Step 3:** Calculate a & b separately from the given structural drawing of stirrup.

**Step 4:** See hook Detail in DWG and Count No. of bend for 90degree or 135degree.

**Step 5:** Now, calculate the cutting length of stirrup 1.

**Step 6:** We know that Cutting Length of Stirrup 2 is same as stirrups 1. Bcoz 4Legged

## First Calculate Ring No. 1




$$a = \left\{ \frac{\text{Width} - (2\text{xcover}) - (2\text{xring dia}) - (2\text{x half of bar})}{3} \right\} \text{X } 2 + \{(2 \text{ x half of bar}) + (2 \text{ x half of ring dia})\}$$

$$= \left\{ \frac{400 - (2 \times 30) - (2 \times 8) - (2 \times 10)}{3} \right\} \text{X } 2 + \{(2 \times 10) + (2 \times 4)\}$$

$$= 230.7 \text{ mm}$$

b = Depth – (2 x Cover) – (2 x half of ring dia)

= 500 – (2 x 30) – (2 x 4)

= 432 mm

Cutting Length of Ring 1 = 2(a+b) + hook - bend deduction

= 2(a+b) +(2 x hook length) – (3 x 2d 90deg) – (2 x 3d 135deg)

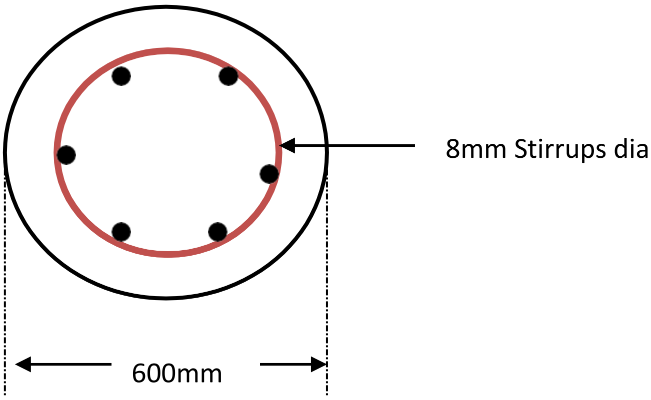
= 2(230.7+432) + (2x10x8) – (3x2x8) – (2x3x8)

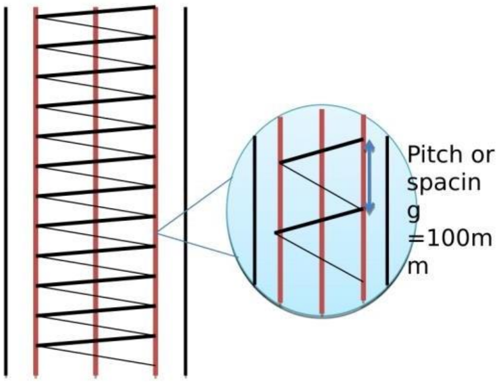
= 1389.4 mm

= 1.389 m

Note - Cutting Length of Ring 2 = same as ring 1 bcoz size of ring is same.

# Procedure to find out cut length of Helix (Spiral) Case:-




Given

Diameter of Column = 600 mm

Height of Column = 10 m

Clear Cover = 40 mm

Spacing in Spiral = 100 mm

Dia. of Spiral Stirrup = 8mm

**Procedure to be followed for calculating cutting length of Helix(spiral) Cage:**

**Step 1:** First of all we Calculate Length of One Spiral.

**Step 2:** Calculate Number of Spiral According to Height.

**Step 3:** Calculate the cutting length of Spiral Cage.

**Step 1:** First of all we Calculate Length of One Spiral.

Length of one Spiral = Circumference of one Spiral = **2 π r**

**= 2 x 3.14 x (radius of column – clear cover)**

**= 2 x 3014 x (300 – 40)**

**= 1632 mm**

**= 1.632 m**

**Step 2:** Calculate Number of Spiral According to Height.

**No of Spiral** = $\frac{\textbf{Length of Column}}{\textbf{Pitch or Spacing}}$ + 1

= $\frac{10000}{100}$ + 1

= **101**

**Step 3:** Calculate the cutting length of Spiral Cage.

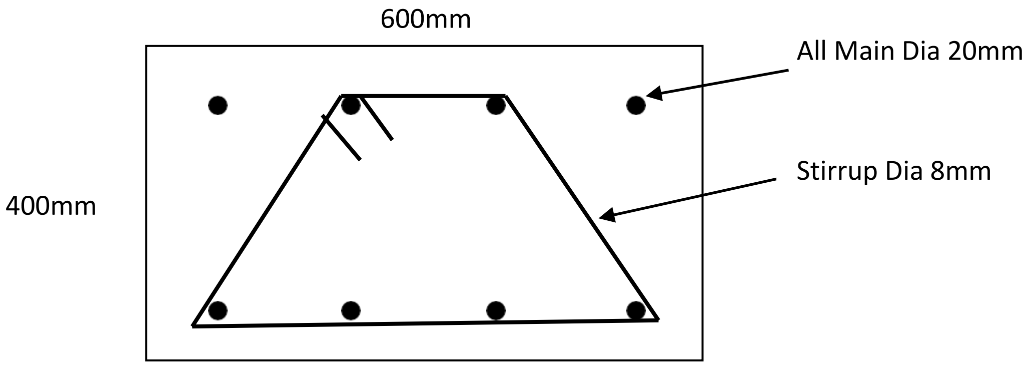
**Total Cutting Length Of Spiral Case = No. Of Spiral x Length of one Spiral**

Total Cutting Length Of Spiral Case = 101 x 1.632

= **164.832 m**

# Procedure to find out cut length of Trapezium Shape Stirrups

If we have col. 400 x 600 mm ..in this Column we found trapezium stirrups ,,,
Now, What is the procedure of Calculating This Stirrups.



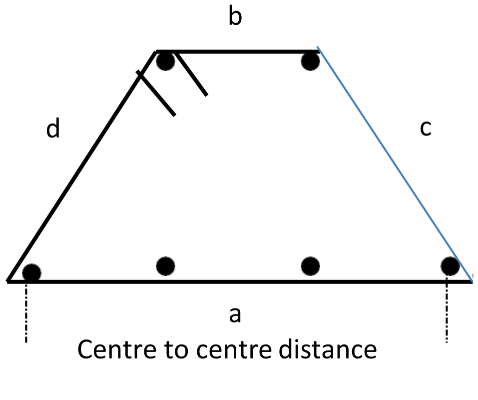

Given

Clear Cover = 25mm

Stirrup Dia = 8mm

Column Main Reinf. = 8 nos 20 mm dia

Dimension of Column = 400 x 600 mm




Centre to centre distance of main bar

= {(Length of Column) – (2 x Clear Cover) – (2 x Stirrups Dia) – (2 x Half of Main Vertical Bar Dia)} /

(Number of Equal Division in between Main Vertical Bar)

## Centre to centre distance of main bar

= {(Length of Column) – (2 x Clear Cover) – (2 x Stirrups Dia) – (2 x Half of Main Vertical Bar Dia)} /

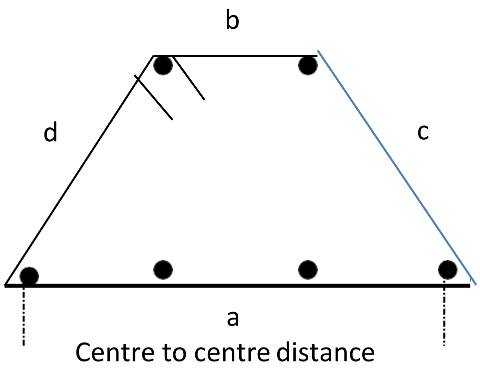
(Number of Equal Division in between Main Vertical Bar)

= {600 – (2 x 40) – (2 x 8) – (2 x 10)} / 3

= (600 – 80 – 16 – 20) / 3

= 484 / 3

**= 161 mm**




**Calculation of a** = (Length of Column) – (2 x Clear Cover)

= 600 – (2 x 40)

= 600 – 80

**= 520 mm**

**Calculation of b =** (C/C distance of Main Vertical Bar) + (2 x Half of Main Vertical Bar Dia) + (2 x Stirrups Dia)

= 161 + (2 x 10) + (2 x 8)

= 161 + 20 + 16

**= 197 mm**

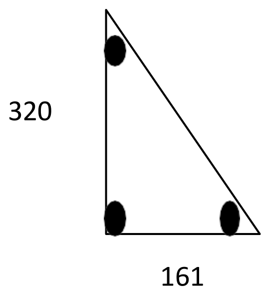
**Calculation of c** = in this calculation we use pyatha goras theorem

**HEIGHT** = Breadth of Column – (2 x Clear Cover) = 400 – (2 x 40)

= 400 – 80 = **320 mm**

**BASE** = C/C Dist. of Main Bar + (Half of Main Bar Dia) + (Stirrups dia)

= 161 + 10 + 8 = **179 mm**

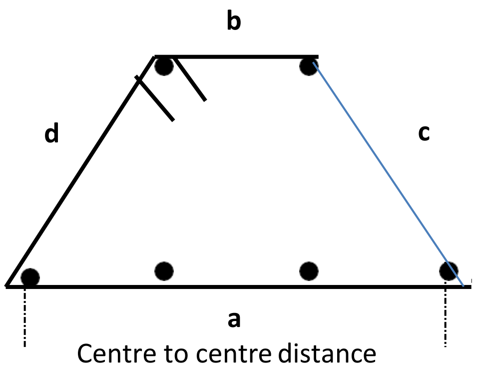


**Calculation of c** = { (BASE)^2 + (HEIGHT)^2} By Pythagoras Theorem..

= √ { (179)^2 + (320)^2}

= √ (32041 + 102400)

**= 367 mm**




**Cutting Length of Trapezium Stirrups** = A + B + (2 X C) + Hook – Bend(5 135deg)

= 520 + 197 + (2 x 367) + (2 x 10 x 8) – (5 x 3 x 8)

= 1491 mm

# Procedure to find out cut length of Triangular Shape Stirrups

**Procedure to be followed for calculating cutting length of Triangular stirrup:**

**Step 1:** Mark c/c distance of stirrup along base as 'a' as per the given structural drawing of stirrup.

**Step 2:** Mark c/c distance of stirrup along side of triangular stirrup as 'b' as per the given structural drawing of stirrup.

**Step 3:** Calculate a & b separately from the given structural drawing of stirrup.

**Step 4:** To calculate H from the given stirrup drawing, draw a perpendicular from apex of triangular stirrup to base of stirrup which is equal to 'b'. (Refer Figure - 2)

**Step 5:** With the help of Pythagoras theorem, find hypotenuse

Now, calculate the cutting length of stirrup.

Calculation part: **Suppose we take 600x500mm Column.**

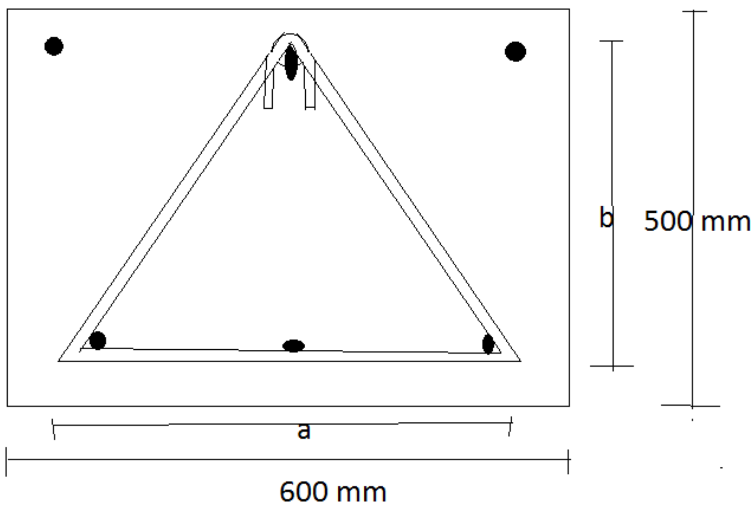
General Notes:

For hook part, consider as 10d.

For 45˚ bend, consider as d.

For 90˚ bend, consider as 2d.

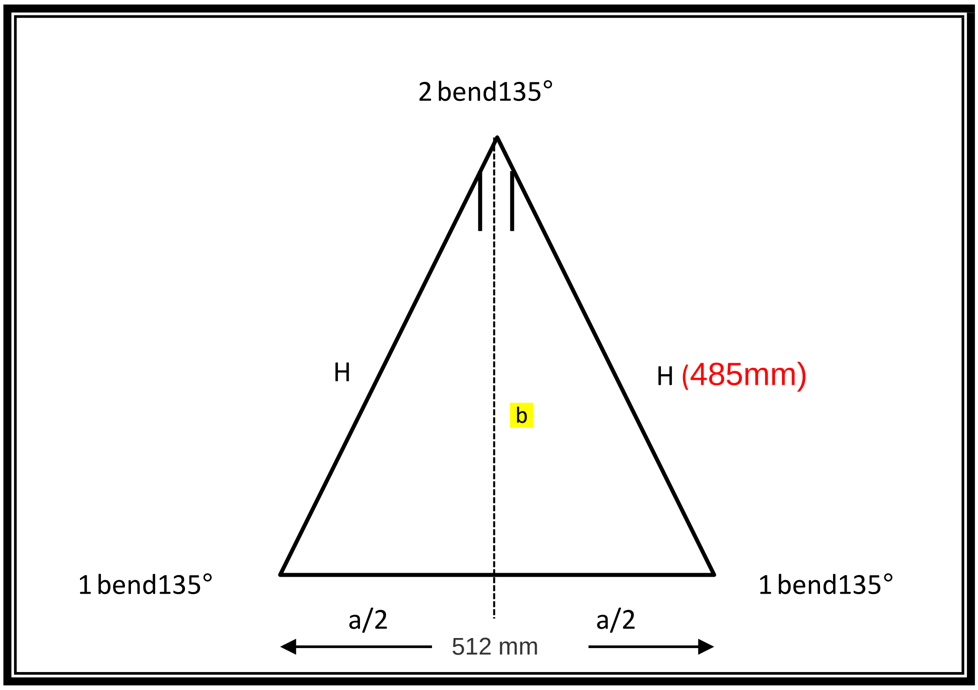
For 135˚ bend, consider as 3d.



Size of column = 600mmx500 mm
Diameter of stirrup bar, Ø = 8mm
No. of 135˚ bend = 4
Take clear cover as 40mm
a = 600 – 2 x clear cover – 2 x (half of dia of bar)
= 600 – 2 x 40 – 2 x (8/2)
= **512 mm.**

b = 500 – 2 x clear cover – 2 x (half of dia of bar)
= 500 -2 x 40 – 2 x (8/2) = **412 mm.**

To calculate H, refer Figure - 2




**By using Hypotenuse Formula,**

- **H = $\sqrt{(a/2)^2 + b^2}$**

H = $\sqrt{(a/2)^2 + b^2}$ = $\sqrt{(512/2)^2 + (412)^2}$

**H = 485mm**.

**Now, Cutting length of Traingular stirrup**
**= 2 x H + a + hook – bend (135˚)**
= 2 x H + a +(2x10xd) – (4no. X 3 x d)
= 2 X 485 + 512 +(2 X10X8) – (4X3X8)
**= 1546mm = 1.546m.**

# Procedure to find out cut length of Diamond Shape Stirrups

**Stirrups:** Stirrups are lateral ties provided in column to resist shear force and to hold longitudinal bars (main bars) of column in position.

Diamond stirrups are nothing but rhombus shaped stirrup.

**Cutting length of Rhombus (Diamond) stirrup:**

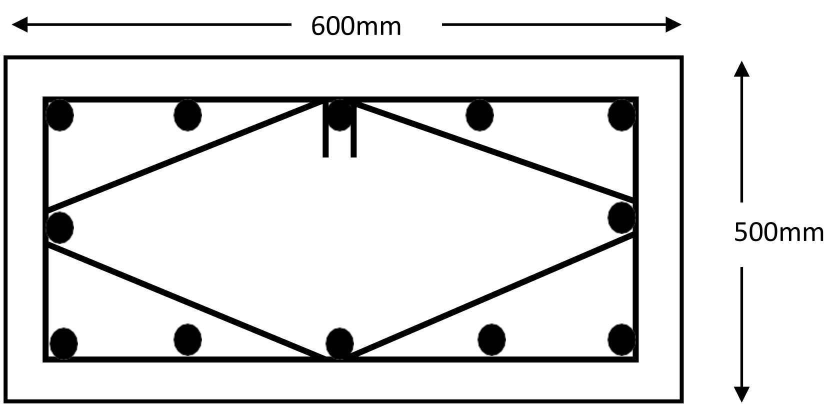
**Procedure to be followed for calculating cutting length of Rhombus (Diamond) stirrup:**

**Step 1:** Mark ‘a’& ‘b’ in given structural drawing of stirrup.

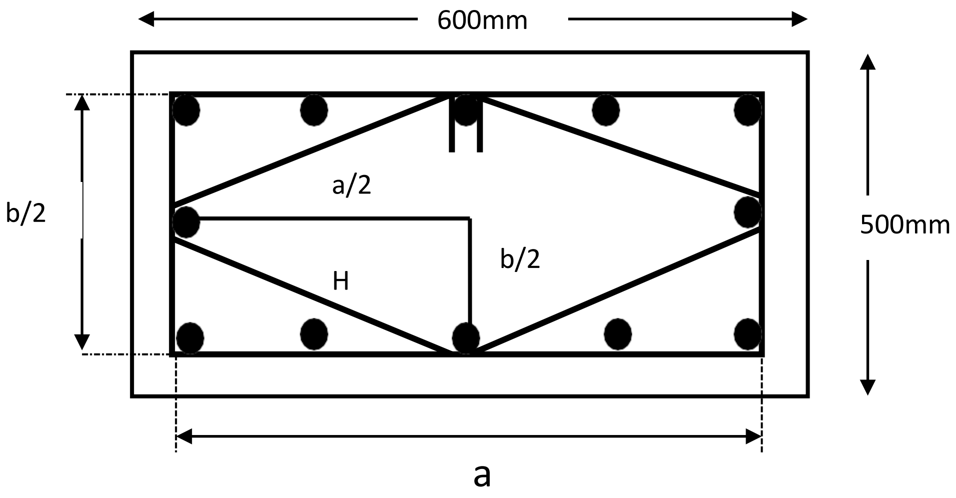
**Step 2:** Calculate any one side of rhombus, H using hypotenuse formula. (refer Figure - 2)

**Step 3:** Calculate the cutting length of rhombus stirrup.

Calculation part:




Size of column = 600 x 500mm
Diameter of stirrup bar = 8mm
Stirrups hook = 10 d
Clear cover = 40mm
No. of 90˚ Bend = 3 & No. of 135˚ Bend = 2




a = 600 – 2 x clear cover = 600- 2 x 40 = 520mm

b = 500 – 2 x clear cover = 500- 2 x 40 =420mm

By using Hypotenuse Formula,(**Pythagoras theorem**)

- $H = \sqrt{(a/2)^2 + (b/2)^2}$

$H = \sqrt{(a/2)^2 + (b/2)^2} = \sqrt{(520/2)^2 + (420/2)^2}$
H = 334.21 mm

Now,**Cutting length of stirrup**

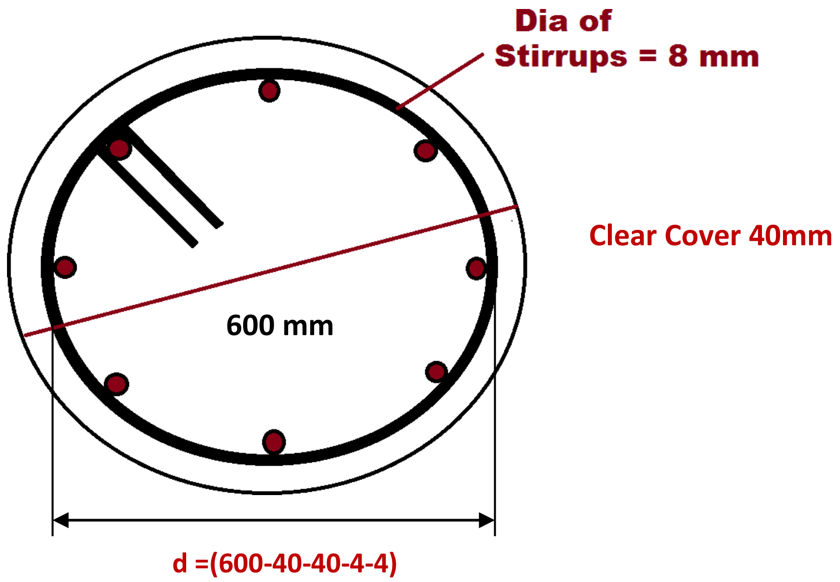
= 4 x H + {2 x 10 x d} (hook) – {3 x 2 x d }(90˚ bend) – {2 x 3 x d }(135˚ bend)

= 4 x 334.21 + {2x10x8} – {3x2x8} – {2x3x8}

**= 1400.84mm = 1.4m**

# Procedure to find out cut length of Circular Column Stirrups

Example...if we have circular column size 600 mm ...then how to find Cutting Length




Circular

Given....

From the Diagram,

Clear Cover = 40mm
Column Diameter (D) = 600 mm
Stirrups = 8mm,,    Hook Length = 10d

**Mark c/c distance of stirrup (d)**

d= (Total Diameter of column – both side cover – both side stirrup half dia.)

d= (600 - 40 – 40 – 4 – 4) = **512mm c/c**

**Cutting Length =** Circumference of stirrup + (2 × hook length) - (2×90°bend)

= π d + (2 x 10 x 8) – (2 x 2 x 8)

= 3.14 x 512 + (160) – (32)

= 1608 – 160 – 32

= **1736 mm = 1.736 Mtr.**

# Procedure to find out cut length of Bent up Bar

As a site engineer, you need to calculate the cutting length of bars according to the slab dimensions and give instructions to the bar benders.

For small area of construction, you can hand over the reinforcement detailing to the bar benders. They will take care of cutting length. But beware, that must not be accurate. Because they do not give importance to the bends and cranks. They may give some extra inches to the bars for the bends which are totally wrong. So it is always recommended that as a site engineer calculate the cutting length yourself.

Where,

Diameter of the bar = 12 mm

Clear Cover = 25 mm

Clear Span (L) = 8000

Slab Thickness = 200 mm

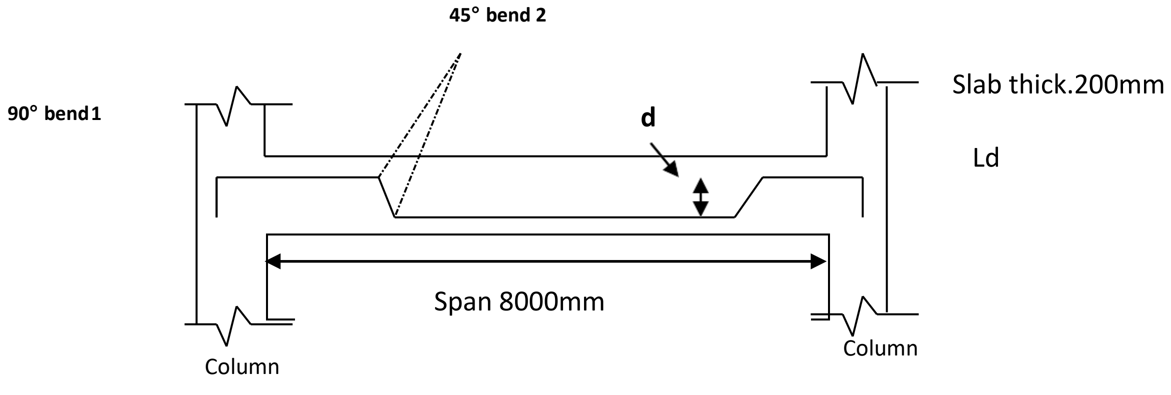
Development Length (Ld) = 40d

**Cutting Length** = Clear Span of Slab + (2 x Development Length) + (2 x inclined length) – (45° bend x 4) – (90° bend x 2)

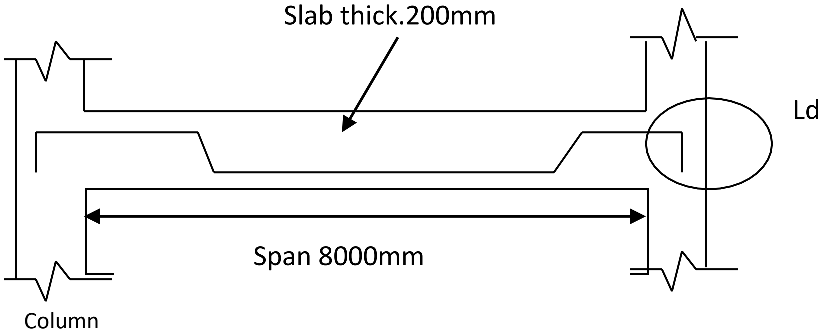
**Inclined length = 0.42 D**

As you can see there are four 45°bends at the inner side (1,2,3 & 4) and two 90° bends ( a,b ).

**45° = 1d ; 90° = 2d**




**Cutting Length** = Clear Span of Slab + (2 X Ld) +(2 x 0.42D) – (1d x 4) - (2d x 2)




**Cutting Length = Clear Span of Slab + (2 X Ld) +(2 x 0.42D) – (1d x 4) – (2d x 2)** [BBS Shape Codes]

Where,

d = Diameter of the bar.

Ld = Development length of bar.

D = Height of the bend bar.

In the above formula, all values are known except ‘D’.

So we need to find out the value of “D”.

D = Slab Thickness – (2 x clear cover) – (diameter of bar)

= 200 – (2 × 25) – 12

= 138 mm

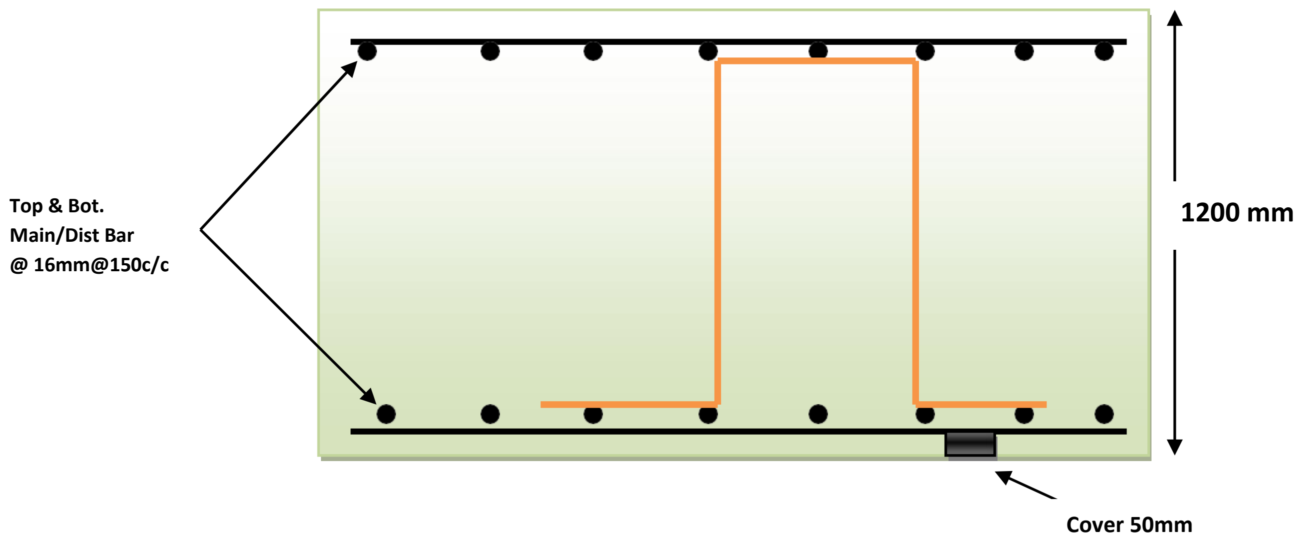
Now, putting all values in the formula

**Cutting Length = Clear Span of Slab + (2 x Ld) +(2 x 0.42D) – (1d x 4) – (2d x 2)**

= 8000 + (2 x 40 x 12) +(2 x 0.42 x 138) – (1 x 12 x 4) – (2 x 12 x 2)

Cutting Length = **8980 mm or 8.98 m.**

# How to calculate Cutting length of Chair Bar in Raft Footing .

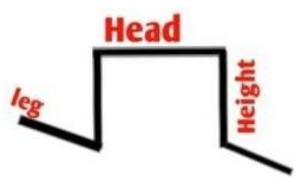



Given :-
Raft Footing
Height of footing = 1.2 m
Main bars & dist. Bar = 16 mm dia @150 mm c/c Top or Bottom.
Clear Cover = 50 mm
Cutting length of chair bar = ?

**Step 1 : Find out the height of chair bar.**

Chair Height =Footing Height - [(Upper + Lower Side Cover) + (Upper side main & dist. bar dia + lower side main bar dia)]

**Chair Height** = 1200 mm – [(50+50) + (16+16+16)] mm = 1052 mm or 1.052 m




**Step 2 : Head of chair bar** = 50 x d (dia= 12 mm)
So, 50 x 12 = 600 (the diameter of bar should not be under 12 mm)

**Step 3 : Chair bar leg** = 2 nos c/c distance + 50 mm (bars which are located at bottom)
= 2 x 150 mm + 50 mm = 350 mm

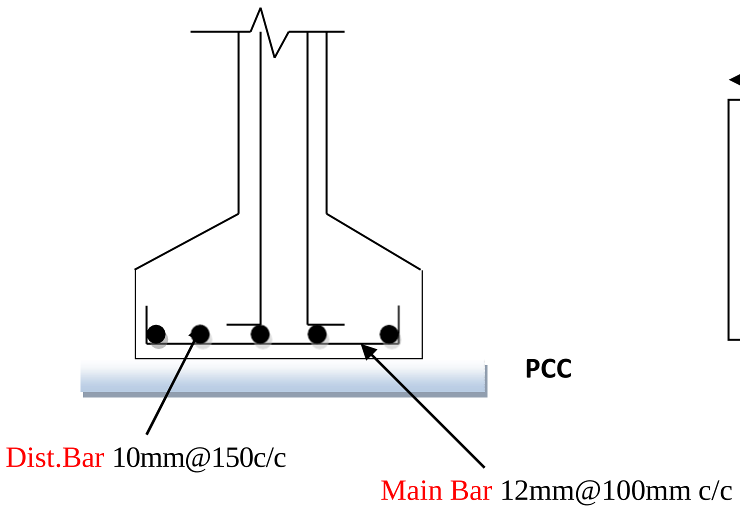
**Cutting length of chair = (1head + 2 height + 2 leg) _4 bend of 90°**

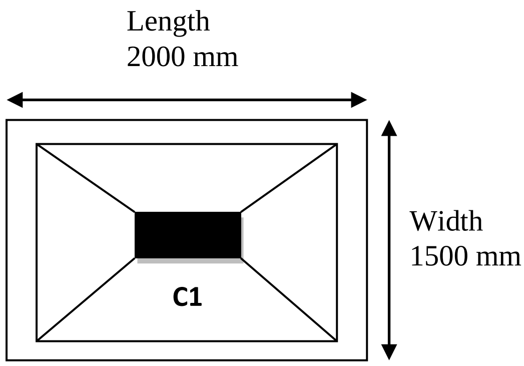
Now, the cutting length will be calculated as follow
=[600 + (1052 x 2) + (350 x 2)] – (4 x 2 x 12) mm (as the chair is bent at 4 sides..4x2d)
= **3308 mm or 3.308 mtr**

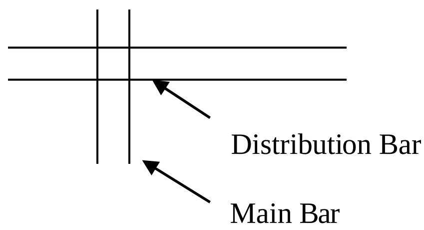
# Bar Bending Schedule Part - C

## 3.1 Bar Bending Schedule for Isolated footing

If we have isolated Footing then how to Calculate Reinforcement for BBS.



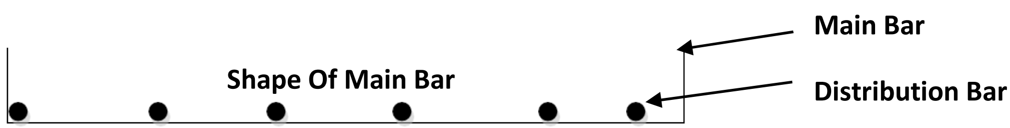




Given

Size of Footing = 2000mm x 1500mm
Clear Cover = 50 mm
No. Of Footing = 1 nos
Main Bar = 12mm @ 100 mm c/c Spacing
Distribution Bar = 10mm @ 150 mm c/c Spacing
Hook Length = 9d

### Step : 1 Cutting Length of Main Bar

The Main Bar is Always in the Short Span ,wheather it is a Slab or Footing.



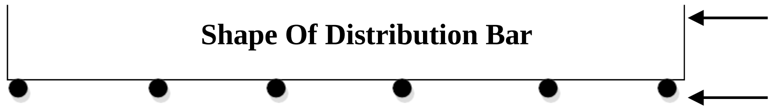

**Cutting Length of Main Bar = Width of Footing – (2 x Clear Cover ) + (2 x 9d hook) – (2 bend 90deg)**

**= 1500 mm – (2 x 50) + (2 x 9 x12) – (2 x 2 x 12)**

**= 1500 mm – 100 + 216 – 48**

**= 1568 mm**

## Step : 2 Cutting Length of Distribution Bar

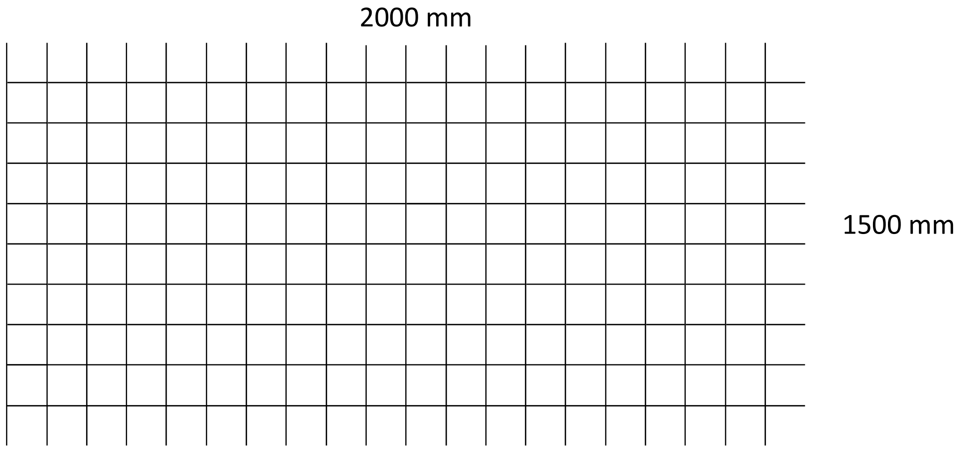



**Cutting Length of Distribution Bar** = Length of Footing – (2 x Clear Cover ) + (2 x 9d hook) – (2 bend 90deg)

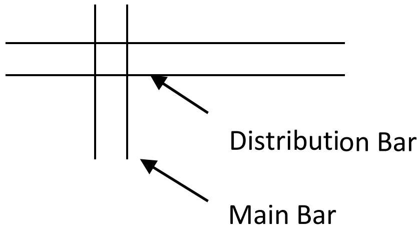
= 2000 mm – (2 x 50) + (2 x 9 x10) – (2 x 2 x 10)

= 2000 mm – 100 + 180 – 40

= **2040 mm**




## Step : 3 Number of Main Bar(12 mm ) in Footing.




**Number of Main Bar** = $\frac{\text{Length} - (2 \times \text{Clear Cover})}{\text{Spacing}} + 1$

= $\frac{2000 - (2 \times 50)}{100} + 1$

= $\frac{1900}{100} + 1$

= 20 Nos.

## Step : 4 Number of Distribution Bar(10 mm ) in Footing.

$$\text{No. of Distribution Bar} = \frac{\text{Width} - (2 \times \text{Clear Cover})}{\text{Spacing}} + 1$$

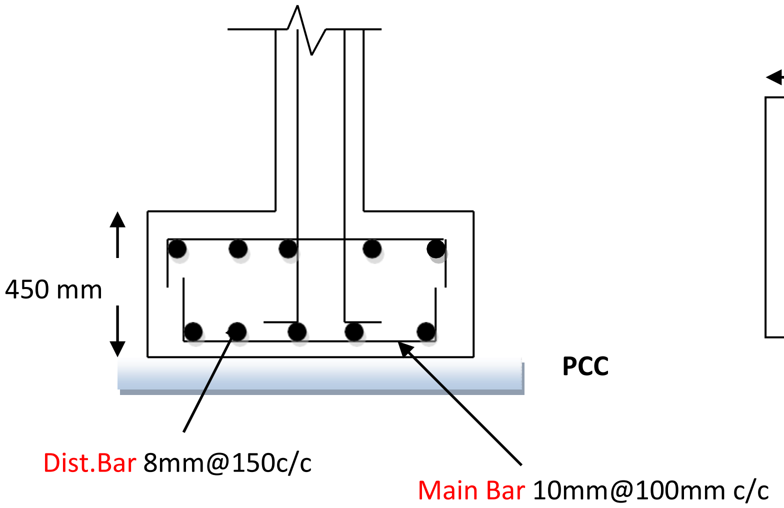
$$= \frac{1500 - (2 \times 50)}{150} + 1$$

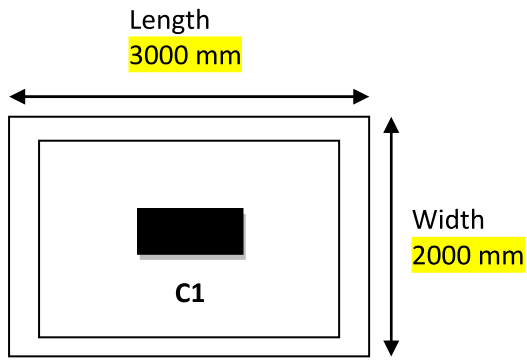
$$= \frac{1400}{150} + 1$$

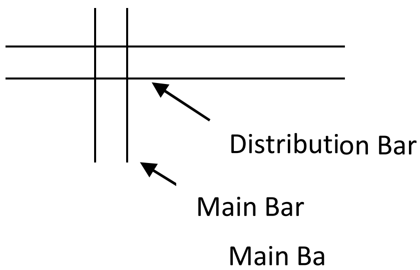
= 10.33 ( we say 10 bar)

## 3.2 Bar Bending Schedule for Raft footing

If we have Raft Rectangular Footing then how to Calculate Reinforcement for BBS.



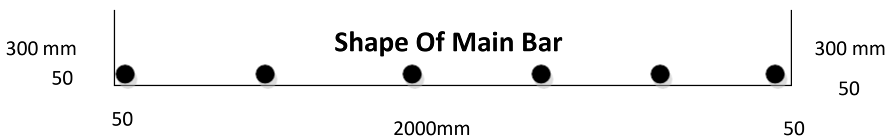

Given

Size of Footing(CF2) = 3000mm x 2000mm
Height = 450mm
Clear Cover = 50 mm
No. Of Footing = 2 nos

Main Bar Top or Bottom = 10mm @ 100 mm c/c Spacing
Distribution Bar Top or Bottom = 8mm @ 150 mm c/c Spacing

**Step : 1 Cutting Length of Main Bar Bottom or Top**

The Main Bar is Always in the Short Span ,wheather it is a Slab or Footing.




**Cutting Length of Main Bar = Width of Footing – (2 x Cover ) + (2 x Height) - (2 bend90deg)**

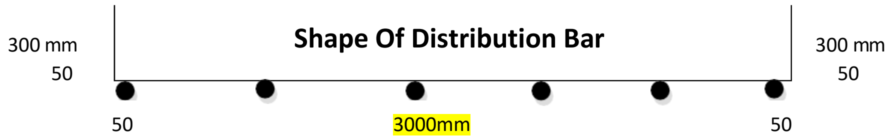
**= 2000 mm – (2 x 50) + (2 x 300) – (2 x 2 x 10 )**

**= 2000 mm – 100 + 600 – 40**

**= 2460 mm**

## Step : 2 Cutting Length of Distribution Bar Bottom or Top

The Main Bar is Always in the Short Span ,wheather it is a Slab or Footing.

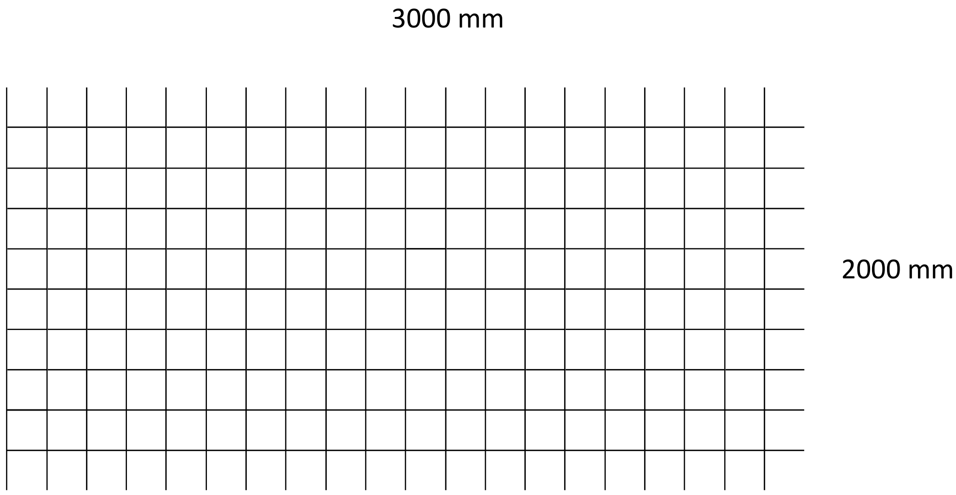



**Cutting Length of Dist. Bar = length of Footing – (2 x Cover ) + (2 x Height) – (2 bend90deg)**

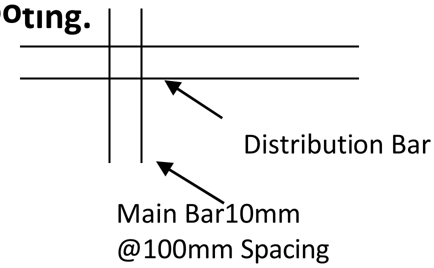
**= 3000 mm – (2 x 50) + (2 x 300) – (2 x 2 x 8 )**

**= 3000 mm – 100 + 600 – 32**

**= 3468 mm**




## Step : 3 Number of Top or Bottom Main Bar(10 mm ) in Footing.




**Number of Main Bar =** $\dfrac{\text{Length} - (2 \times \text{Clear Cover})}{\text{Spacing}} + 1$

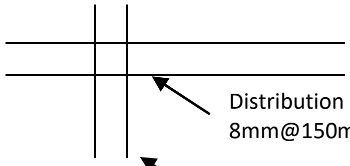
$= \dfrac{3000 - (2 \times 50)}{100} + 1$

$= \dfrac{2900}{100} + 1$

**= 30 Nos. X 2(top or bottom)**

**= 60 Nos.**

## Step : 4 Number of Top or Bottom Distribution Bar(10 mm ) in Footing.




$$\text{Number of Main Bar} = \frac{\text{width} - (2 \times \text{Clear Cover})}{\text{Spacing}} + 1$$

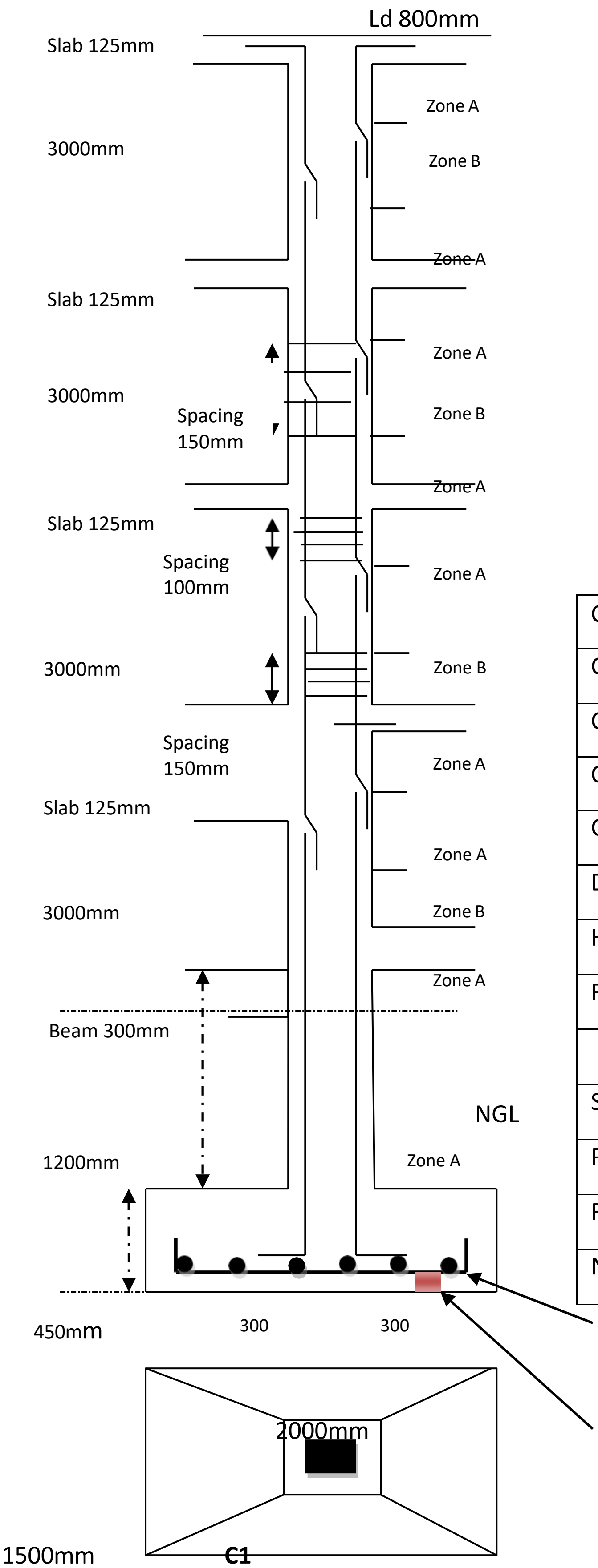
$$= \frac{2000 - (2 \times 50)}{150} + 1$$

$$= \frac{1900}{150} + 1$$

= 13.66 Nos{14 bar}. X 2(top or bottom)

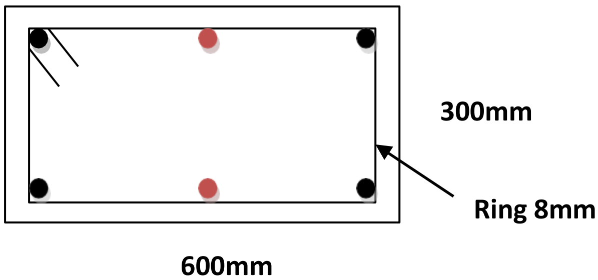
= 28 Nos.

# 3.3 Bar Bending Schedule For Column(G+3)




**Given**

C 1 Column Size 600 x 300mm




● 20mm 4 nos

● 16mm 2 nos

| | |
|---|---|
| Clear Cover in Column | 40mm |
| Clear Cover in slab | 25mm |
| Clear Cover in footing | 50mm |
| Overlap Length | 50d |
| Column L | 300mm |
| Development Length Ld | 50 d |
| Hook | 9d |
| Ring Spacing at Zone A L/4 | 100mm |
| at Zone B L/2 | 150mm |
| Slab Thickness | 125mm |
| Plinth Beam Depth | 300mm |
| Floor to Floor Internally | 3000mm |
| No. Of Column | 5 |

Footing Mesh Reinforcement
Main Bar 20mm
Distribution Bar 20mm

Footing Cover 50mm

# Step 1 – Find the Cutting length of Vertical Bar(20mm)

**Cutting Length of Vertical bar 20 mm=** (Length of bar Below Plinth Beam)+(Plinth Beam)
+ (Full Length of Bar Above Plinth beam)

First we Calculate Ful Length Of Bar below Plinth Level
Length of bar Below Plinth Beam
= (Column L) + (Footing Height – Clear Cover – Main bar – Dist.Bar) + (Column Height below Plinth)
= 300 + ( 450 – 50 – 20 – 20 ) + 1200 mm
= 300 + 360 + 1200 mm
= 1860 mm = 1.860 Meter

Second we Calculate Full Length Of Bar Above Plinth Level.
= (G.F + 1st + 2nd + 3rd Floor Height Internally) + (Slab Thickness G.F + 1st + 2nd) + ( 4TH Slab Ld)
=(4 x 3000 ) + ( 3 x 125 ) + (50 x 20)
=12000 mm + 375 mm+ 1000 mm
**=13375mm=13.375 Meter**.

**Cutting Length of Vertical bar 20 mm**= (Length of bar Below Plinth Beam)+(Plinth Beam)
+ (Full Length of Bar Above Plinth beam)

= 1860 mm + 300 mm + 13375 mm

**= 15535 mm = 15.535 Meter**

15.335m > 12m i.e. provide **Overlap According to Practically Requirment**...if we will provide 1 lap only then..problem face in handling of vertical bar,so Overlap Provide Floor to Floor For Easily Handling and Perfection in Alignment of bar..

= 15535 + ( 4 x 50 x d)

= 15535 + ( 4 x 50 x 20)

= 15535 + 4000

**Cutting Length of Vertical bar 20 mm= 19535 mm or 19.535 Meter**

OverLap Note Point – 1. Splice Located minimum but away from column & Beam Junction.this portion left Atleast L/4 portion ,
2. Laps should be staggered and alternate.
3.Laps should not be parallel to each other.

## Step 2 – Find the Cutting length of Vertical Bar(16mm)

First we Calculate Ful Length Of Bar below Plinth Level
Length of bar Below Plinth Beam
= (Column L) + (Footing Height – Clear Cover – Main bar – Dist.Bar) + (Column Height below Plinth)
= 300 + ( 450 – 50 – 20 – 20 ) + 1200 mm
= 300 + 360 + 1200 mm
= 1860 mm = 1.860 Meter

Second we Calculate Ful Length Of Bar Above Plinth Level.
= (G.F + $1^{st}$ + $2^{nd}$ + $3^{rd}$ Floor Height Internally) + (Slab Thickness G.F + $1^{st}$ + $2^{nd}$) + ( $4^{TH}$ Slab Ld)
=(4 x 3000 ) + ( 3 x 125 ) + (50 x 16)
=12000 mm + 375 mm+ 800 mm
=13175mm=13.175 Meter.

Cutting Length of Vertical bar 16 mm= (Length of bar Below Plinth Beam)+(Plinth Beam)
+ (Full Length of Bar Above Plinth beam)

= 1860 mm + 300 mm + 13175 mm
= 15335 mm = 15.335 Meter

15.335m > 12m i.e. provide **Overlap According to Practically Requirment**...if we will provide 1 lap only then..problem face in handling of vertical bar,so Overlap Provide Floor to Floor For Easily Handling and Perfection in Alignment of bar..

= 15335 + ( 4 x 50 x d)
= 15335 + ( 4 x 50 x 16)
= 15335 + 3200
Cutting Length of Vertical bar 16 mm= 18535 mm or 18535 Meter

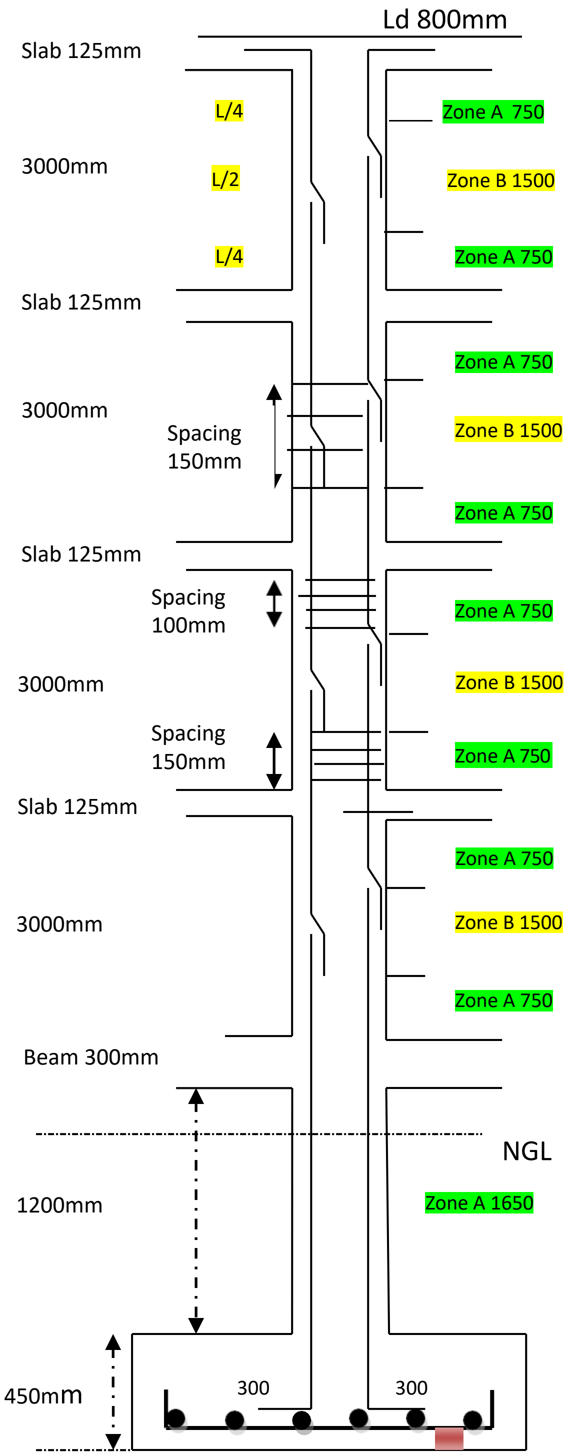
## Cutting length of 20mm/16mm Vertical Bar

| | |
|---|---|
| Cutting Length of Vertical bar 20 mm | 19535 mm or 19.535 Meter |
| Cutting Length of Vertical bar 16 mm | 18535 mm or 18.535 Meter (diff in overlap) |

## Step 3 – Cutting Length of Stirrups

Length of One Hook = **9d**
Calculation of A = 600 – 40 -40 – 4 – 4 = 512 mm
Calculation of B = 300 – 40 -40 – 4 – 4 = 212 mm
Cutting length of Stirrup = Perimeter of stirrup + No. Of Hook – Bend Deduction90/135deg
= 2(A+B) + (2x9d Hook)-(3x2d 90Deg Bend)-(2x3d 135 Deg Bend)
= 2(512+212) + ( 2x9x8) - (3x2x8 ) - (2x3x8)
= 1496 mm

# Step 4 – Number of Stirrups in Zone A or Zone B




**1st Number of Ring in Zone A ????**

Number of Ring =( Distance/Spacing)+1

Zone A Total Length
= 1650 + ( 8 x 750 ) + (3x125 Slab )+(300 beam)

Zone A Spacing(given) = 100mm c/c

**Number of Ring in Zone A**=( Distance/Spacing)+1
=(8325/100)+1
= 83.25 +1= 84 Rings

**2nd Number of Ring in Zone B ????**

Number of Ring =( Distance/Spacing)+1

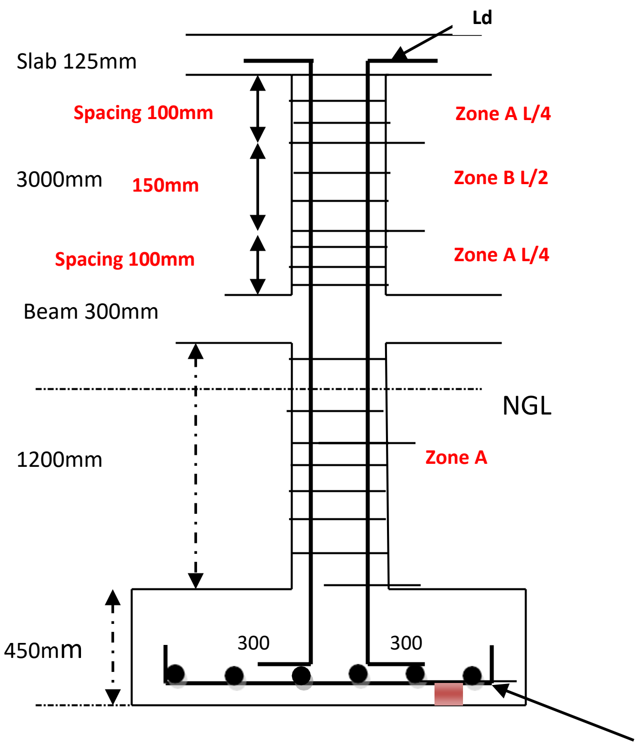
Zone A Total Length
= 1500 X 4
= 6000 mm

Zone B Spacing(given) = 150mm c/c

**Number of Ring in ZoneB** =( Distance/Spacing)+1
=(6000/150)+1
= 40 +1= **41 Rings**

| | |
|---|---|
| Number of Ring in Zone A | = 84 Rings |
| Number of Ring in ZoneB | = 41 Rings |
| Total Number of Ring in Zone A/ZoneB | = 125 Rings |

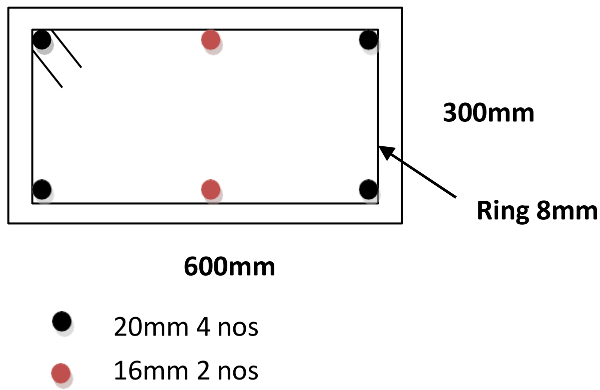
# Bar Bending Schedule For Column Without Overlap




Footing Mesh Reinforcement
Main Bar 20mm
Distribution Bar 20mm

## Given

C2 Column Size 600 x 300mm




| | |
|---|---|
| Clear Cover in Column | 40mm |
| Clear Cover in slab | 25mm |
| Clear Cover in footing | 50mm |
| Column L | 300mm |
| Development Length Ld | 50 d |
| Hook | 9d |
| Ring Spacing at Zone A L/4 | 100mm |
| at Zone B L/2 | 150mm |
| Slab Thickness | 125mm |
| Plinth Beam Depth | 300mm |
| Floor to Floor Internally | 3000mm |
| Number of Column | 10 |

## Step 1 – Find the Cutting length of Vertical Bar(20mm)

| |
|---|
| Cutting Length of Vertical bar 20 mm= (Length of bar Below Plinth Beam)+(Plinth Beam) + (Full Length of Bar Above Plinth beam) |

First we Calculate Ful Length Of Bar below Plinth Level
Length of bar Below Plinth Beam
= (Column L) + (Footing Height – Clear Cover – Main bar – Dist.Bar) + (Column Height below Plinth)
= 300 + ( 450 – 50 – 20 – 20 ) + 1200 mm
= 300 + 360 + 1200 mm
= 1860 mm = 1.860 Meter
Second we Calculate Full Length Of Bar Above Plinth Level.
= (G.F Height + Slab Ld)
={ 3000 + (50 x 20)}
= 3000 mm + 1000 mm
**=4000mm=4 Meter**

**Cutting Length of Vertical bar 20 mm**= (Length of bar Below Plinth Beam)+(Plinth Beam)
+ (Full Length of Bar Above Plinth beam)
= 1860 mm + 300 mm + 4000 mm

= 6160 mm = 6.160 Meter

6.610 m < 12m i.e......its Mean **NO NEED TO OVERLAP**

## Step 2 – Find the Cutting length of Vertical Bar(16mm)

First we Calculate Full Length Of Bar below Plinth Level
Length of bar Below Plinth Beam
= (Column L) + (Footing Height – Clear Cover – Main bar – Dist.Bar) + (Column Height below Plinth)
= 300 + ( 450 – 50 – 20 – 20 ) + 1200 mm
= 300 + 360 + 1200 mm
= 1860 mm = 1.860 Meter

Second we Calculate Ful Length Of Bar Above Plinth Level.
= (G.F Height + Slab Ld)
={ 3000 + (50 x 16)}
= 3000 mm + 800 mm
=3800mm=3.8 Meter.

**Cutting Length of Vertical bar 16 mm**= (Length of bar Below Plinth Beam)+(Plinth Beam)
+ (Full Length of Bar Above Plinth beam)

= 1860 mm + 300 mm + 3800 mm
= 5960 mm = 5.96 Meter

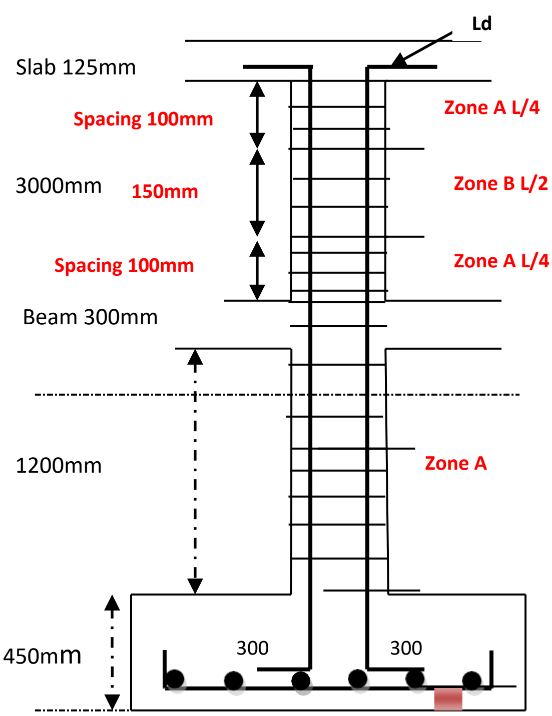
Cutting length of 20mm/16mm Vertical Bar

| | |
|---|---|
| Cutting Length of Vertical bar 20 mm | 6160 mm or 6.160 Meter |
| Cutting Length of Vertical bar 16 mm | 5960 mm or 5.960 Meter |

## Step 3 – Cutting Length of Stirrups

Length of One Hook = **9d**
Calculation of A = 600 – 40 -40 – 4 – 4 = 512 mm
Calculation of B = 300 – 40 -40 – 4 – 4 = 212 mm
Cutting length of Stirrup = Perimeter of stirrup + No. Of Hook – Bend Deduction90/135deg
= 2(A+B) + (2x9d Hook)-(3x2d 90Deg Bend)-(2x3d 135 Deg Bend)
= 2(512+212) + ( 2x9x8) - (3x2x8 ) - (2x3x8)
= 1496 mm

## Step 4 – Number of Stirrups in Zone A or Zone B




| | |
|---|---|
| Number of Ring in Zone A | = 36 Rings |
| Number of Ring in ZoneB | = 11 Rings |
| Total Number of Ring in Zone A/ZoneB | = 46 Rings |

1st Number of Ring in Zone A ????

Number of Ring =( Distance/Spacing)+1

Zone A Total Length
= 1650 + ( 2 x 750 L/4 ) + (300 beam)
=3450mm
Zone A Spacing(given) = 100mm c/c

Number of Ring in Zone A=( Distance/Spacing)+1
=(3450/100)+1
= 34.5 +1= 36 Rings

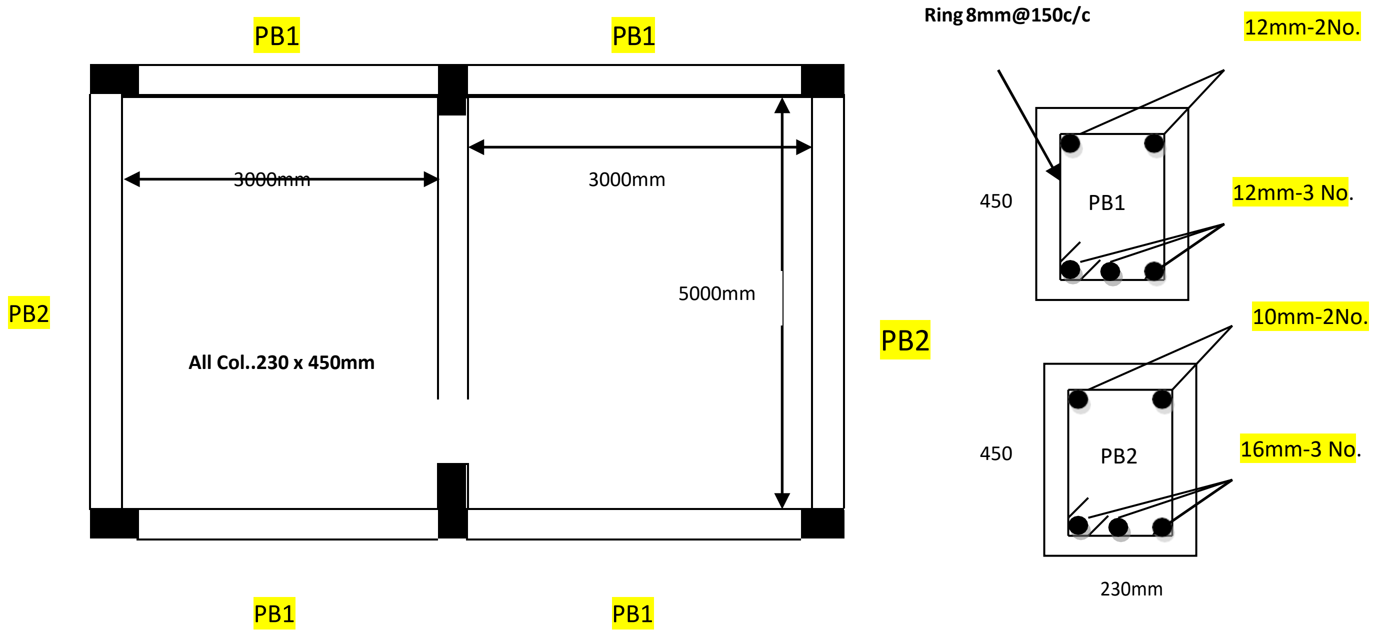
2nd Number of Ring in Zone B ????

Number of Ring =( Distance/Spacing)+1

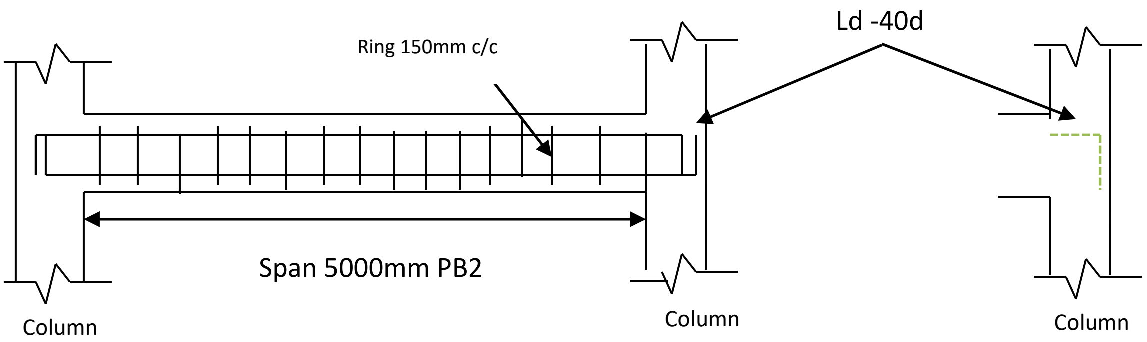
Zone A Total Length
= 1500mm
Zone B Spacing(given) = 150mm c/c

Number of Ring in ZoneB=( Distance/Spacing)+1
=(1500/150)+1
= 10 +1= 11 Rings

# Bar Bending Schedule For Plinth Beam

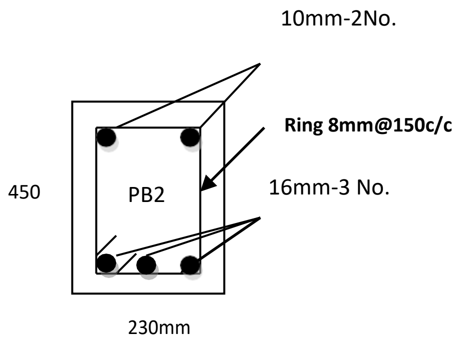



**We Calculate Reinforcement of Plinth Beam PB2**

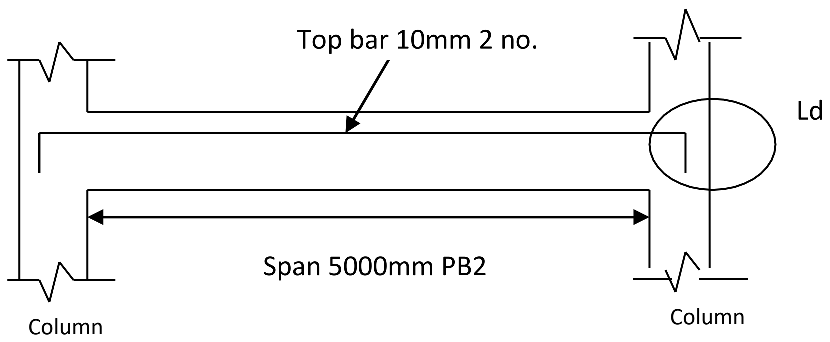



**Given.**

- Clear Span of Beam = 5000 mm
- Development Length Ld = 40d
- Clear Cover = 25 mm assume
- Bottom = 3 numbers of 16mm
- Top = 2 numbers of 10mm
- Stirrups = 8mm @ 150mm
- No of PB2 BEAM = 2



**Step 1 : Find cutting length of Main top bar**



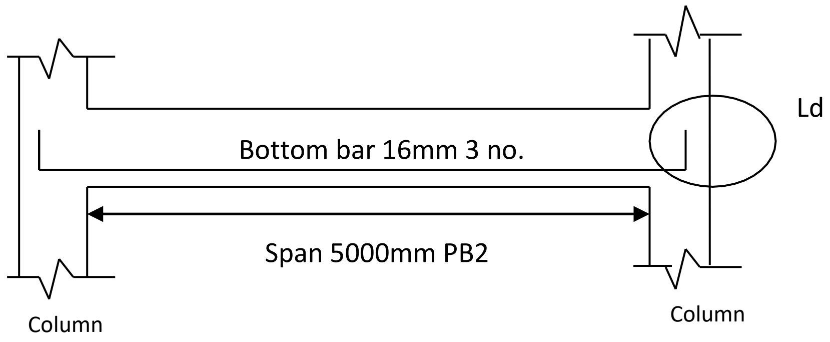

Cutting length of top bar = Clear Span + 2 x Development length( Ld ) – (2 bend 90deg)

= 5000 + (2 x 40d) –( 2 x 2d)

= 5000 + (2 x 40 x 10) – (2 x 2 x 10)

= 5760 mm

**Step 2 : Find cutting length of Main Bottom bar**



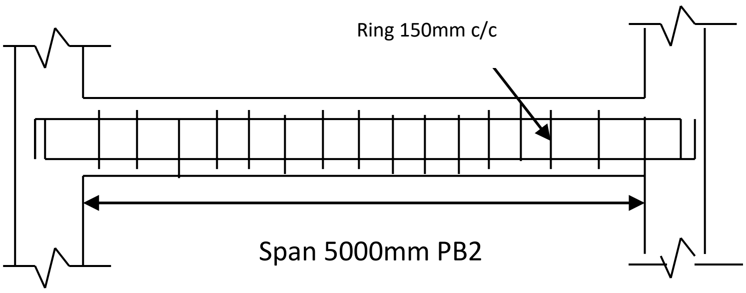

Cutting length of Bottom bar = Clear Span + 2 x Development length( Ld ) – (2 bend 90deg)

= 5000 + (2 x 40d) –( 2 x 2d)

= 5000 + (2 x 40 x 16) – (2 x 2 x 16)

= 6216 mm

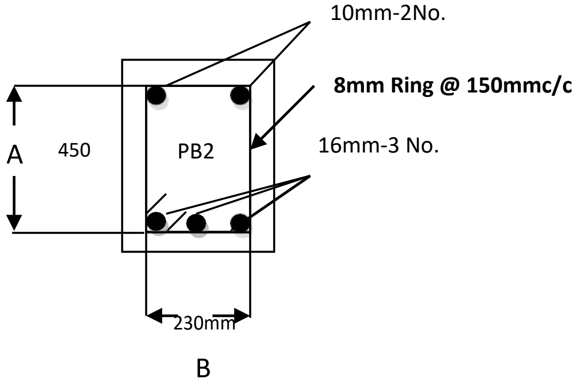
**Step 3 : Find Out No. Of Ring in Beam.**




Number of Stirrups required = (Clear Span of Beam/Spacing Stirrups)+ 1

= (5000 / 150) +1 = 34 No.s

**Step 4 – Find out cutting length of Stirrup**




Length of One Hook = **9d**

Calculation of A = 450 – 25 – 25 – 4 – 4 = 392

Calculation of B = 230 – 25 – 25 – 4 – 4 = 172

Cutting length of Stirrup = Perimeter of stirrup + No. Of Hook – Bend Deduction90/135deg

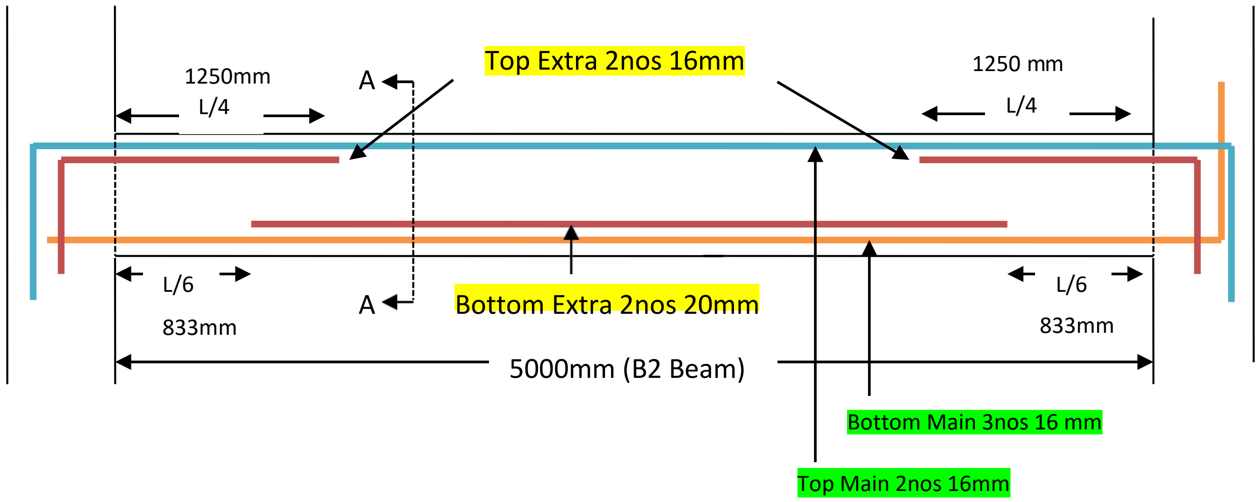
= 2(A+B) + (2x9d Hook)-(3x2d 90Deg Bend)-(2x3d 135 Deg Bend)

= 2(392+172) + ( 2x9x8) - (3x2x8 ) - (2x3x8)

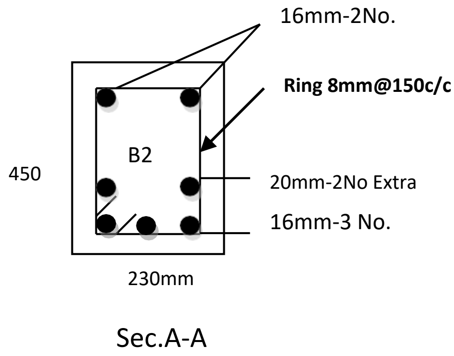
= 1176 mm

# Bar Banding Schedule For Beam With Extra Bar

**Suppose Same Drawing Span Related to Plinth Beam Drawing, then how to find BBS**

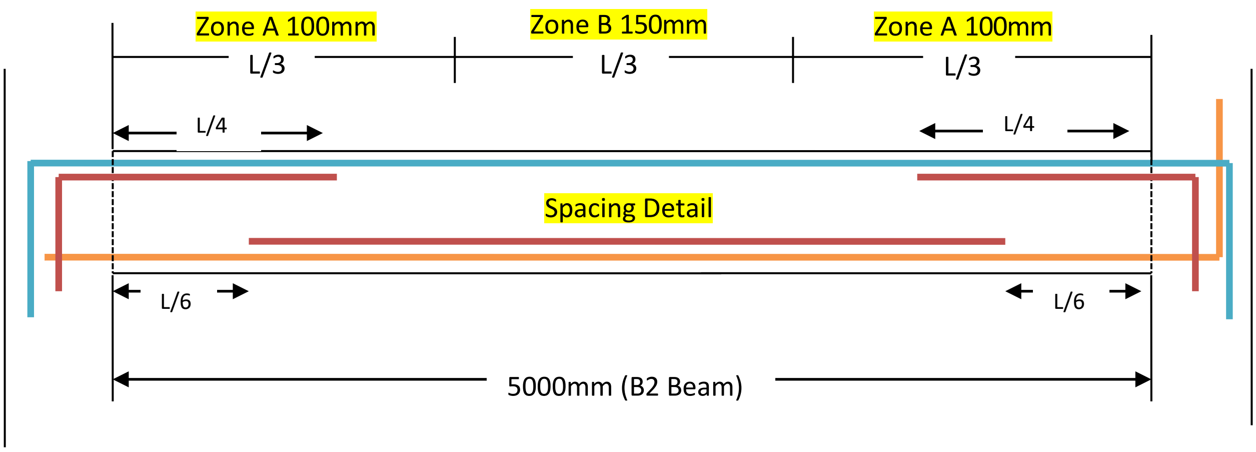



**Given.**

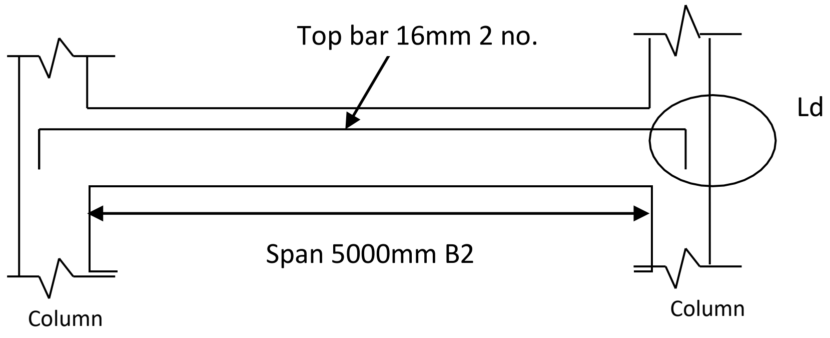



- Clear Span of B2 Beam = 5000 mm
- Development Length Ld = 40d
- Clear Cover = 25 mm assume
- Bottom Main = 3 nos 16mm
- Bottom Extra = 2 nos 20mm
- Top Main = 2 nos of 16mm
- Top Extra =2nos 16mm

- Stirrups = 8mm @ 100mm at Support ,,150mm at mid
- Number of Beam B2 = 2



**Step 1 : Find cutting length of Main top bar**

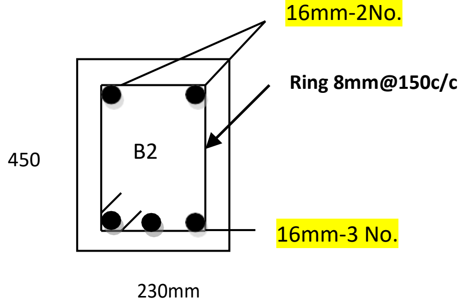



Cutting length of top bar = Clear Span + 2 x <u>Development length</u>( Ld ) – (2 bend 90deg)

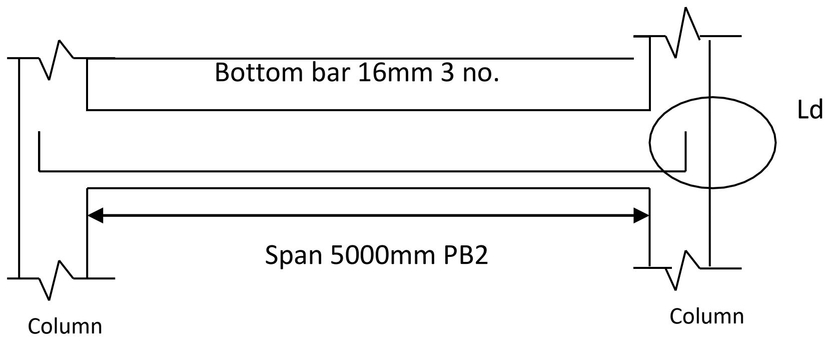
= 5000 + (2 x 40d) –( 2 x 2d)

= 5000 + (2 x 40 x 16) – (2 x 2 x 16)

= 6216 mm




**Step 2 : Find cutting length of Main Bottom bar**



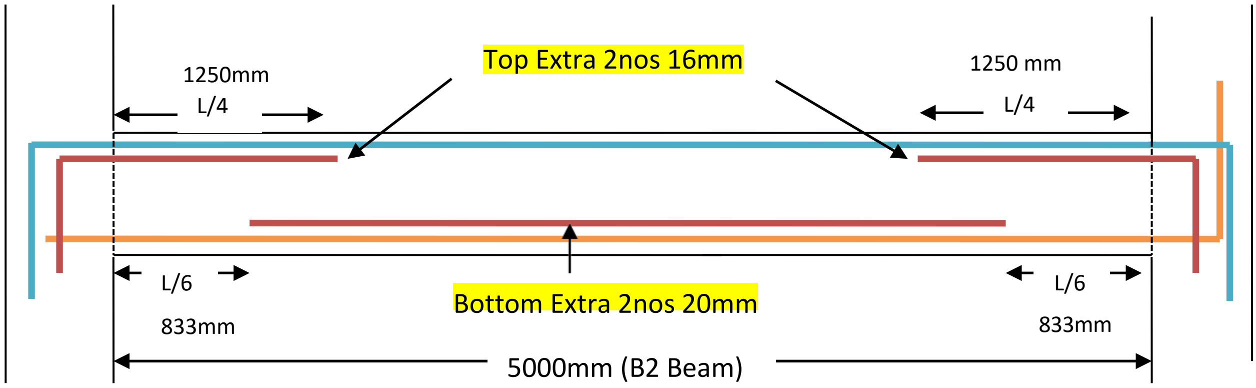

Cutting length of Bottom bar = Clear Span + 2 x <u>Development length</u>( Ld ) – (2 bend 90deg)

= 5000 + (2 x 40d) –( 2 x 2d)

= 5000 + (2 x 40 x 16) – (2 x 2 x 16)

= 6216 mm

**Step 3 : Find cutting length of Main top Extra bar**

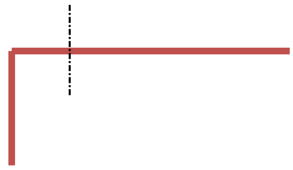



Cutting length of top Extra bar = L/4 Span + Development length( Ld ) – (1 bend 90deg)

= (5000/4) + ( 40d) –( 1 x 2d)

= 1250 + ( 40 x 16) – ( 2 x 16)

= 1858 mm



**Step 3 : Find cutting length of Bottom Extra bar**



Cutting length of top Extra bar = Total Span – L/6 Span Both Side

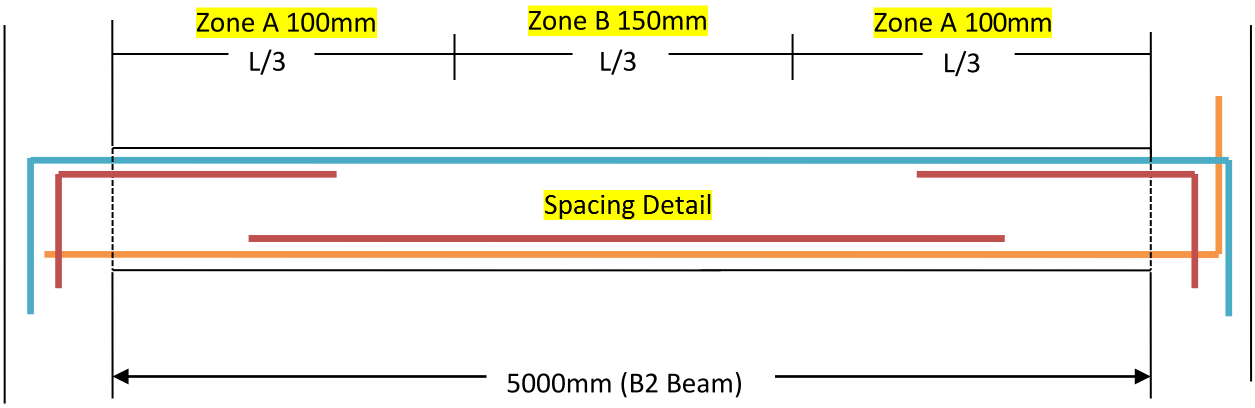
= 5000 – (2 x 5000/6)

= 5000 – (2 x 833)

=5000 – 1666

= 3334 mm

**Step 3 : Find Out No. Of Ring in Beam.**




For Zone A
Distance of Zone A = L/3 = 5000/3 = 1666mm

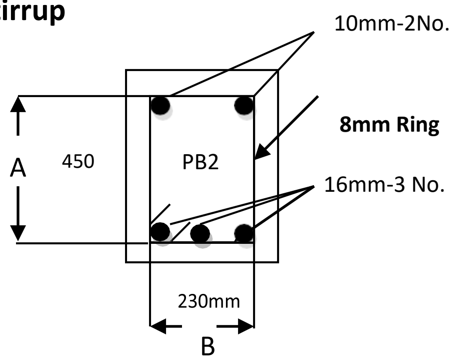
No. Of Ring in Zone A = (Distance of Zone A)/Spacing + 1
= 1666/100 + 1
= 18 nos x 2 Side
= 36 Nos

For Zone B
Distance of Zone B = L/3 = 5000/3 = 1666mm

No. Of Ring in Zone A = (Distance of Zone B)/Spacing + 1
= 1666/150 + 1
= 12 Nos

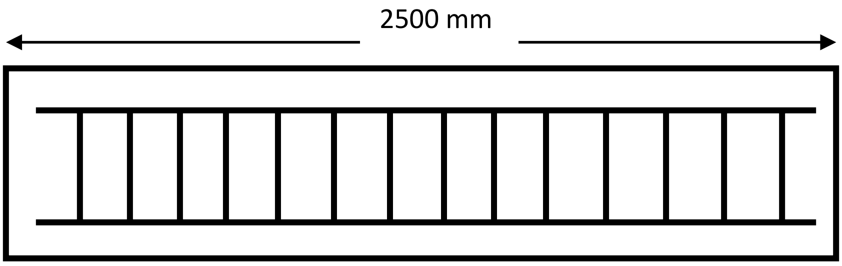
Total No of Ring = 36 + 12 = 48 Ring

**Step 4 – Find out cutting length of Stirrup**

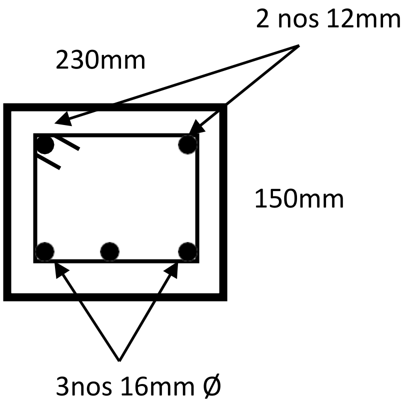



Length of One Hook = **9d**
Calculation of A = 450 – 25 – 25 – 4 – 4 = 392
Calculation of B = 230 – 25 – 25 – 4 – 4 = 172
Cutting length of Stirrup = Perimeter of stirrup + No. Of Hook – Bend Deduction90/135deg
= 2(A+B) + (2x9d Hook)-(3x2d 90Deg Bend)-(2x3d 135 Deg Bend)
= 2(392+172) + ( 2x9x8) - (3x2x8 ) - (2x3x8)
= 1176 mm

# BAR BENDING SCHEDULE OF LINTEL BEAM




**L1 Lintel ( 150mm x 230mm)**




## Given

Length of Lintel (L1) = 2500 mm

Clear Cover = 25 mm

Dimension of Lintel = 230 x 150mm

Stirrups = 8mm Ø @ 125 c/c

Top Reinforcement = 12 mm Ø 2 nos

Bottom Reinforcement = 16 mm Ø 3 nos

Number Of L1 Lintel = 10

## Step 1. Cutting Length Of Top Bars

Length of Top bar = Length of lintel – clear cover for both sides

= 2500 – 2 x 25 [Clear cover for both sides]

=2450 mm

= 2.4 m.

## Step 2. Cutting Length Of Bottom Bars

Length of Bottom bar = Length of lintel – clear cover for both sides

= 2500 – 2 x 25 [Clear cover for both sides]

= 2450 mm = 2.4 m

## Step 3. Cutting Length Of Stirrups:

a = 230 -25 -25 -8 = 172 mm

b = 150 – 25 – 25 -8 = 84 mm.

Cutting length of stirrups = 2(a+b) + Hooks Length –Bend

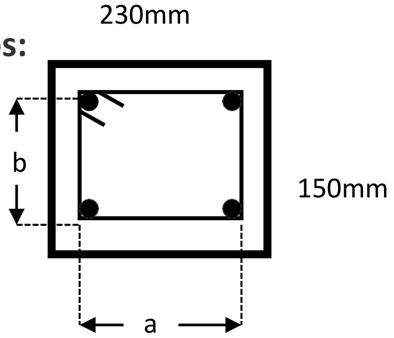
Hooks length = 10d

Cutting length of stirrups = 2(a+b) +2x10x8 –(3x2x8 90 deg) – (2 x 3 x8 135deg)

= 2(172 + 82) + 160 -48 – 48

= 572 mm

## Step 4. Calculate No Of Stirrups:

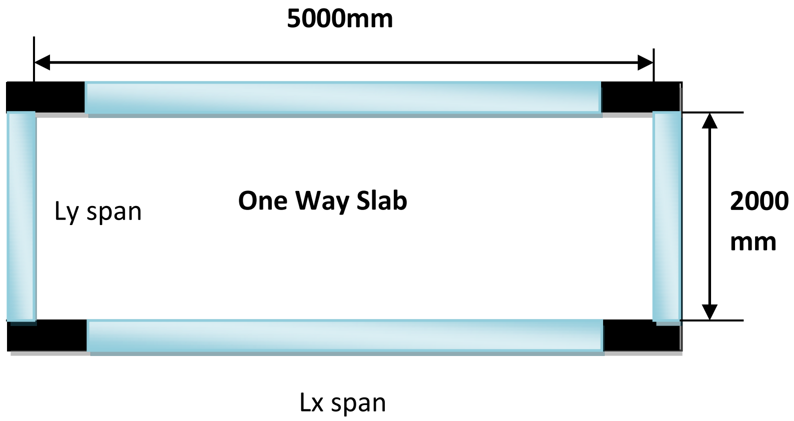


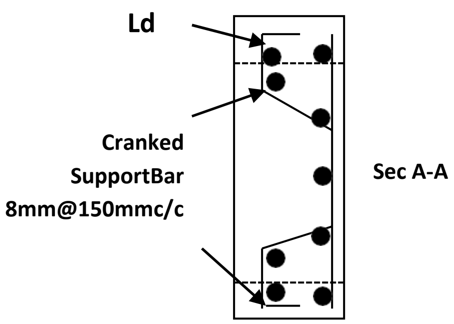

No of stirrups ={(Total length of lintel)/(c/c distance between strriups)} + 1

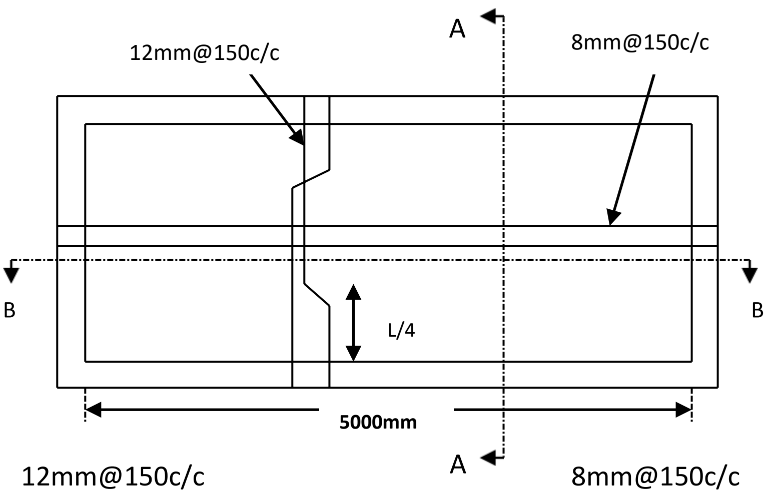
= (2500/125) + 1

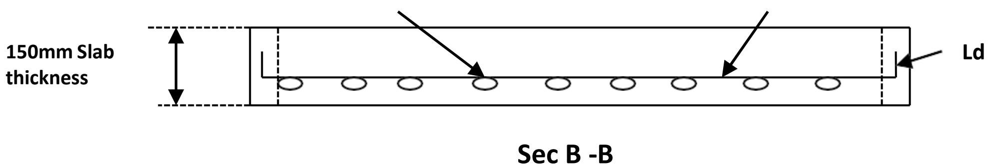
= 21

# Bar Bending Schedule For One Way Slab




# Given

- Main bars =12 mm @ 150 mm c/c spacing
- Distribution bars = 8 mm @ 150 mm c/c spacing.
- Cranked support bar = 8mm @ 150 mm c/c spacing.
- Top and Bottom. Clear Cover = 25 mm
- Development length = 40 d
- Slab Thickness = 150 mm
- See Slab Section

# Bar Bending Schedule Calculation for One Way Slab

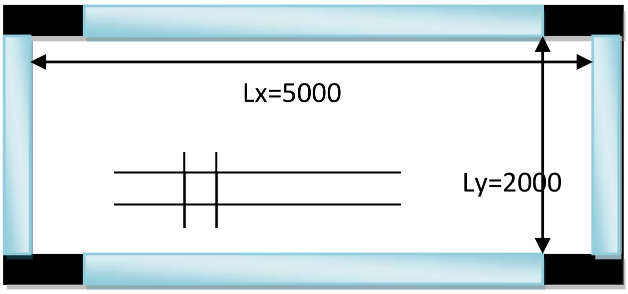
## Step 1... Calculate Number Of Bar in slab

Number of Bars Formula = (Length / spacing) + 1

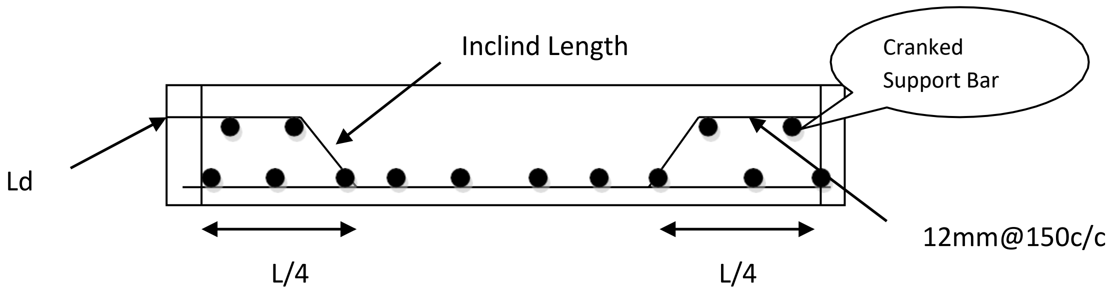
Number of Main Bars = (Lx / spacing) + 1 = (5000/150) + 1 = 34 nos

Number of Distribution Bars = (Ly / spacing) + 1 = (2000 / 150) + 1 = 14 nos

s




## Step 2...Calculate cutting length



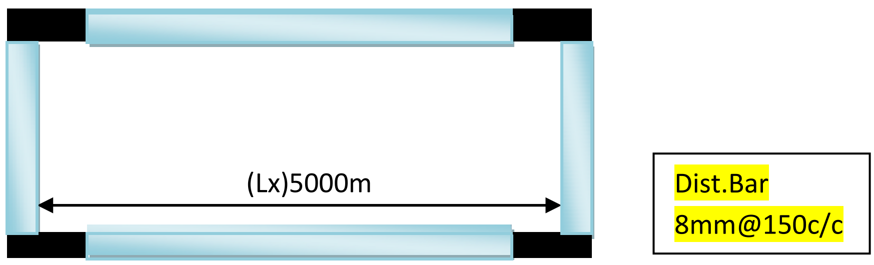

**Cutting Length of Main Bar**,

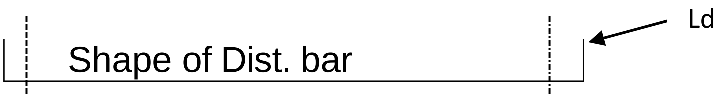
**= Clear Span of Slab (Ly) + (2 X Developement Length) +(1 x Inclined length) – (45° bend x 2) – (90° bend x 2)**

D = Slab thickness – 2 side clear cover – dia of bar = 150 – 50 -12 = 88 mm

We know that one side Crank Length = 0.42 D,
= 2000 + (2 x 40 x 12) + (1 x 0.42 x D) – (1d x 2) – (2d x 2)
= 2000 + 960 + 0.42D – (1x12x2) – (2x12x2)
= 2960 +0.42D – 24– 48
= 2960+(0.42 x 88) – 24– 48
= 2925 mm or 2.92 m

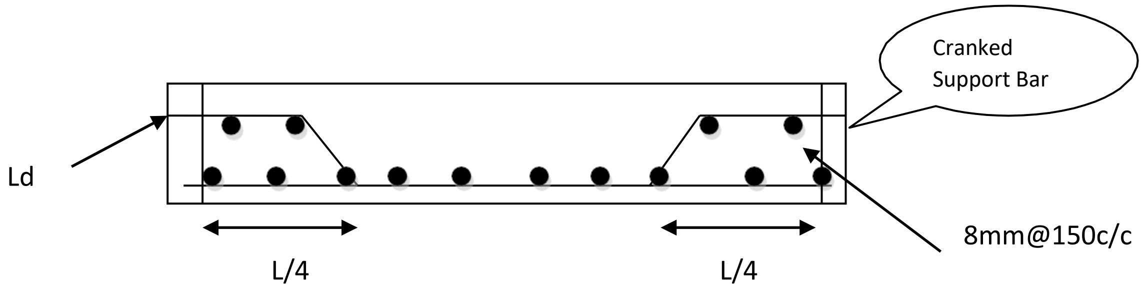
## Cutting length of distribution bar




= Clear Span (Lx) + (2 x Development Length (Ld)) – **(90° bend x 2)**
= 5000 + (2 x 40 x 8) ) – (2x8x2)
= 5608 mm or 5.60 m

### Step 3..Number of Bar required for Both Side Cranked Support Bar.




Drawing section A-A

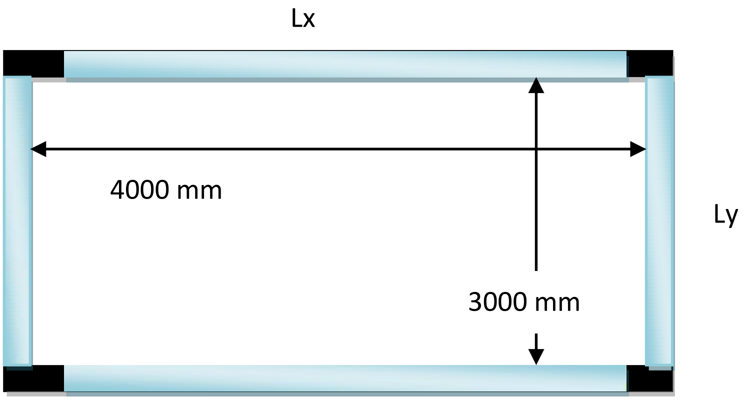
Number of top bars = (Ly/4) / spacing + 1
= (2000/4) / 150 +1
= 4 Nos x 2 sides
Number of top bars = 8 Nos bar

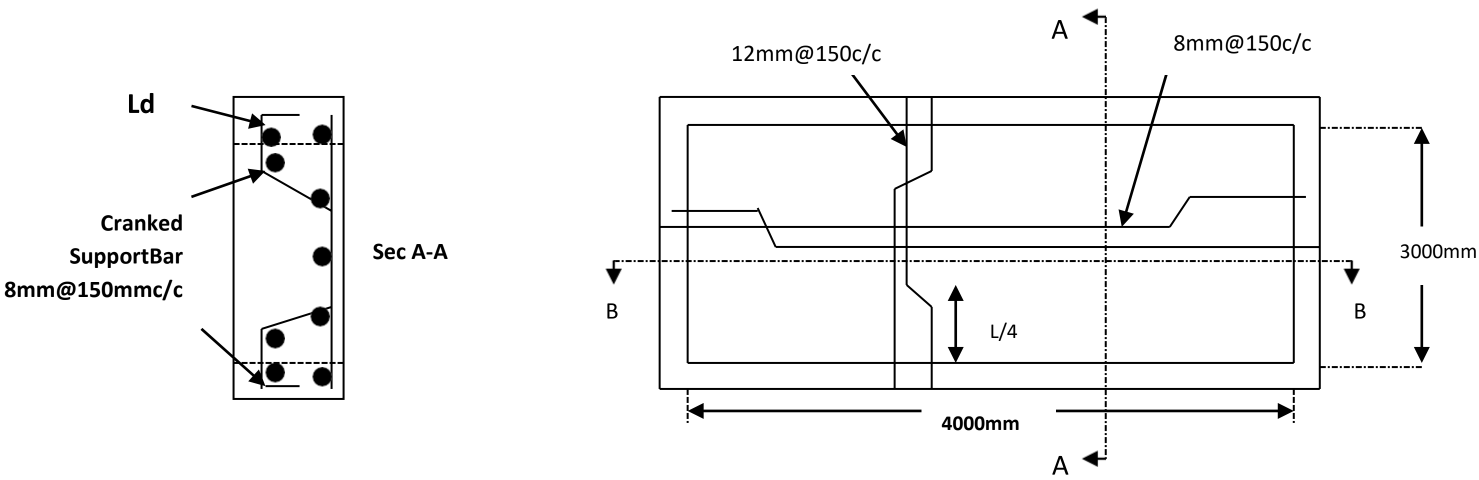
Length of Cranked Support Bar (L) = Same as distribution bars = 5.60 m

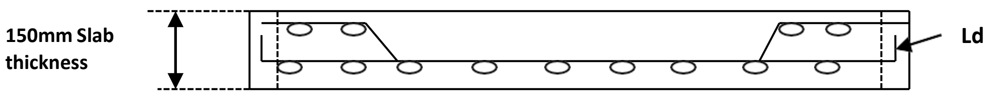
# Bar Bending Schedule For two Way Slab

**Is it two way slab ?**

**Two Way Slab**
**=(Lx/ly )< 2**
**=(4000/3000) < 2**
**=1.33 < 2**
**This is Two Way Slab**




**Sec B -B**

## Given

- Main bars 12 mm @ 150 mm c/c spacing
- Distribution bars 8 mm @ 150 mm c/c spacing.
- Cranked support bar 8mm/10mm @ 150 mm c/c spacing.
- Top and Bottom Clear Cover is 25 mm
- Development length 40 d
- Slab Thickness – 150 mm
- See Slab Section

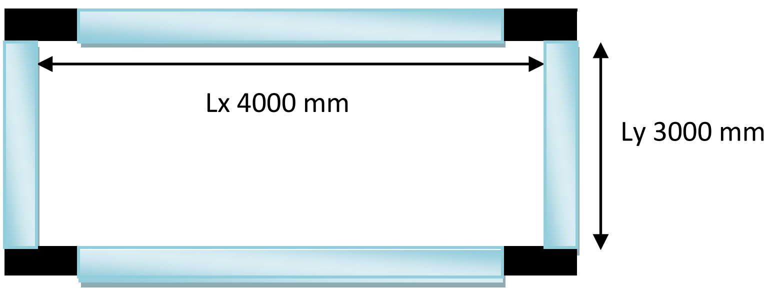
# Bar Bending Schedule Calculation for Two Way Slab

## Step 1... Calculate Number Of Bar

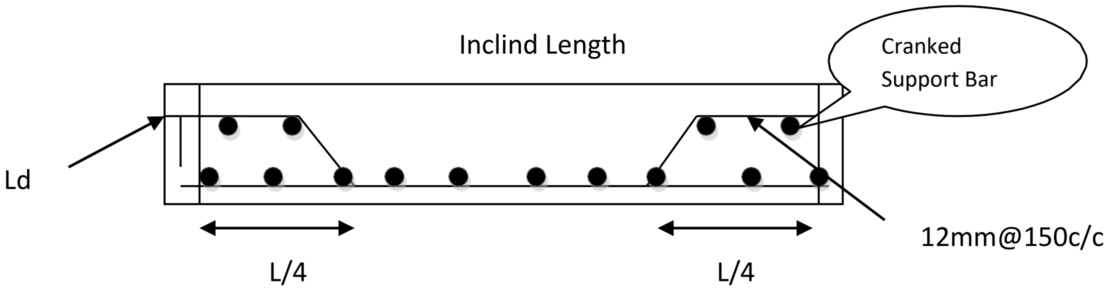
Number of Bars Formula = (Length of slab / spacing) + 1

Number of Main Bars = (Lx / spacing) + 1 = (4000/150) + 1 = 27 nos

Number of Distribution Bars = (Ly / spacing) + 1 = (3000 / 150) + 1 = 21 nos




## Step 2...Calculate cutting length




Cutting Length of Main Bar,

**= Clear Span of Slab (Ly) + (2 X Developement Length) +(1 x inclined length) – (45° bend x 2) – (90° bend x 2)**

D = Slab thickness – 2 side clear cover – dia of bar
= 150 – 50 -12 = 88 mm

we know that one side crank inclined length is 0.42D,

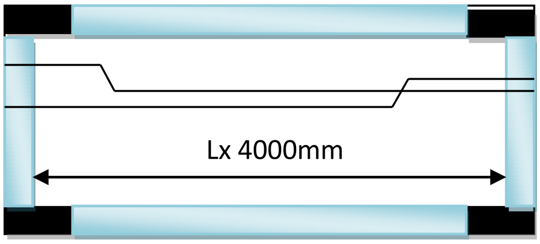
= 3000 + (2 x 40 x 12) + (1 x 0.42 x D) – (1d x 2) ) – (2d x 2)

= 3000 + 960 + 0.42D – (1x12x2) ) – (2x12 x 2)

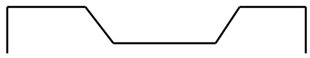
= 3480 + 0.42 D -24-48

= 3960+(0.42 x 88)-24-48

**Cutting Length of Main Bar** = 3925 mm or 3.92 m cutting length of distribution bar




Shape of BAR

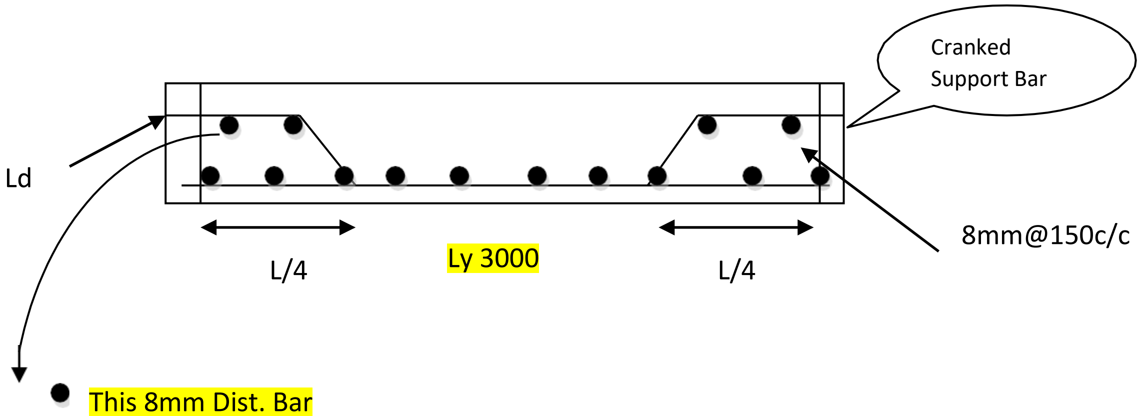


**= Clear Span of Slab (Lx) + (2 X Developement Length) +(1 x inclined length) – (45° bend x 2) – (90° bend x 2)**

we know that one side crank inclined length is 0.42D
= 4000 + (2 x 40 x 8) + (1 x 0.42 x D) – (1d x 2) ) – (2d x 2)
= 4000 + 320 + (0.42×88) – (1x8x2) ) – (2x8x2)
= 4612mm or 4.61 m

D = Slab thickness – 2 side clear cover – dia of bar
= 150 – 50 -12 = 88 mm

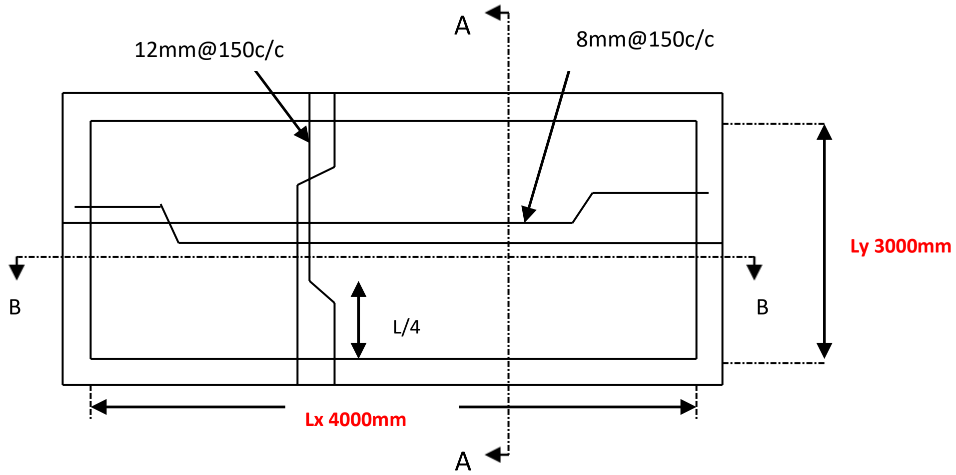
**Step 3 Calculate Top Bar (Extra)** ; Top Bars are provided at the top of critical length (L/4) area, Please refer the drawing section A-A

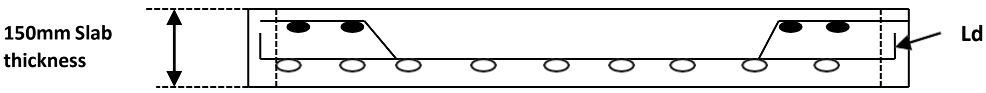



8mm distribution cranked support bar
Number of Top bars on Lx side = (Ly/5) / spacing + 1 = (3000/5) / 150 +1
= 5 Nosx2side
=10nos

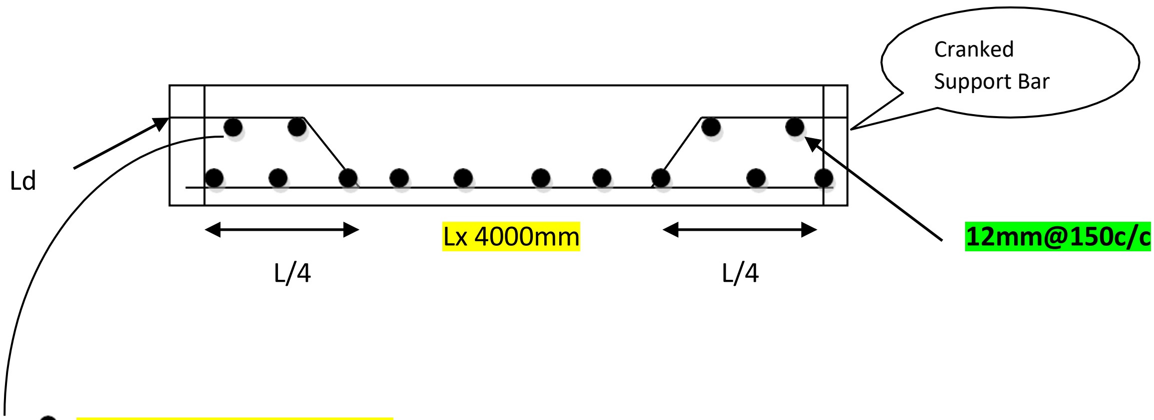
Length of top bar on Ly side = Clear Span of Slab (Ly) + (2 X Development Length) ) – (90° bend x 2)

= 4000+(2x40x8) – (2x8x2)
= 4000+640-32
= 4608 mm or 4.60 m




**Section B -B**




- This 12mm bar Calculation

12mm main cranked support bar

Number of Top bars on Ly side = (Lx/5) / spacing + 1

= (4000/5) / 150 + 1

= 6 Nosx2side

=12nos

Length of top bar on Ly side = Clear Span of Slab (Ly) + (2 X Development Length) – (90° bend x 2)

= 3000+(2*40*12) -(2*12*2)

= 3000+960 -48

= 3912 mm or 3.91 m