How to calculate cutting length in bar bending schedule? -Numerical

In this article, I am going to explain how to calculate cutting length in bar bending schedule for steel of different types of structure.

Bar Bending of steel is an estimation of the cutting of steel. I have summarised in the previous article. If you have not read, then read here.

Complete Bar Bending Schedule for Different Structure (Free e-Book)

Steps involved in finding the cutting length

1. First of writing the dimension of the structure.
2. Note down the diameter of steel bars for which cutting length is to be calculated.
3. Now, deduct the concrete cover or clear cover to get the actual length of perimeter bars.
4. Calculate the length of the hook of the bars.
5. Calculate the bend length of steel bars.
6. Add step 3 and 4 and subtract step 5 from it.
7. It will gives you total cutting length of steel bars.

General Formula to calculate cutting length of any steel bars:

Cutting Length of bars = Perimeter of Shape + Total hook length – Total Bend Length

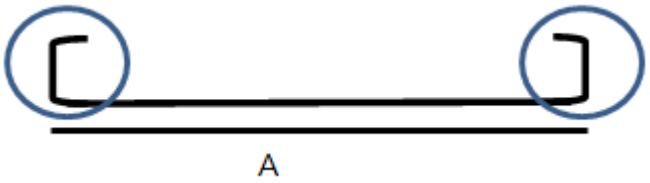
Standards value of Bends & Hooks used in construction

- 1 Hook length = 9d or 75mm
- 45° Bend length = 1d
- 90° Bend length = 2d
- 135° Bend length = 3d

Remember, d = Diameter of Bar

how to calculate cutting length in bar bending schedule?

1) Cutting length of the main bar with hook



Circled part is known as Hook whose length is 9d.

Length of hook = 9d, where d is the diameter

Cutting length = A + 2 x (9d – 2 x 2d) = 7d

2d is subtracted to for bending of a steel rod at 90°. There are two bends in one hook length so, multiply it by two.

On-Site

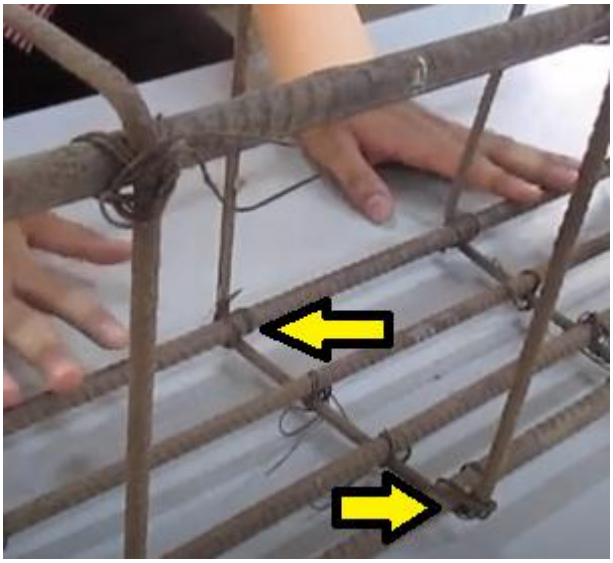
2) Cutting length of the main bar with bend:

Length of hooks varies from = 10d to 16d, where d = diameter

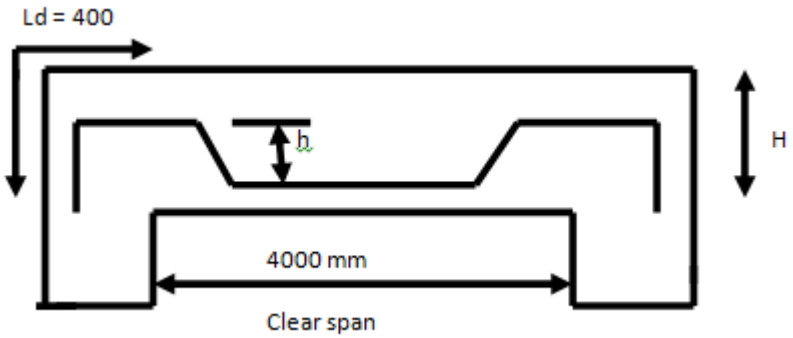
Length of main bar = L + 12d + 12d – length of bends

(Taking hook length = 12d)

On-Site



3) Cutting length of a crank or bent up bar:



Calculating for cutting length of the bar

Clear span + crank length + Development L – (1d x No. of bends) – (2d x No. of bends)

Clear span + (2 x 0.42 x h) + (2 x Ld) – (1d x No. of bends) – (2d x No. of bends)

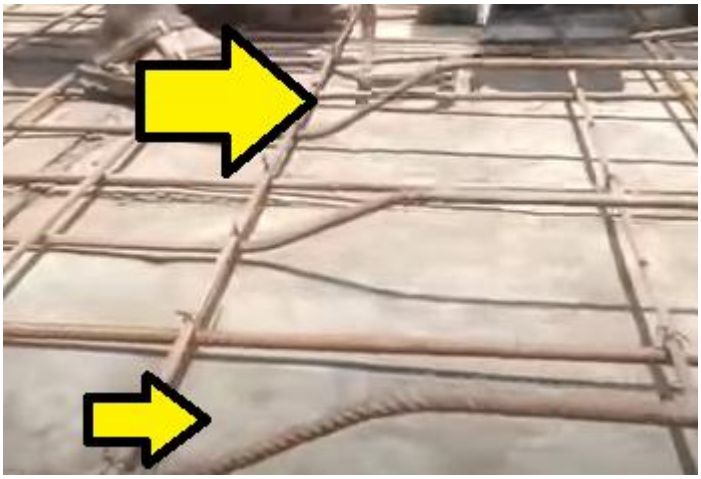
Depth of bar crank

h= Slab thickness – (2 x clear cover) – d

45 Bend = 1d

90 Bend = 2d

On-Site



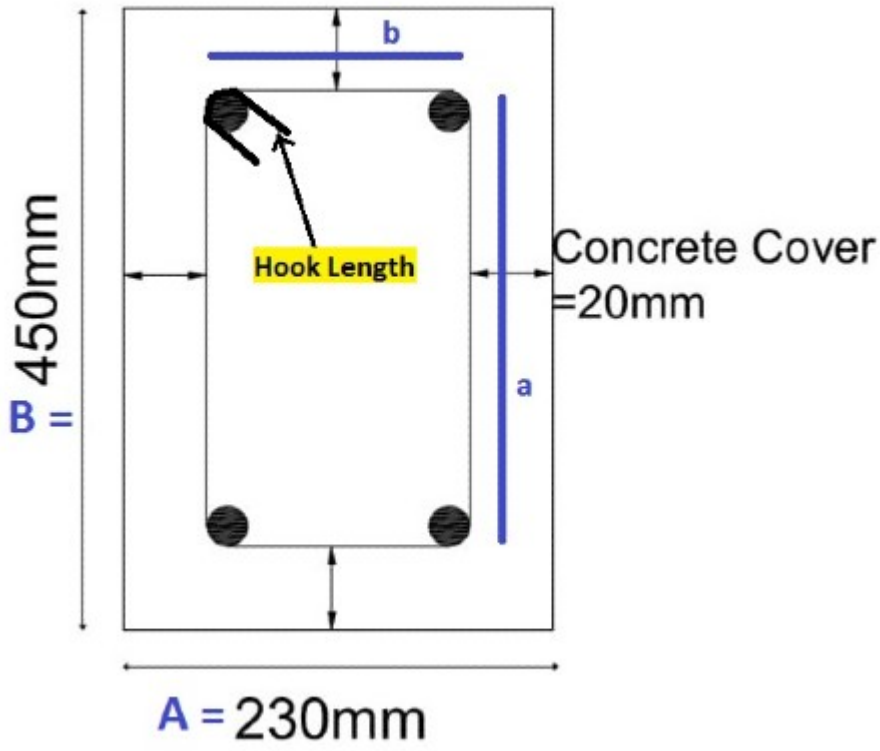
4) Cutting length for Rectangular Stirrups or Ties:-

On-Site

Rectangular column or rectangular beams are generally used in construction. So, we need to calculate mostly the cutting length of rectangular stirrups.

Numerical Example,

Find the cutting length of the rectangular tie having diameter 8 mm and column having size 230mm x 450mm and clear cover 40 mm.



Given,

Diameter of ties/stirrups = 8 mm

Clear Cover = 40 mm

Dimension of column = 450 mm x 230 mm

Formula,

(L) = Total Cutting length of Rectangular Stirrup = Perimeter of Rectangular Stirrup + Total Hook length – Total Bend Length

Step:-1

Perimeter of Rectangular stirrups (P) = 2a +2b

Where, a = A – Clear Cover – Clear Cover = 230 – 20 – 20 = 190 mm

b = B – Clear Cover – Clear Cover = 450 – 20 – 20 = 410 mm

Therefore,

(P) = 2a +2b

(P) = 2 x 190 +2 x 410 = 1200 mm

Step:- 2

Total Hook length = 9d+9d = 18 d = 18 x 8 = 144 mm (Because there is two hooks and length of one hook is 9d, where d is diameter of stirrups.)

Step:-3

Total Bend Length = (3 x 90^0 Bend length + 2 x 135^0 Bend length)

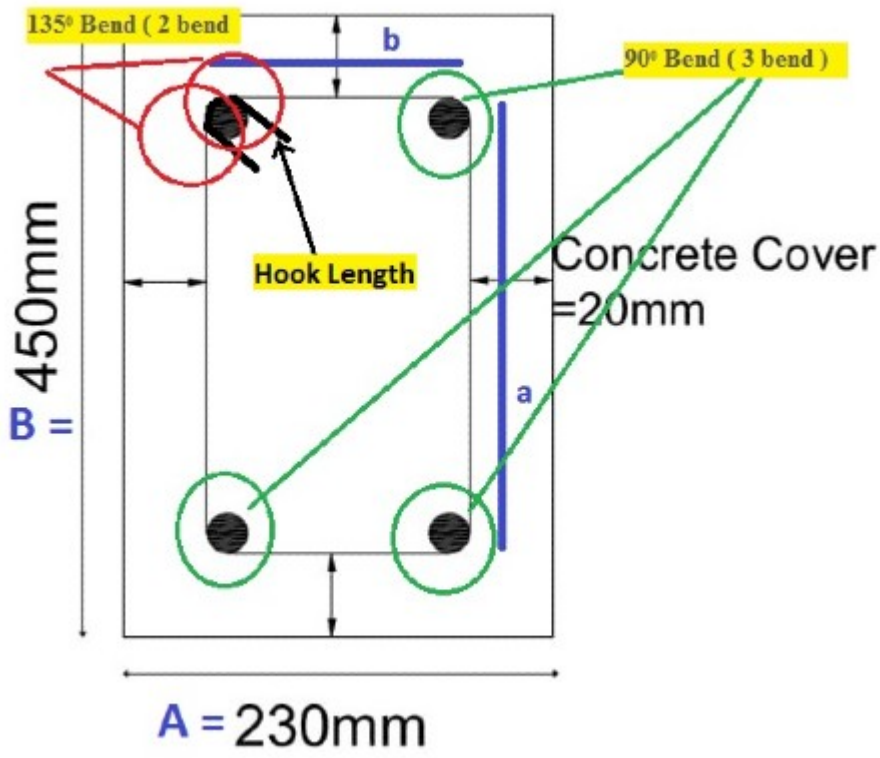
= 3 x 2d + 2 x 3d

= 12d

= 12 x 8

= 96mm

(Because there are three bends of 90^0 and two bends of 135^0)



Step:-4

Hence Put all the value in above formula we get,

(L) = Total Cutting length of Rectangular Stirrup = Perimeter of Rectangular Stirrup + Total Hook length – Total Bend Length

(L) = 1200 mm + 144 mm – 96mm

(L) = 1448 mm

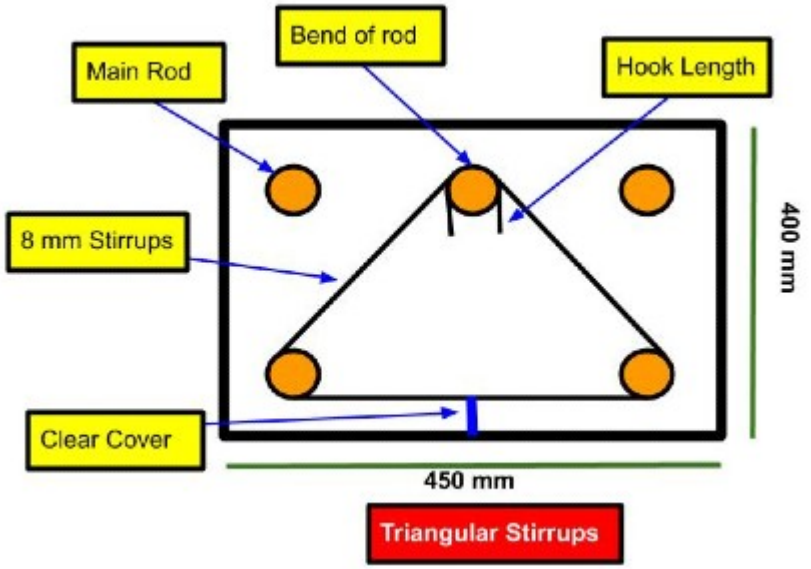
Hence the total cutting length of rectangular stirrups or ties is 14.48 cm or 0.1448 meter.

5) Cutting length of triangular stirrups:

Formula,

Total Cutting length of Triangular Stirrup = Perimeter of Triangle + Total Hook length – Total Bend Length

Q) Find the cutting length of triangular stirrups having diameter 8 mm and dimension of column (400 x 450) mm with clear cover 25 mm.

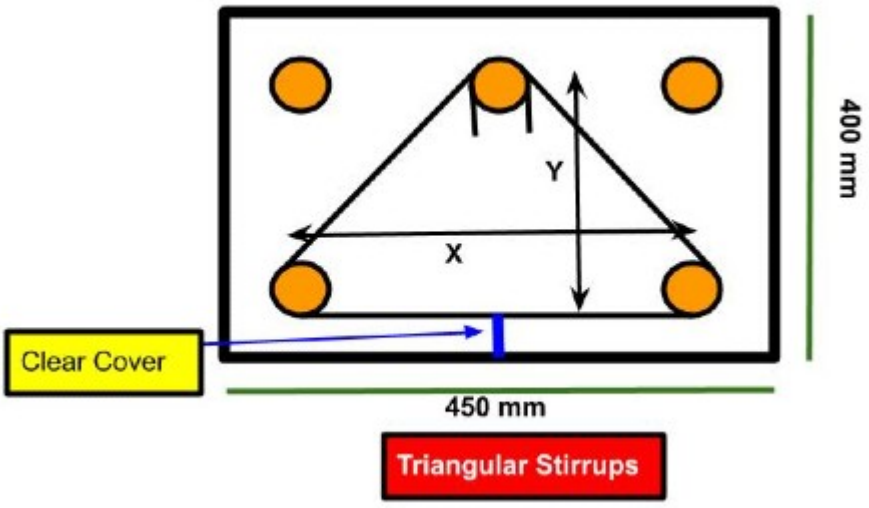


Given,

Dimension of Column = 450mm x 400mm

Diameter of stirrups = 8 mm

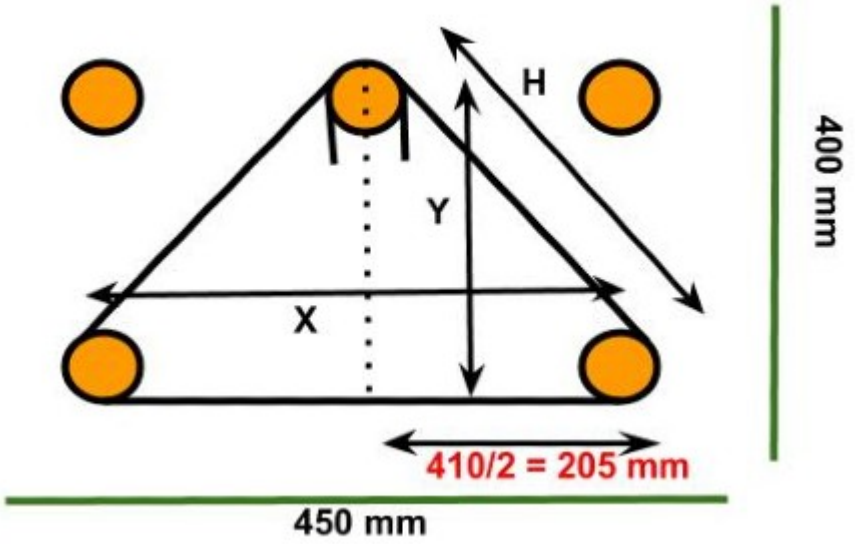
Clear Cover = 25 mm



Now,
X = 450-20-20 = 410mm
Y = 400-20-20 = 360mm

From Pythagorean theorem,

$$\text{Hypotenuse}^2 = (\text{Opposite})^2 + (\text{Adjacent})^2$$



i.e. $H^2=(x/2)^2 + y^2$

$H^2=205^2 + 360^2$

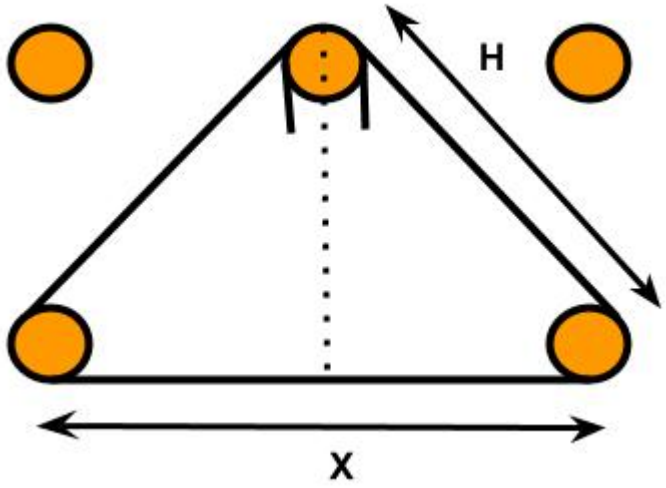
$H^2=205^2 + 360^2$

$H = 414.27$ mm

Formula,

Total Cutting length of Triangular Stirrup = Perimeter of Triangle + Total Hook length – Total Bend Length

Step:- 1



Perimeter of Triangular stirrups = H + H + X = 414.27 mm + 414.27 mm + 410mm

P = 1238.54 mm

Step: – 2

Total Length of the hooks: 9d +9d = 18d = 18 x 8 = 144 mm

Since, there are two hooks of 9d.

Step:-3

Total length of Bends = 4 x 3d = 12d= 12 x 8 = 96mm

Since, there are 4 bends which are bent at an angle of 135^{0}

Step: – 4

Use formula,

Total Cutting length of Triangular Stirrup (L) = Perimeter of Triangle + Total Hook length – Total Bend Length

(L) = 1238.54 mm + 144 mm – 96mm

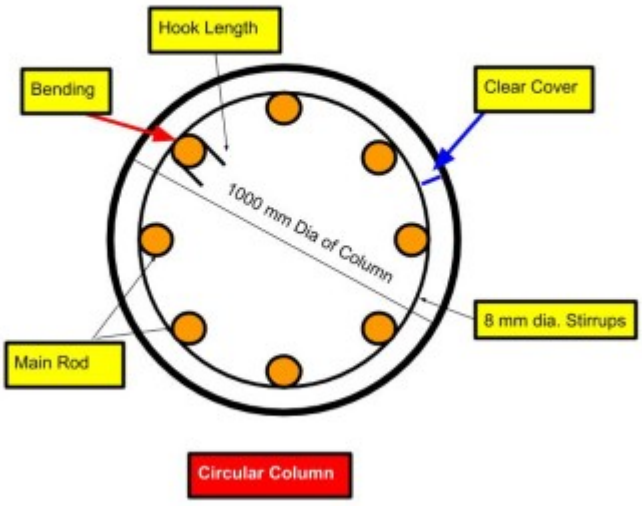
(L) = 1286.54 mm

Hence the total cutting length of rectangular stirrups = 1286.54 mm = 128.65 cm or 1.286 meter.

On-Site

6) Cutting Length for Circular Stirrup:

Find the cutting length of circular stirrups having diameter 8 mm and dimension of column is 1000 mm with clear cover 25 mm.



Given,

Diameter of Column = 1000 mm

Diameter of stirrups (d) = 8 mm

Clear Cover (C/C) = 25 mm

Formula,

Total Cutting length of Circular Stirrup or Ring (L) = Circumference of Circular Stirrup + Total Hook length – Total Bend Length

Step:-1

Circumference of Circular Stirrup = πD

But,

D is the diameter of the stirrups ring not the column.

To calculate the diameter of circular stirrups we have to subtract he clear cover from the diameter of the column.

So, D = Diameter of column – clear cover of left side – clear cover of right side.

i.e D = 1000 – 25 – 25 = 950 mm

Now,

Circumference of Circular Stirrup = πD

=

3.14 x 950

=

2983 mm

Step:-2

Total Length of the hook = 9d+9d= 18d = 18 x 8 = 144 mm

Where d is diameter of stirrups.

Since, There are two hooks and length of one hooks is 9d.

Step:- 3

Total Length of Bends: = = 2 x 3d = 6d= 6 x 8 = 48mm

Since, There are 2 bends which are bent at an angle of 135^0

Length of one bends at 135^0 is 3d.

Step:- 4

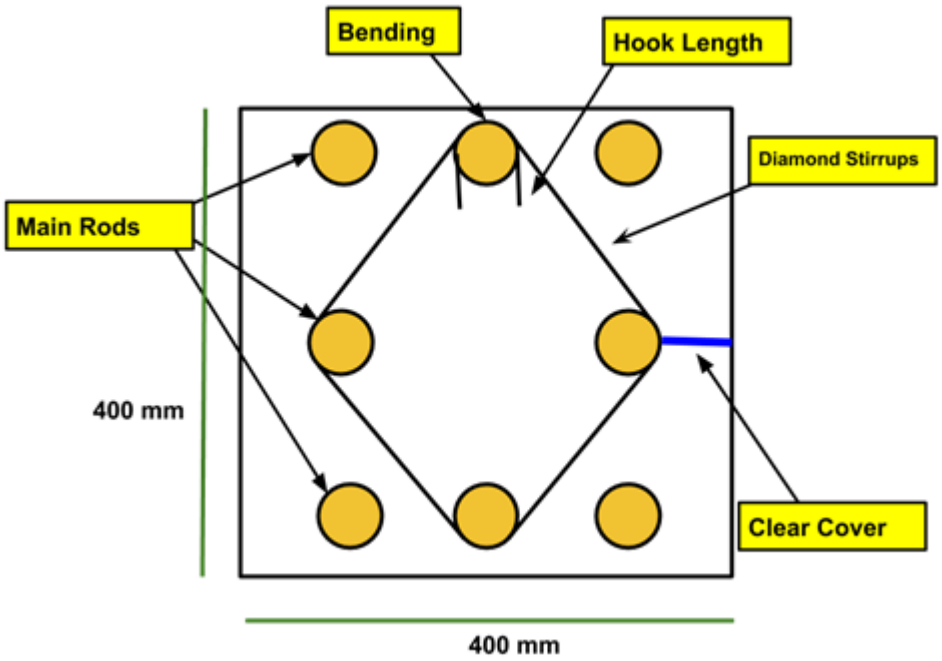
Use the formula,

Total Cutting length of Circular Stirrup or Ring (L) = Circumference of Circular Stirrup + Total Hook length – Total Bend Length

(L) = 2983 mm + 144 mm – 48mm
= 3079 mm 0r, 307.9 cm or 3.079 meter

7) Cutting length of diamond stirrups:

Q) Find the cutting length of diamond stirrups having diameter 8 mm and dimension of column 400mm x 400mm with clear cover 20 mm.



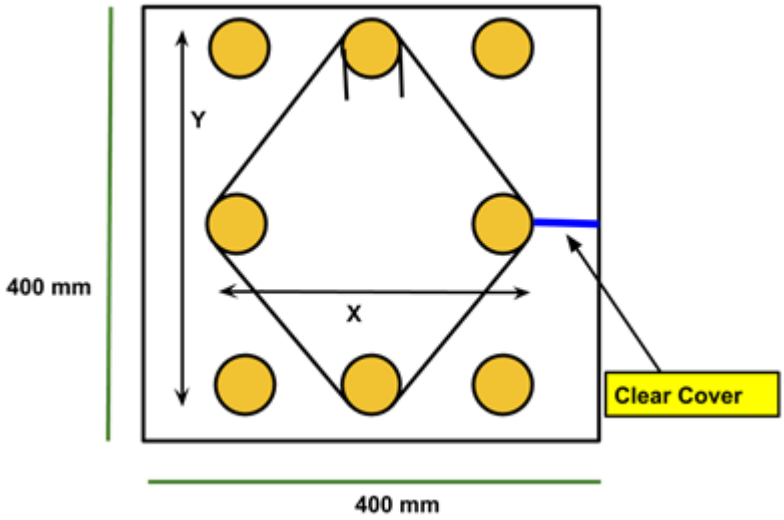
Given,

The dimension of Column = 400m x 400m

The diameter of diamond stirrups = 8 mm

Clear cover = 20 mm

Now,



X = 400 – Clear Cover – Clear cover = 400-20-20 = 360mm
Y = 400 – Clear Cover – Clear cover = 400-20-20 =360mm

From Pythagorean theorem,
Hypotenuse^2=(Opposite)^2 + (Adjacent)^2
$H^2= (x/2)^2 +(y/2)^2$
$H^2= (360/2)^2 + (360/2)^2$
$H^2= (180)^2 + (180)^2$
H= 254.5 mm

From Pythagorean theorem,
Hypotenuse^2=(Opposite)^2 + (Adjacent)^2
$H^2= (x/2)^2 +(y/2)^2$
$H^2= (360/2)^2 + (360/2)^2$
$H^2= (180)^2 + (180)^2$
H= 254.5 mm

Now,

Formula,

Total Cutting length of Diamond Stirrup = Perimeter of Diamond shape + Total Hook length – Total Bend Length

Step:- 1

Perimeter of Diamond shape = 4 x H = 4 x 254.5 = 1016 mm

Step:- 2

Total Hook length = 9d +9d = 18d = 18 x 8 =144 mm

Since, There are two hooks of length 9d.

Step :-3

Total Bend Length = 3 x 90^0 Bend length + 2 x 135^0 Bend length= 3 x 2d + 2 x 3d = 12d = 12 x 8 = 96mm

Since, There are 3 bends which are bent at an angle of 90^0 and 2 bends which are bent at an angle of 135^0

Step:-4

Use Formula,

Total Cutting length of Diamond Stirrup(L) = Perimeter of Diamond shape + Total Hook length – Total Bend Length

(L) = 1016 mm + 144 mm + 96mm

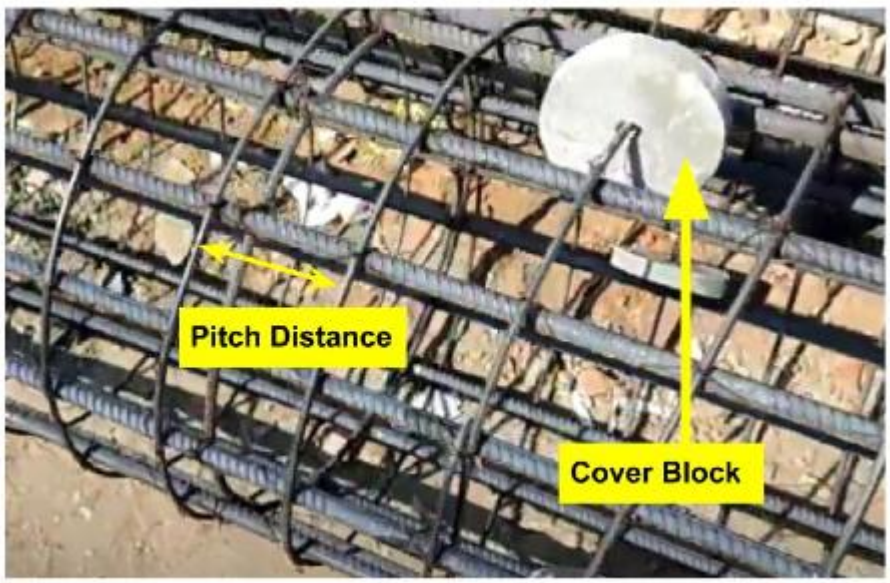
(L) = 1256 mm

Hence, Total cutting length of diamond stirrups is 1256 mm = 125.6 cm or 1.256 meter.

On-Site

8) Cutting length of spiral or helix stirrups:

Q) Calculate the total length of spirals having diameter of spiral bars 8mm and length of the pile 20 m, Pitch or spacing for the spiral bar is 200mm and diameter of the pile is 1m; assume clear cover is 50mm for pile?



Given,

Diameter of pile = 1 meter = 1000mm

Pitch or spacing of spiral bar = 200mm

Length of pile = 20m

Diameter of spiral bar = 8 mm

Clear cover = 50mm

We have,

Diameter of Spiral ring = Diameter of pile – Clear cover – Clear cover = 1000 – 50 – 50 = 900 mm

Formula,

Total Cutting length of spiral bar = Length of the spiral bar + Total length of laps

Step:- 1

Calculate Total length of the spiral bar = no of Spirals x Length of one spiral ring

But,

But,

$$\text{No. of Spiral} = \frac{\text{Length of Piles}}{\text{spacing of pitch}} + 1$$

$$= \frac{20000}{200} + 1$$

$$= 100 + 1$$

$$= 101 \text{ nos}$$

Also,

Length of one spiral ring = = 3.41 x 900 mm = 3069 mm (Where D is Diameter of Spiral.)

Now, Using formula,

Total length of the spiral bar (L) = N.o of Spirals x

Length of one spiral ring

= 101 x 3069

= 309969 mm

Step:-2

Total length of laps = Numbers of laps required x Length of one Lap

Here,

Numbers of laps required = Total length of spirals x

= 309969 mm x = 25.8

= 25.8 say 26 nos.

Also,

Length of one Lap = 50 D = 50 x 8 = 400 mm (Assume)

Now,

Total length of laps = Numbers of laps required x Length of one Lap

Total length of laps = 26 x 400 = 10400 mm

Hence,

Using Formula,

Total Cutting length of spiral bar (Lc) = Length of the spiral bar + Total length of laps

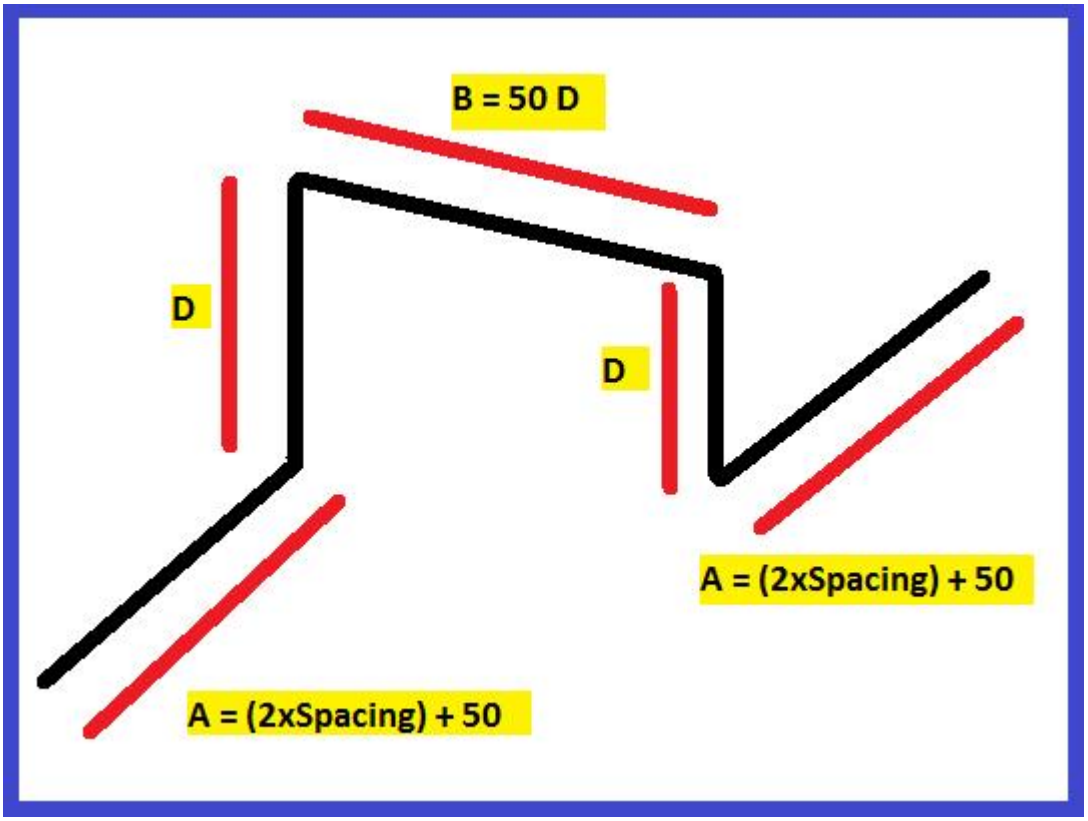
(Lc) = 309969 mm + 10400 mm

(Lc) = 320369 mm

Hence, the total cutting length of Spiral stirrups is 320369 mm = 32036.9 cm or 320.369 meter.

On-Site

9) Cutting length of chair bar



Cutting length of chair bar = 2A + 2D +B – (4 x 90 Bend Length)

Where, A = (2 x spacing) + 50 , and B = 50d

D = Footing height – [(Upper + Lower CC) + (Upper side main & dist bar dia + Lower side main bar dia)]

On-Site

Hence in this way we can calculate cutting length of steel in bar bending schedule.

I hope this article on “how to calculate cutting length in bar bending schedule” remains helpful for you.

Happy Learning – Civil Concept

Contributed by,

Civil Engineer – Ranjeet Sahani

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Size of steel bars used for Construction – Civil Concept

Step by Step- RCC roof Slab steel calculation- Numerical Example