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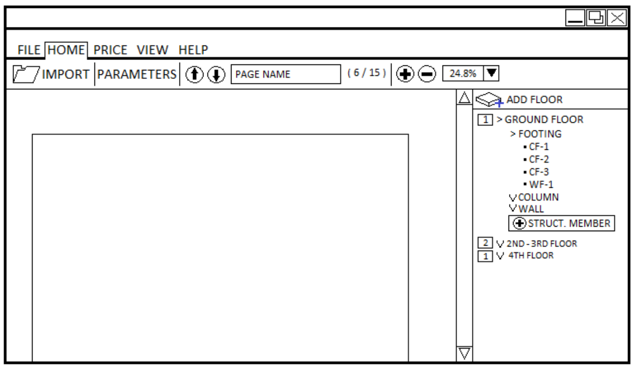
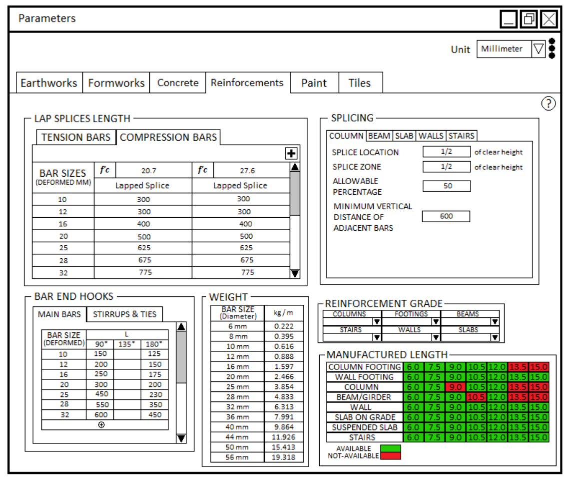
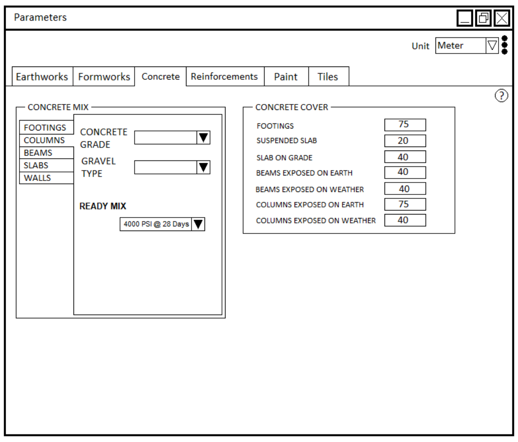
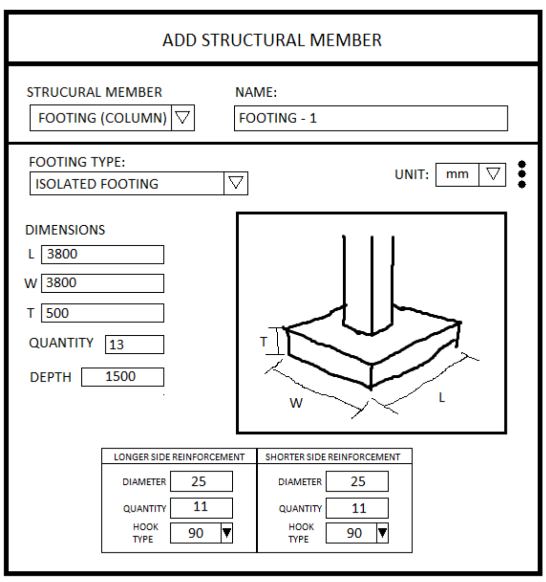
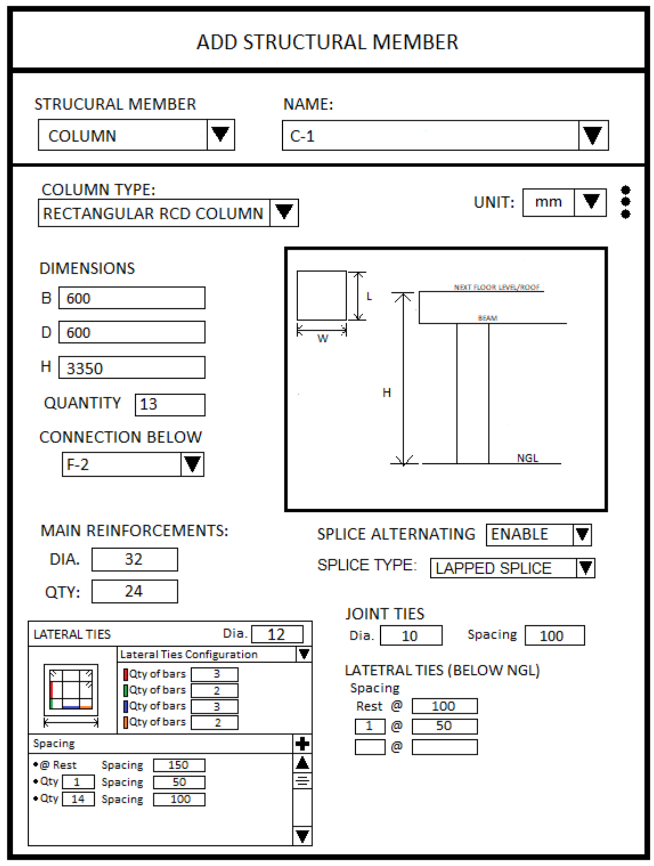


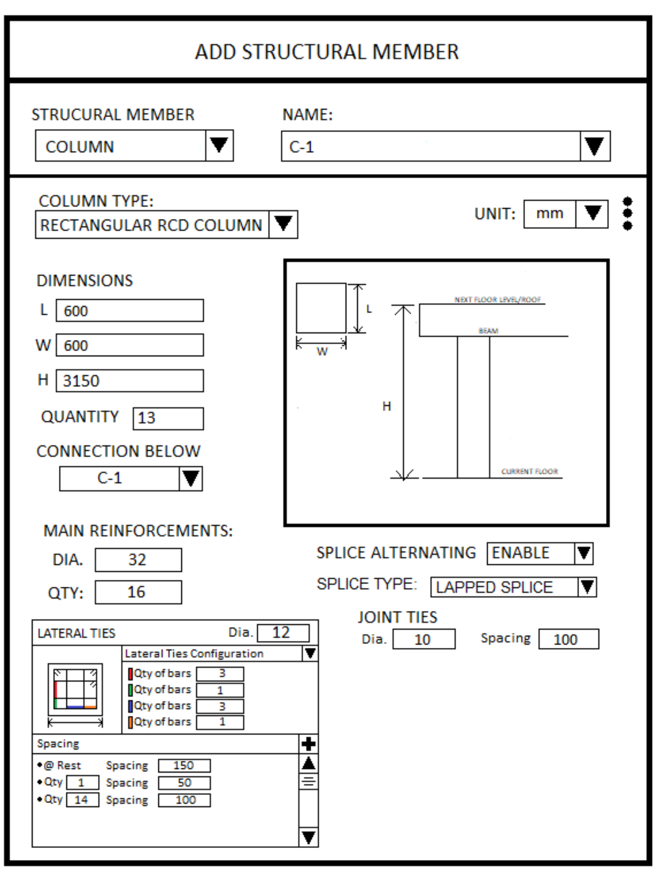




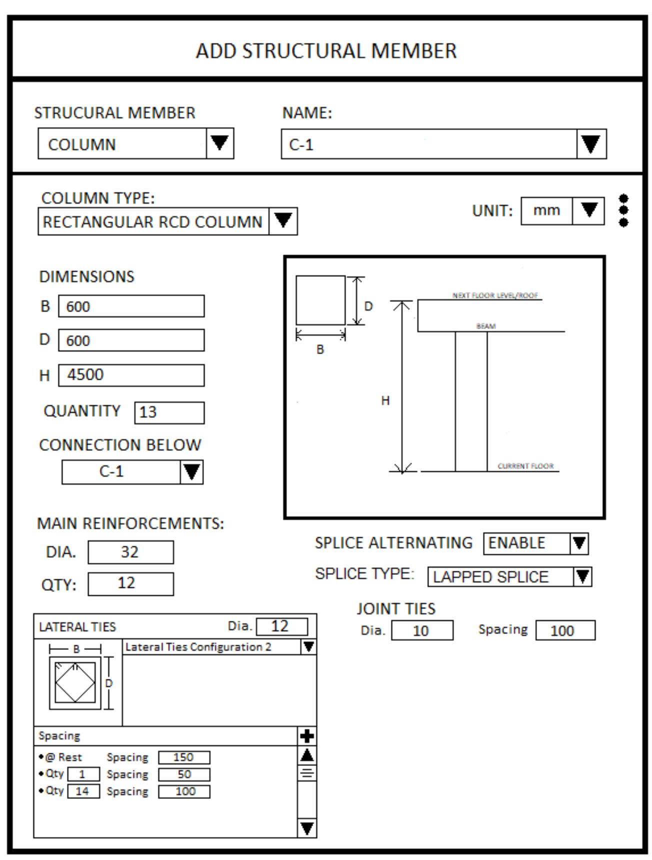




@ GROUND FLOOR



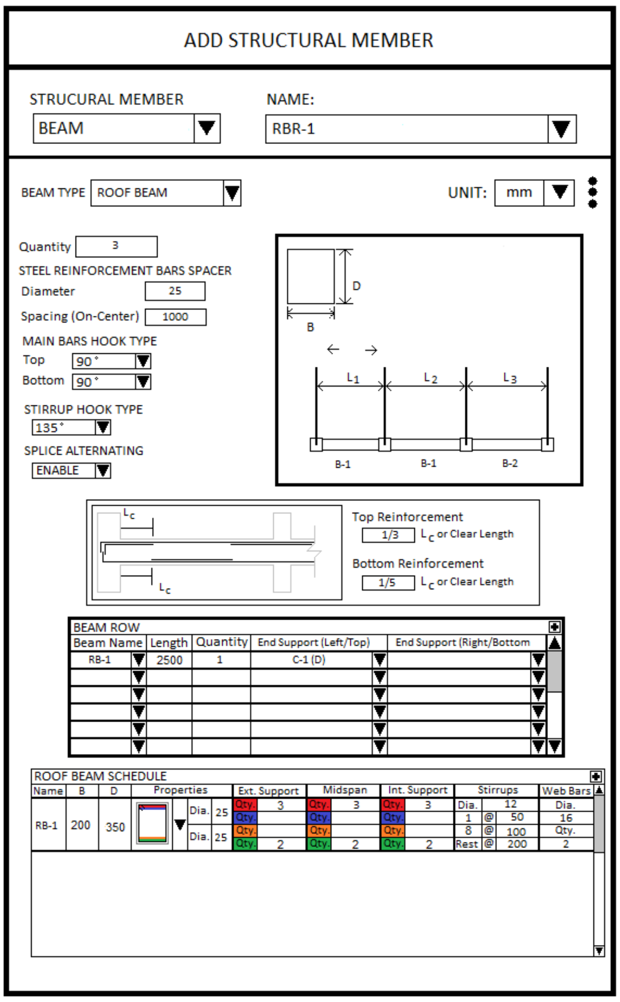
@ 2ND & 3RD FLOOR



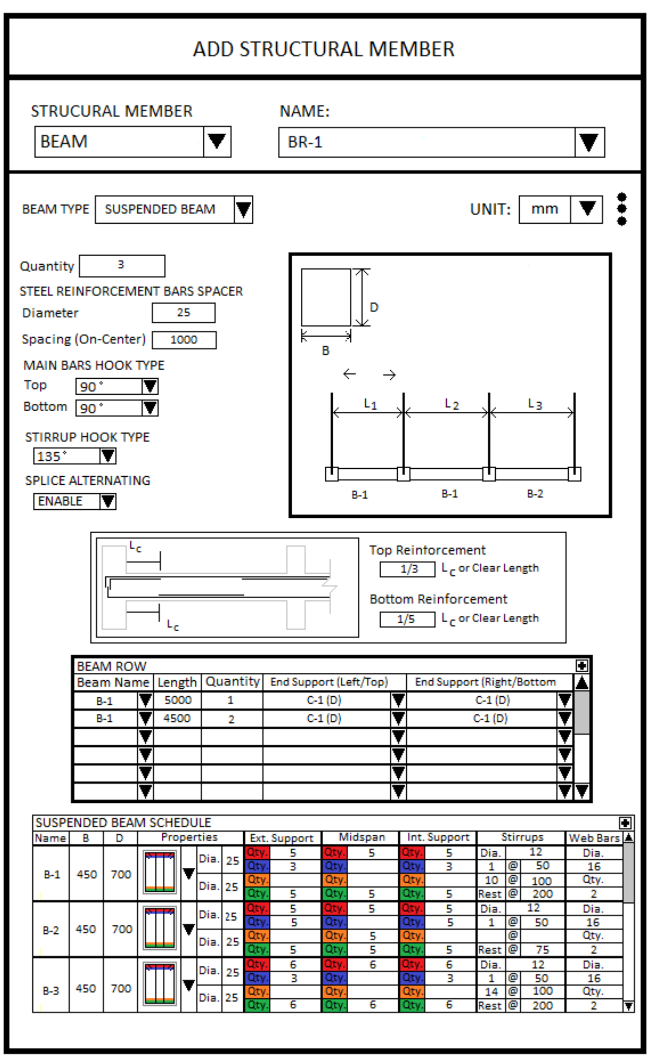
@ 4TH FLOOR

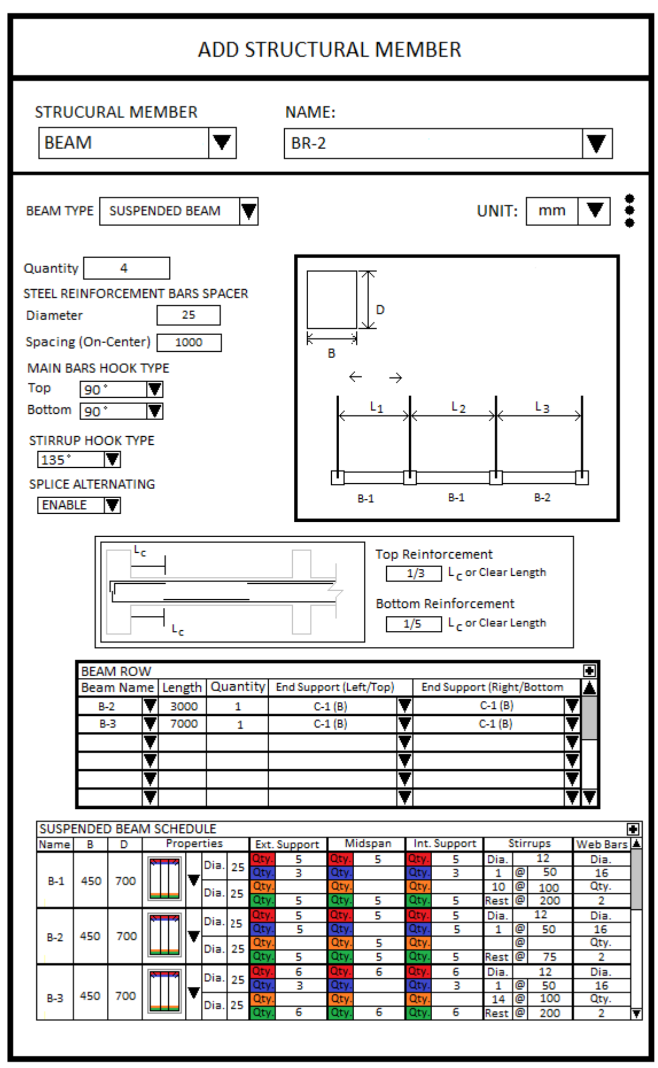
Connected Beams

@ Ground Floor

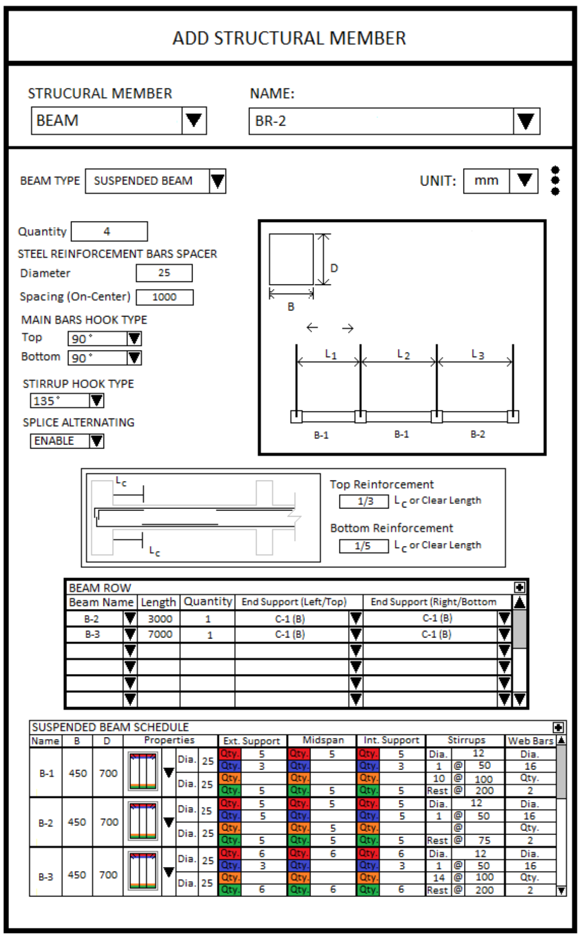


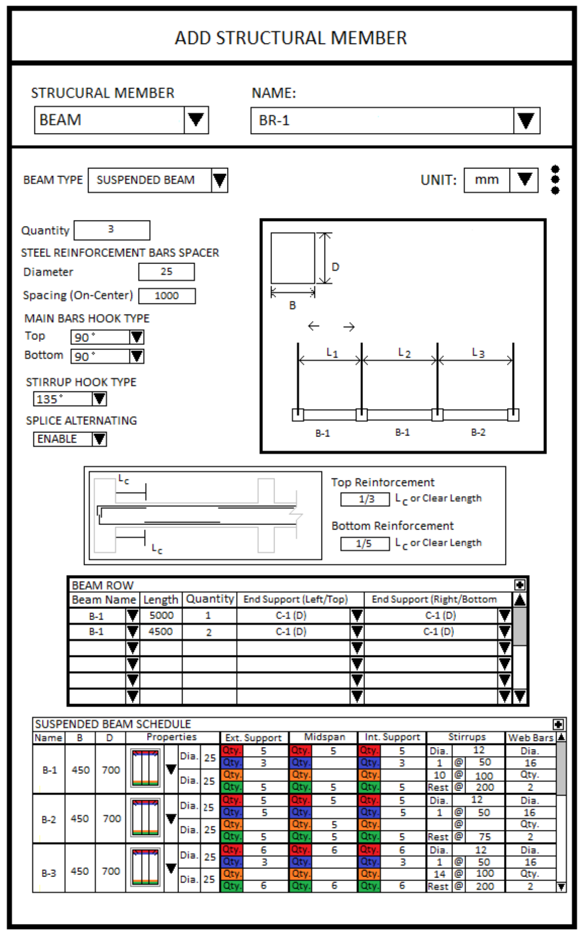
@ 2nd & 3rd Floor

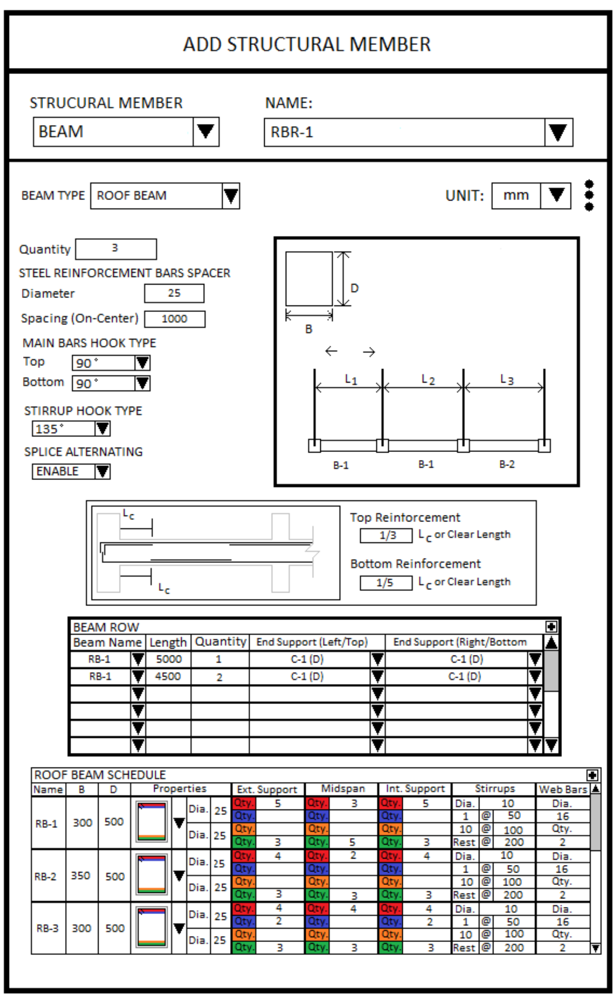


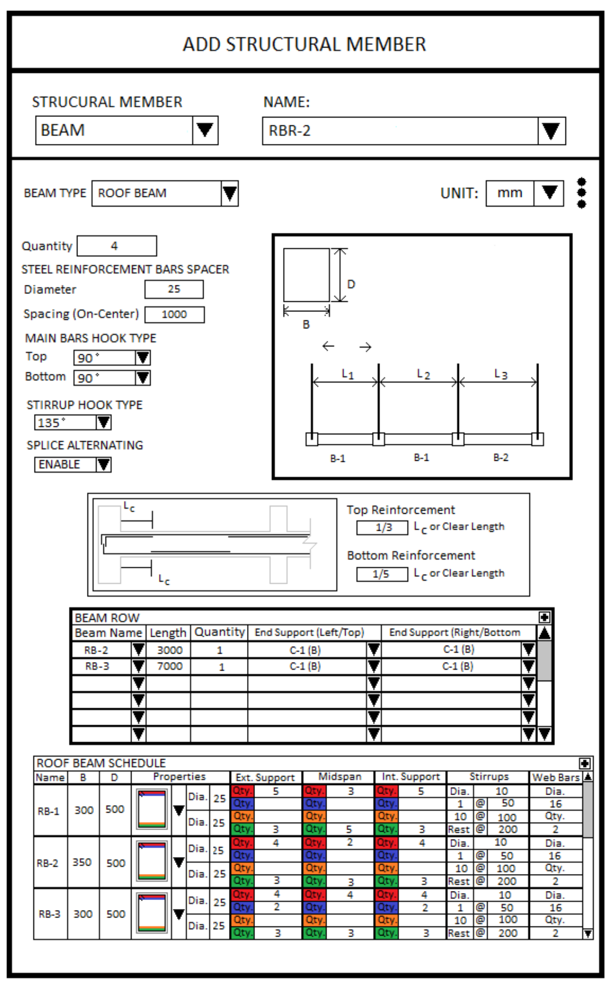


@ 4th Floor









STEPS

1. The program will check the availability of the manufactured bar lengths.

Example: The available manufactured bar lengths (L_M) are 6, 7.5, 10.5, and 12 meters.

2. The program then will check the “connection below” in order to determine the required variables for the column and the n_{TOP}.

Example: @ C – 1

Ground Floor; Connected to F – 2

Second Floor & Third Floor; Connected to C – 1(Ground Floor) - (they are typical)

Fourth Floor; Connected to C – 1(2nd-3rd Floor)

Since C – 1 is connected from Ground Floor to 4th Floor. Thus, $n_{TOP} = 4$

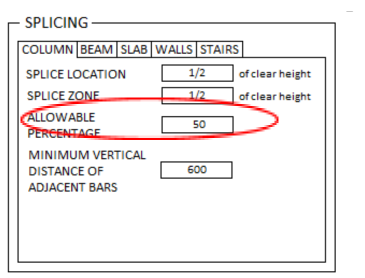
3. Check the allowable percentage and compute the number of floor addition (Z), where it will also represent the first Z floors.

$$Z = \frac{100}{Allowable\ Bars(\%)}$$

Note:

- If $Z < 2$, it must be **round down to whole number**
- If $Z \geq 2$, it must be **round up to whole number**

Example:



$Allowable\ Percentage(\%) = 50$, then. $Z = \frac{100}{50} = 2$

4. The program will then compute the quantity of the reinforcement of each required bar length of their respected set.

LEGEND

Note:

- If is greater than or equal to the maximum (number of floors), thus will be replaced by .
- If the quantity of the bar has a decimal, the quantity of the odd number will be rounded down, while the quantity of the even number will be rounded up

If n is Odd

$$Qty_n\ (Req) = \frac{Allowable\ Bars(\%)\left(Qty_{(n+Z-1)}\right)}{100}$$

Example:

The quantity of column main reinforcement of Ground Floor, 2nd & 3rd Floor, and 4th Floor are 24, 16, and 12 respectively

$$Qty_1\ (Req) = \frac{50\left(Qty_{n+Z-1}\right)}{100} = \frac{50\left(Qty_{1+2-1}\right)}{100} = \frac{50\left(Qty_2\right)}{100} = \frac{50(16)}{100} = 8\ pcs$$

$$Qty_2\ (Req) = \frac{50\left(Qty_{n+Z-1}\right)}{100} = \frac{50\left(Qty_{2+2-1}\right)}{100} = \frac{50\left(Qty_3\right)}{100} = \frac{50(16)}{100} = 8\ pcs$$

$$Qty_3\ (Req) = \frac{50\left(Qty_{n+Z-1}\right)}{100} = \frac{50\left(Qty_{3+2-1}\right)}{100} = \frac{50\left(Qty_4\right)}{100} = \frac{50(12)}{100} = 6\ pcs$$

$$Qty_4\ (Req) = \frac{50\left(Qty_{n+Z-1}\right)}{100} = \frac{50\left(Qty_{4+2-1}\right)}{100} = \frac{50\left(Qty_5\right)}{100} \rightarrow \frac{50\left(Qty_4\right)}{100} = \frac{50(12)}{100} = 6\ pcs$$

5. Then the program will compute the quantity of extra bars.

For $n \leq Z$

- For $Qty_{G(n)}\ (Req)$

If $n < Z$

$$Qty_{G(n)}(Req) = Qty_n - \sum_{1}^{Z} Qty_n(Req) - \sum_{n+1}^{Z} Qty_{G(n)}(Req)$$

If $n = Z$

$$Qty_{G(n)}(Req) = Qty_n - \sum_{1}^{Z} Qty_n(Req)$$

- For $Qty_{A(n)}(Req)$, The program will create a sequence of quantities where it starts from $n + Z$, Where the answers from the previous equation will subtract the current answer

$$Qty_{A(nx)}(Req) = \frac{Qty_n}{Z} - Qty_{(n+Z)}(Req) - \sum_{x=a}^{x} Qty_{A(nx)}(Req)$$

Every computation, the program will check the condition using this equation

If $n < Z$

$$y = Qty_{(n)}(Req) - Qty_{(n+Z)}(Req) - \sum Qty_{A(nx)}(Req)$$

If $n = Z$

$$y = Qty_{(n)}(Req) + Qty_{G(n)}(Req) - Qty_{(n+Z)}(Req) - \sum Qty_{A(nx)}(Req)$$

Note:

- If $y \le 0$, the rest of $Qty_{A(nx)}(Req)$ of the sequence will become zero, and if $(n + Z - m) < n$ then the sequence will stop.
- $x =$ It is an indicator for the sequence, for example: if $x = a$ it means the computation is at floor $n + Z$. And if $x = a$ it means the computation is at floor $n + Z - 1$.
- $\sum_{n+x}^{n+Z} Qty_{A(n)}(Req)$ is the series of $Qty_{A(n)}$ from $n + Z$. And at the beginning of the sequence. This equation will be zero.

For $n > Z$

For $Qty_{A(n)}(Req)$, The program will create a sequence of quantities where it starts from $n + Z$ up to n, Where the answers from the previous equation will subtract the current answer

$$Qty_{A(nx)}(Req) = \frac{Qty_{(n+Z-m)}}{Z} - Qty_{(n+Z)}(Req) - \sum_{x=a}^{x} Qty_{A(nx)}(Req)$$

Every computation, the program will check the condition using this equation

$$y = Qty_{(n)}(Req) + Qty_{A((n-Z)a)}(Req) - Qty_{(n+Z)}(Req) - \sum Qty_{A(n)}(Req)$$

Note:

- $\sum_{n+Z+1-m}^{n+Z} Qty_{A(n)}(Req)$ is the series of $Qty_{A(n)}$ from $n + Z$. And at the beginning of the sequence. This equation will be zero.
- If $(n + z) \ge n_{TOP}$, thus n_{TOP} will replace $n + z$

Example:

- For $Qty_1\,(Ground\ Floor)\ 2 = 2 \therefore n = Z$

$$Qty_{G(1)}(Req) = Qty_1 - \sum_{1}^{2} Qty_n(Req) - \sum_{1+1}^{2} Qty_{G(n)}(Req)$$

$$Qty_{G(1)}(Req) = Qty_1 - \sum_{1}^{2} Qty_n(Req) - \left[Qty_2 - \sum_{1}^{2} Qty_n(Req)\right]$$

$$Qty_{G(1)}(Req) = 24 - [8 + 8] - [16 - (8 + 8)]$$

$$Qty_{G(1)}(Req) = 8\, pcs$$

The sequence starts from $(n + Z - 0) = (1 + 2 - 0) = 3$

Since the is at , then this equation will be zero.

$$Qty_{A(1a)}\,(Req) = \frac{Qty_{(n+Z-m)}}{Z} - Qty_1(Req) - \sum_{n+Z+1-m}^{n+Z} Qty_{A(n)}(Req)$$

$$Qty_{A(1a)}\,(Req) = \frac{Qty_{1+2-0}}{Z} - Qty_1(Req) - (0)$$

$$Qty_{A(1a)}\,(Req) = \frac{16}{2} - 6 - (0) = 2$$

Checking:

$$y_a = Qty_{(n)}(Req) - Qty_{(n+Z)}(Req) - \sum Qty_{A(nx)}(Req)$$

$$y_a = Qty_{(1)}(Req) - Qty_{(1+2)}(Req) - \sum Qty_{A(nx)}(Req)$$

$y_a = 8 - 6 - 2 = 0$, Since $y = 0$, the succeeding $Qty_{A(1x)}\,(Req)$ will be equal to **zero**.

Succeeding $Qty_{A(1x)}$

$@\,(n + Z - 1) = (1 + 2 - 1) = 2{:}\quad Qty_{A(1b)}\,(Req) = 0$

$@\,(n + Z - 2) = (1 + 2 - 2) = 1{:}\quad Qty_{A(1c)}\,(Req) = 0$

$@\,(n + Z - 3) = (1 + 2 - 3) = 0{:}\quad Since\ (n + Z - m) < n\ the\ sequence\ will\ stop$

- For $Qty_2\,(2nd\ Floor)$. $2 = 2 \therefore n = Z$

$$Qty_{G(2)}(Req) = Qty_2 - \sum_{1}^{2} Qty_n(Req) = 16 - [8 + 8] = 0$$

Since the is at , then this equation will be zero.

$@\,(n + Z - 0) = (2 + 2 - 0) = 4{:}\ Qty_{A(2a)}\,(Req)$

$$Qty_{A(2a)}\,(Req) = \frac{Qty_{(n+Z-m)}}{Z} - Qty_{(n+Z)}(Req) - \sum_{x=a}^{x} Qty_{A(nx)}(Req)$$

$$Qty_{A(2a)}\,(Req) = \frac{Qty_{(2+2-0)}}{Z} - Qty_{(2+2)}(Req) - (0)$$

$$Qty_{A(2a)}\,(Req) = \frac{12}{2} - 6 - 0 = 0$$

Checking:

$$y_a = Qty_{(2)}(Req) + Qty_{G(2)}\,(Req) - Qty_{(2+2)}(Req) - \sum Qty_{A(2x)}(Req)$$

$$y_a = 8 + 0 - 6 - (0) = 2 \therefore The\ Succeeding\ Qty_{A(4x)}(Req) \neq 0$$

$@\,(n + Z - 1) = (2 + 2 - 1) = 3{:}\ Qty_{A(2b)}\,(Req)$

$$Qty_{A(2b)}\,(Req) = \frac{Qty_{(2+2-1)}}{2} - Qty_{(2+2)}(Req) - \sum_{x=a}^{a} Qty_{A(nx)}(Req)$$

$$Qty_{A(2b)}\,(Req) = \frac{Qty_{(3)}}{2} - Qty_{(4)}(Req) - \left(Qty_{A(2a)}\,(Req)\right)$$

$Qty_{A(2b)}\,(Req) = \frac{16}{2} - 6 - (0) = 2$

Checking:

$$y_b = Qty_{(2)}(Req) + Qty_{G(2)}\,(Req) - Qty_{(2+2)}(Req) - \sum Qty_{A(2x)}(Req)$$

$$y_b = Qty_{(2)}(Req) + Qty_{G(2)}\,(Req) - Qty_{(4)}(Req) - \left(Qty_{A(2a)}(Req) + Qty_{A(2b)}(Req)\right)$$

$y_b = 8 + 0 - 6 - (0 + 2) = 0$, Since$y_b = 0$, the succeeding $Qty_{A(2x)}\,(Req)$ will be equal to **zero**.

Succeeding $Qty_{A(2x)}$

$@\,(n + Z - 2) = (2 + 2 - 2) = 2{:}\, Qty_{A(2c)}\,(Req) = 0$

$@\,(n + Z - 3) = (2 + 2 - 3) = 1{:}\ \mathit{Since}\ (n + Z - 3) < n,\ \mathit{thus\ the\ sequence\ will\ stop.}$

- For $Qty_3\,(3rd\ Floor).\ 3 > 2 \therefore n > Z$

$@\,(n + Z - 0) = (3 + 2 - 0) = 5{:}\quad Qty_{A(3a)}\,(Req)$

$$Qty_{A(3a)}\,(Req) = \frac{Qty_{(n+Z-m)}}{Z} - Qty_{(n+Z)}(Req) - \sum_{x=a}^{x} Qty_{A(3x)}(Req)$$

Since the is at , then this equation will be zero.

$$Qty_{A(3a)}\,(Req) = \frac{Qty_{(3+2-0)}}{Z} - Qty_{(3+2)}(Req) - 0$$

$$Qty_{A(3a)}\,(Req) = \frac{Qty_{(4)}}{Z} - Qty_{(4)}(Req) - 0 \qquad \mathit{Since}\ (n + Z) > n_{TOP}$$

$$Qty_{A(3a)}\,(Req) = \frac{12}{2} - 6 - 0 = 0$$

Checking:

$$y_a = Qty_{(3)}(Req) + Qty_{A((3-2)a)}\,(Req) - Qty_{(3+2)}(Req) - \sum Qty_{A(3x)}(Req) y_a = Qty_{(3)}(Req) + Qty_{A(1a)}\,(Req) - Qty_{(4)}(Req$$

$$y_a = 6 + 2 - 6 - \left(Qty_{A(3a)}(Req)\right) = 6 + 2 - 6 - (0) = 2 \therefore \mathit{The\ Succeeding}\ Qty_{A(3x)}(Req) \neq 0$$

$@\,(n + Z - 1) = (3 + 2 - 1) = 4{:}\quad Qty_{A(3b)}\,(Req)$

$$Qty_{A(3b)}\,(Req) = \frac{Qty_{(3+2-1)}}{Z} - Qty_{(3+2)}(Req) - \sum_{x=a}^{a} Qty_{A(3x)}(Req)$$

$$Qty_{A(3b)}\,(Req) = \frac{Qty_{(4)}}{2} - Qty_{(4)}(Req) - \left(Qty_{A(3a)}(Req)\right) \qquad \mathit{Since}\ (n + Z) > n_{TOP}$$

$$Qty_{A(3b)}\,(Req) = \frac{12}{2} - 6 - (0) = 0$$

Checking:

$$y_b = Qty_{(3)}(Req) + Qty_{A((3-2)a)}\,(Req) - Qty_{(3+2)}(Req) - \sum Qty_{A(3x)}(Req)$$

$$y_b = Qty_{(3)}(Req) + Qty_{A(1a)}\,(Req) - Qty_{(4)}(Req) - \sum Qty_{A(3x)}(Req)$$

$$y_b = 6 + 2 - 6 - (0 + 0) = 2 \therefore \mathit{The\ Succeeding}\ Qty_{A(3x)}(Req) \neq 0$$

$@\,(n + Z - 2) = (3 + 2 - 2) = 3{:}\quad Qty_{A(3c)}\,(Req)$

$$Qty_{A(3c)}\,(Req) = \frac{Qty_{(3+2-2)}}{Z} - Qty_{(3+2)}(Req) - \sum_{x=a}^{b} Qty_{A(3x)}(Req)$$

$$Qty_{A(3c)}\,(Req) = \frac{Qty_{(3)}}{2} - Qty_{(4)}(Req) - \left(Qty_{A(3a)}(Req) + Qty_{A(3b)}(Req)\right) \qquad \mathit{Since}\ (n + Z) > n_{TOP}$$

$Qty_{A(3c)}(Req) = \frac{18}{2} - 6 - (0 + 0) = 2$

Checking:

$y_c = Qty_{(3)}(Req) + Qty_{A((3-2)a)}(Req) - Qty_{(3+2)}(Req) - \sum Qty_{A(3x)}(Req)$

$y_c = 6 + 2 - 6 - (0 + 0 + 2) = 0$, Since $y_c = 0$, the succeeding $Qty_{A(3x)}(Req)$ will be equal to **zero**

The Succeeding $Qty_{A(3x)}(Req)$:

$@\ (n + Z - 3) = (3 + 2 - 3) = 2:\ Since\ (n + Z - 3) < n,\ thus\ the\ sequence\ will\ stop.$

- For $Qty_4\ (4th\ Floor)$

$@\ (n + Z - 0) = (4 + 2 - 0) = 6:\quad Qty_{A(4a)}(Req)$

$Qty_{A(4a)}(Req) = \frac{Qty_{(4+2-0)}}{Z} - Qty_{(4+2)}(Req) - \sum_{x=a}^{x} Qty_{A(4x)}(Req)$

Since the is at , then this equation will be zero.

$Qty_{A(4a)}(Req) = \frac{Qty_{(4)}}{Z} - Qty_{(4)}(Req) - 0$

$Qty_{A(4a)}(Req) = \frac{12}{2} - 6 = 0$

Checking:

$y_a = Qty_{(4)}(Req) + Qty_{A((4-2)a)}(Req) - Qty_{(4+2)}(Req) - \sum Qty_{A(4x)}(Req)$

$y_a = 6 + 2 - 6 - (0) = 2 \therefore The\ Succeeding\ Qty_{A(4x)}(Req) \neq 0$

$@\ (n + Z - 1) = (4 + 2 - 1) = 5:\quad Qty_{A(4b)}(Req)$

$Qty_{A(4b)}(Req) = \frac{Qty_{(4+2-0)}}{Z} - Qty_{(4+2)}(Req) - \sum_{x=a}^{a} Qty_{A(3x)}(Req)$

$Qty_{A(4b)}(Req) = \frac{Qty_{(4)}}{Z} - Qty_{(4)}(Req) - \left(Qty_{A(3a)}(Req)\right)$

$Qty_{A(4b)}(Req) = \frac{12}{2} - 6 - (0) = 0$

Checking:

$y_b = Qty_{(4)}(Req) + Qty_{A((4-2)a)}(Req) - Qty_{(4+2)}(Req) - \sum Qty_{A(4x)}(Req)$

$y_b = 6 + 2 - 6 - (0 + 0) = 2 \therefore The\ Succeeding\ Qty_{A(4x)}(Req) \neq 0$

$@\ (n + Z - 2) = (4 + 2 - 2) = 4:\quad Qty_{A(4c)}(Req)$

$Qty_{A(4c)}(Req) = \frac{Qty_{(4+2-2)}}{Z} - Qty_{(4+2)}(Req) - \sum_{x=a}^{b} Qty_{A(3x)}(Req)$

$Qty_{A(4c)}(Req) = \frac{Qty_{(4)}}{Z} - Qty_{(4)}(Req) - \left(Qty_{A(3a)}(Req) + Qty_{A(3b)}(Req)\right)$

$Qty_{A(4c)}(Req) = \frac{12}{2} - 6 - (0 + 0) = 0$

Checking:

$y_b = Qty_{(4)}(Req) + Qty_{A((4-2)a)}(Req) - Qty_{(4+2)}(Req) - \sum Qty_{A(4x)}(Req)$

$y_b = 6 + 2 - 6 - (0 + 0 + 0) = 2 \therefore The\ Succeeding\ Qty_{A(4x)}(Req) \neq 0$

$@\ (n + Z - 2) = (4 + 2 - 2) = 4:\ Since\ (n + Z - 3) < n,\ thus\ the\ sequence\ will\ stop.$

6. The program will check if the difference of the columns effective dimension of the current floor to the floor below. [$CC_{cw} = Column\ Concrete\ Cover\ exposed\ to\ weather$]

$$Dim_{B(n)} = (B_{n+1} - CC_{cw}) - (B_n - CC_{cw})$$

$$Dim_{D(n)} = (D_{n+1} - CC_{cw}) - (D_n - CC_{cw})$$

Example:

Dimensions; @Ground Floor (D = 600, B = 600), @2nd & 3rd Floor (D = 600, B = 600), and @4th Floor (D = 600, B = 600).

- For Ground Floor:

$$Dim_{D(1)} = (D_{1+1} - CC_{cw}) - (D_1 - CC_{cw}) = (600 - 40) - (600 - 40) = 0$$

$$Dim_{B(1)} = (B_{1+1} - CC_{cw}) - (B_1 - CC_{cw}) = (600 - 40) - (600 - 40) = 0$$

- For 2nd Floor

$$Dim_{D2} = \left(D_{2+1} - CC_{cw}\right) - \left(D_2 - CC_{cw}\right) = (600 - 40) - (600 - 40) = 0$$

$$Dim_{B2} = (B_{2+1} - CC_{cw}) - (B_2 - CC_{cw}) = (600 - 40) - (600 - 40) = 0$$

- For 3rd Floor

$$Dim_{D3} = \left(D_{3+1} - CC_{cw}\right) - \left(D_3 - CC_{cw}\right) = (600 - 40) - (600 - 40) = 0$$

$$Dim_{B2} = \left(B_{3+1} - CC_{cw}\right) - \left(B_3 - CC_{cw}\right) = (600 - 40) - (600 - 40) = 0$$

7. The program will determine the largest depth of the **suspended beam** and **roof beam** that is connected to the column

Note:

- The indicator that the particular beam is connected to the column is if the column is selected as a support on the beam. As shown in this picture.

- If the column of the current floor both have *Suspended* and *Roof Beam*, thus they will be compared

Like @ Ground Floor there is a Roof Beam (RB-1) with D=400 and @ 2nd Floor there is a Suspended Beam (B-1) with D=700, Since D=400< D=700, thus B-1 will be chosen.

Example:

@ Ground Floor: B-1 ($D = 700$), B-2 ($D = 700$), B-3 ($D = 700$), and RB-1 ($D = 350$)

@ 2nd Floor: B-1 ($D = 700$), B-2 ($D = 700$), and B-3 ($D = 700$).

@ 3rd Floor: B-1 ($D = 700$), B-2 ($D = 700$), and B-3 ($D = 700$)

@ 4th Floor: RB-1($D = 300$), RB-2 ($D = 350$), and RB-3 ($D = 300$)

Thus,

@ Ground Floor: $Dim_{Beam(1)} = 700\ mm$

@ 2nd Floor: $Dim_{Beam(2)} = 700\ mm$

@ 3rd Floor; $Dim_{Beam(3)} = 700\ mm$

@ 4th Floor; $Dim_{Beam(4)} = 350\ mm$

8. The program will then compute the Diagonal Length of the column on their respective floors.

Legend:

a) If $n < n_{Top}$

$$L_D = \sqrt{\left(Dim_{Dn}\right)^2 + \left(Dim_{Bn}\right)^2 + \left(Dim_{Beam(n)}\right)^2}$$

b) If $n = n_{Top}$

$$L_D = \frac{B_n - 2CC_{CW} - 2d_t}{2} - CC_{CW} - R_L$$

Where R_L:

Case 1: $d_{Mb} = 10\ mm \rightarrow 25\ mm$

$$R_L = 2.5d_{Mb}$$

Case 2: $d_{Mb} = 28\ mm \rightarrow 36\ mm$

$$R_L = 3d_{Mb}$$

Case 2: $d_{Mb} = 40\ mm \rightarrow 56\ mm$

$$R_L = 3.5d_{Mb}$$

Example:

For Ground Floor

Since the $Hook\ Type$: 90° and the diameter of main reinforcement is $32\ mm$, Thus

$$L_{D(1)} = \sqrt{\left(Dim_{D1}\right)^2 + \left(Dim_{B1}\right)^2 + \left(Dim_{Beam(1)}\right)^2} = \sqrt{(0)^2 + (0)^2 + (700)^2} = 700$$

For 2nd Floor

$$L_{D(2)} = \sqrt{\left(Dim_{D2}\right)^2 + \left(Dim_{B2}\right)^2 + \left(Dim_{Beam(2)}\right)^2} = \sqrt{(0)^2 + (0)^2 + (700)^2} = 700$$

For 3rd Floor

$$L_{D(3)} = \sqrt{\left(Dim_{D3}\right)^2 + \left(Dim_{B3}\right)^2 + \left(Dim_{Beam(3)}\right)^2} = \sqrt{(0)^2 + (0)^2 + (700)^2} = 700$$

For 4th Floor

Since the bar diameter (d_{Mb}) is 32 mm. Thus,

$$R_L = 3d_{Mb} = 3(32) = 96$$

$$L_{D(4)} = \frac{B_4 - 2CC_{CW} - 2d_t}{2} - CC_{CW} - R_L = \frac{600 - 2(40) - 2(10)}{2} - 40 - 96 = 114$$

9. The program then will compute the clear height of the column in its respected floor

$$H_C = H_n - Dim_{Beam(n)}$$

Example:

For Ground Floor

$$H_{C1} = H_1 - D_{Beam(1)} = 3350 - 700 = 2650\ mm$$

For 2nd Floor

$$H_{C2} = H_2 - D_{Beam(2)} = 3150 - 700 = 2450\ mm$$

For 3rd Floor

$$H_{C3} = H_3 - D_{Beam(3)} = 3150 - 700 = 2450\ mm$$

4th Floor

$$H_C = Hn - D_{Beam(4)} = 4500 - 350 = 4150\ mm$$

10. The program will determine the Splice Length.

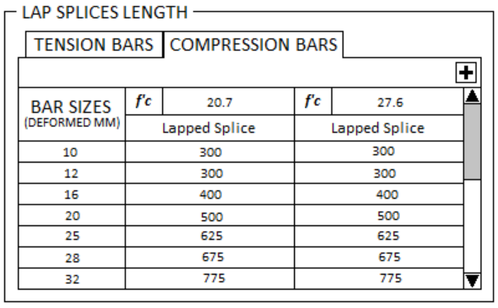
Case 1: The Splice Type is **Mechanical** or **Welded Splice (Butt)**

$$S_L = 0$$

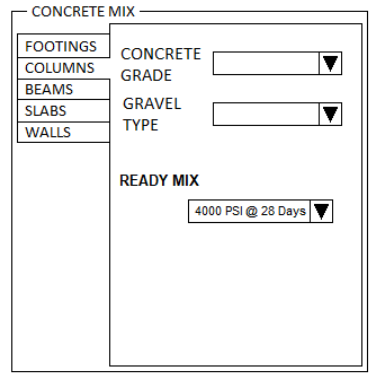
Case 2: The Splice Type is **Lapped Splice** or **Welded Splice (Lapped)**

$$S_L = (Based\ on\ the\ table\ @\ Compression)$$

Example:



BAR SIZES (DEFORMED MM)	f'c 20.7 Lapped Splice	f'c 27.6 Lapped Splice
10	300	300
12	300	300
16	400	400
20	500	500
25	625	625
28	675	675
32	775	775



The $Concrete\ Strength\ (f'c) = 4000\ psi\ or\ 27.6$

For Ground Floor

The Splice Type is **Lapped Splice** and main rebar diameter is $32\ mm$

$$S_{L(1)} = 775\ mm$$

For 2nd Floor

The Splice Type is **Lapped Splice** and main rebar diameter is $32\ mm$

$$S_{L(2)} = 775\ mm$$

For 3rd Floor

The Splice Type is **Lapped Splice** and main rebar diameter is $32\ mm$

$$S_{L(3)} = 775\ mm$$

For 4th Floor

The Splice Type is **Lapped Splice** and main rebar diameter is $32\ mm$

$$S_{L(4)} = 775\ mm$$

11. The program first determines the Effective Length

LEGEND:

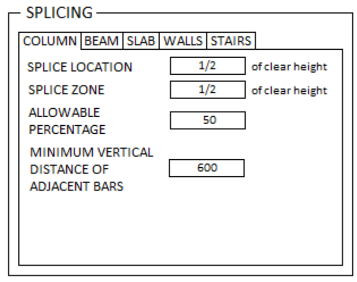
If the $Splice\ Alternating\ is$ **Enable**, then;

$$E_{Dn} = \left(1 - S_{LOC}\right)H_C - \frac{S_L}{2}$$

If the $Splice\ Alternating\ is$ **Disable**, then;

$$E_{Dn} = \left(1 - S_{LOC}\right)H_C + \frac{D_A}{2}$$

Example:



For Ground Floor: $Splice\ Alternating\ is$ **Enable**

$$E_{D(1)} = \left(1 - S_{LOC}\right)H_{C(1)} - \frac{S_{L(1)}}{2} = \left(1 - \frac{1}{2}\right)(2650) - \frac{775}{2} = 937.5$$

For 2nd Floor: $Splice\ Alternating\ is$ **Enable**

$$E_{D(2)} = \left(1 - S_{LOC}\right)H_{C(2)} - \frac{S_{L(2)}}{2} = \left(1 - \frac{1}{2}\right)(2450) - \frac{775}{2} = 837.5$$

For 3rd Floor: $Splice\ Alternating\ is$ **Enable**

$$E_{D(3)} = \left(1 - S_{LOC}\right)H_{C(3)} - \frac{S_{L(3)}}{2} = \left(1 - \frac{1}{2}\right)(2450) - \frac{775}{2} = 837.5$$

For 4th Floor: $Splice\ Alternating\ is$ **Enable**

$$E_{D(4)} = \left(1 - S_{LOC}\right)H_{C(4)} - \frac{S_{L(4)}}{2} = \left(1 - \frac{1}{2}\right)(4150) - \frac{775}{2} = 1687.5$$

12. the program then, will compute the required length for $Qty_n\ (Req)$.

(Must be converted into meter)

Legend: [must be based on the table in the parameters

If $n_{Top} = 1$

$$L_B\ of\ Qty_n\ (Req) = H_{C(n)} + L_{D(n)} + D_F + L_{H(90°)} - d_{bs} - d_{bl} - CC_F$$

If $n_{Top} > 1$

If the $Splice\ Alternating\ is$ **Enable**

- Case 1: $n \le Z$ and $n < \left(n_{Top} - Z + 1\right)$

$$L_B\ of\ Qty_n\ (Req) = \left[\sum_{1}^{n} H_{C(n)}\right] + \left[\sum_{0}^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} - E_{Dn} - d_{bs} - d_{bl} - CC_F$$

- Case 2: $n \le Z$ and $n \ge \left(n_{Top} - Z + 1\right)$

$$L_{B(a)}\ of\ Qty_n\ (Req) = \left[\sum_{1}^{n} H_{C(n)}\right] + \left[\sum_{0}^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} - E_{Dn} - d_{bs} - d_{bl} - CC_F$$

$$L_{B(b)}\ of\ Qty_n\ (Req) = \left[\sum_{n}^{n_{Top}} H_{C(n)}\right] + \left[\sum_{n}^{n_{Top}} L_{D(n)}\right] + E_{Dn} + S_{L(n)} - H_{C(n)}$$

And if $\left[L_{B(a)}\ of\ Qty_n\ (Req) + L_{B(b)}\ of\ Qty_n\ (Req) - 2S_{Ln}\right] \le Largest\ L_M$. $L_{B(c)}\ of\ Qty_n\ (Req)$ will replace both $L_{B(a)}\ of\ Qty_n\ (Req)$ and $L_{B(b)}\ of\ Qty_n\ (Req)$, Where.

$$L_{B(c)}\ of\ Qty_n\ (Req) = L_{B(a)}\ of\ Qty_n\ (Req) + L_{B(b)}\ of\ Qty_n\ (Req) - S_{Ln}$$

- Case 3: $n > Z$ and $n < \left(n_{Top} - Z + 1\right)$

$$L_B \; of \; Qty_n \; (Req) = \left[\sum_{n-Z+1}^{n} H_{C(n)}\right] + \left[\sum_{n-Z}^{n-1} L_{D(n)}\right] + E_{D(n-Z)} + S_{L(n-Z)} - E_{Dn}$$

- Case 4: $n > Z$ and $n \geq \left(n_{Top} - Z + 1\right)$

$$L_{B(a)} \; of \; Qty_n \; (Req) = \left[\sum_{n-Z+1}^{n} H_{C(n)}\right] + \left[\sum_{n-Z}^{n-1} L_{D(n)}\right] + E_{D(n-Z)} + S_{L(n-Z)} - E_{Dn}$$

$$L_{B(b)} \; of \; Qty_n \; (Req) = \left[\sum_{n}^{n_{Top}} H_{C(n)}\right] + \left[\sum_{n}^{n_{Top}} L_{D(n)}\right] + E_{Dn} + S_{L(n)} - H_{C(n)}$$

And if $\left[L_{B(a)} \; of \; Qty_n \; (Req) + L_{B(b)} \; of \; Qty_n \; (Req) - 2S_{Ln}\right] \leq Largest \; L_M$. $L_{B(c)} \; of \; Qty_n \; (Req)$ will replace both $L_{B(a)} \; of \; Qty_n \; (Req)$ and $L_{B(b)} \; of \; Qty_n \; (Req)$, Where.

$$L_{B(c)} \; of \; Qty_n \; (Req) = L_{B(a)} \; of \; Qty_n \; (Req) + L_{B(b)} \; of \; Qty_n \; (Req) - S_{Ln}$$

If the $Splice \; Alternating \; is$ **Disable**

- Case 1: $n \leq Z$ and $n < \left(n_{Top} - Z + 1\right)$

$$L_{B(a)} \; of \; Qty_a \; (Req) = \left[\sum_{1}^{n} H_{C(n)}\right] + \left[\sum_{0}^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} - E_{Dn} - d_{bs} - d_{bl} - CC_F$$

$$L_{B(b)} \; of \; Qty_a \; (Req) = \left[\sum_{1}^{n} H_{C(n)}\right] + \left[\sum_{0}^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} - E_{Dn} + S_{Ln} + D_A - d_{bs} - d_{bl} - CC_F$$

Case 2: $n \leq Z$ and $n \geq \left(n_{Top} - Z + 1\right)$

$$L_{B(a)} \; of \; Qty_a \; (Req) = \left[\sum_{1}^{n} H_{C(n)}\right] + \left[\sum_{0}^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} - E_{Dn} - d_{bs} - d_{bl} - CC_F$$

$$L_{B(b)} \; of \; Qty_a \; (Req) = \left[\sum_{1}^{n} H_{C(n)}\right] + \left[\sum_{0}^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} + S_{Ln} + D_A - E_{Dn} - d_{bs} - d_{bl} - CC_F$$

$$L_{B(c)} \; of \; Qty_n \; (Req) = \left[\sum_{n}^{n_{Top}} H_{C(n)}\right] + \left[\sum_{n}^{n_{Top}} L_{D(n)}\right] + E_{Dn} + S_{Ln} - H_{C(n)}$$

$$L_{B(d)} \; of \; Qty_n \; (Req) = \left[\sum_{n}^{n_{Top}} H_{C(n)}\right] + \left[\sum_{n}^{n_{Top}} L_{D(n)}\right] + E_{Dn} - D_A - H_{C(n)}$$

And if $\left[L_{B(a)} \; of \; Qty_n \; (Req) + L_{B(c)} \; of \; Qty_n \; (Req) - 2S_{Ln}\right] \leq Largest \; L_M$. $L_{B(e)} \; of \; Qty_n \; (Req)$ will replace both $L_{B(a)} \; of \; Qty_n \; (Req)$ and $L_{B(c)} \; of \; Qty_n \; (Req)$, Where.

$$L_{B(e)} \; of \; Qty_n \; (Req) = L_{B(a)} \; of \; Qty_n \; (Req) + L_{B(c)} \; of \; Qty_n \; (Req) - S_{Ln}$$

And if $\left[L_{B(b)} \; of \; Qty_n \; (Req) + L_{B(d)} \; of \; Qty_n \; (Req) - 2S_{Ln}\right] \leq Largest \; L_M$. $L_{B(f)} \; of \; Qty_n \; (Req)$ will replace both $L_{B(b)} \; of \; Qty_n \; (Req)$ and $L_{B(d)} \; of \; Qty_n \; (Req)$, Where.

$$L_{B(f)} \; of \; Qty_n \; (Req) = L_{B(b)} \; of \; Qty_n \; (Req) + L_{B(d)} \; of \; Qty_n \; (Req) - S_{Ln}$$

- Case 3: $n > Z$ and $n < \left(n_{Top} - Z + 1\right)$

$$L_{B(a)}\ of\ Qty_a\ (Req) = \left[\sum_{n-Z+1}^{n} H_{C(n)}\right] + \left[\sum_{n-Z}^{n-1} L_{D(n)}\right] + E_{D(n-Z)} + S_{L(n-Z)} - E_{Dn}$$

$$L_{B(b)}\ of\ Qty_a\ (Req) = \left[\sum_{n-Z+1}^{n} H_{C(n)}\right] + \left[\sum_{n-Z}^{n-1} L_{D(n)}\right] + E_{D(n-Z)} + S_{Ln} - E_{Dn}$$

- Case 4: $n > Z$ and $n \geq \left(n_{Top} - Z + 1\right)$

$$L_{B(a)}\ of\ Qty_a\ (Req) = \left[\sum_{n-Z+1}^{n} H_{C(n)}\right] + \left[\sum_{n-Z}^{n-1} L_{D(n)}\right] + E_{D(n-Z)} + S_{L(n-Z)} - E_{Dn}$$

$$L_{B(b)}\ of\ Qty_a\ (Req) = \left[\sum_{n-Z+1}^{n} H_{C(n)}\right] + \left[\sum_{n-Z}^{n-1} L_{D(n)}\right] + E_{D(n-Z)} + S_{Ln} - E_{Dn}$$

$$L_{B(c)}\ of\ Qty_n\ (Req) = \left[\sum_{n}^{n_{Top}} H_{C(n)}\right] + \left[\sum_{n}^{n_{Top}} L_{D(n)}\right] + E_{Dn} + S_{Ln} - H_{C(n)}$$

$$L_{B(d)}\ of\ Qty_n\ (Req) = \left[\sum_{n}^{n_{Top}} H_{C(n)}\right] + \left[\sum_{n}^{n_{Top}} L_{D(n)}\right] + E_{Dn} - D_A - H_{C(n)}$$

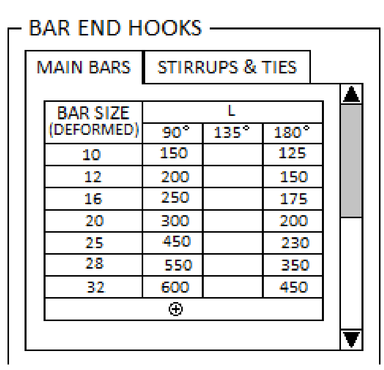
And if $\left[L_{B(a)}\ of\ Qty_n\ (Req) + L_{B(c)}\ of\ Qty_n\ (Req) - 2S_{Ln}\right] \leq Largest\ L_M$. $L_{B(e)}\ of\ Qty_n\ (Req)$ will replace both $L_{B(a)}\ of\ Qty_n\ (Req)$ and $L_{B(c)}\ of\ Qty_n\ (Req)$, Where.

$$L_{B(e)}\ of\ Qty_n\ (Req) = L_{B(a)}\ of\ Qty_n\ (Req) + L_{B(c)}\ of\ Qty_n\ (Req) - S_{Ln}$$

And if $\left[L_{B(b)}\ of\ Qty_n\ (Req) + L_{B(d)}\ of\ Qty_n\ (Req) - 2S_{Ln}\right] \leq Largest\ L_M$. $L_{B(f)}\ of\ Qty_n\ (Req)$ will replace both $L_{B(b)}\ of\ Qty_n\ (Req)$ and $L_{B(d)}\ of\ Qty_n\ (Req)$, Where.

$$L_{B(f)}\ of\ Qty_n\ (Req) = L_{B(b)}\ of\ Qty_n\ (Req) + L_{B(d)}\ of\ Qty_n\ (Req) - S_{Ln}$$

Example:



BAR SIZE (DEFORMED)	L 90°	L 135°	L 180°
10	150		125
12	200		150
16	250		175
20	300		200
25	450		230
28	550		350
32	600		450

The Splice Alternating is **Enable** $Z = 2$ $n_{Top} = 4$ $\left(n_{Top} - Z + 1\right) = 4 - 2 + 1 = 3$

For Ground Floor ($n = 1$)

$1 < 2 : n < 2$ and $1 < 3 : n < \left(n_{Top} - Z + 1\right)$, Thus **Case 1**: Main Bar Diameter is **32 mm**

$$L_B\ of\ Qty_1\ (Req) = \left[\sum_{1}^{n} H_{C(n)}\right] + \left[\sum_{0}^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} - E_{Dn} - d_{bs} - d_{bl} - CC_F$$

$$L_B\ of\ Qty_1\ (Req) = \left[\sum_{1}^{1} H_{C(n)}\right] + \left[\sum_{0}^{0} L_{D(n)}\right] + D_F + L_{H(90°)} - E_{D(1)} - d_{bs} - d_{bl} - CC_F$$

$$L_B\ of\ Qty_1\ (Req) = [2650] + [0] + 1500 + 600 - 937.5 - 25 - 25 - 75$$

$$L_B\ of\ Qty_1\ (Req) = 3687.5\ mm \rightarrow 3.6875\ m$$

For 2nd Floor ($n = 2$)

$2 = 2 : n = Z$ and $2 < 3 : n < \left(n_{Top} - Z + 1\right)$, Thus **Case 1**: Main Bar Diameter is **32 mm**

$$L_B\ of\ Qty_2\ (Req) = \left[\sum_{1}^{n} H_{C(n)}\right] + \left[\sum_{0}^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} - E_{Dn} - d_{bs} - d_{bl} - CC_F$$

$$L_B\ of\ Qty_2\ (Req) = \left[\sum_{1}^{2} H_{C(n)}\right] + \left[\sum_{0}^{1} L_{D(n)}\right] + D_F + L_{H(90°)} - E_{D(2)} - d_{bs} - d_{bl} - CC_F$$

$$L_B\ of\ Qty_2\ (Req) = [2650\ +\ 2450] + [700] + 1500\ +\ 600\ -\ 837.5\ -\ 25\ -\ 25\ -\ 75$$

$$L_B\ of\ Qty_2\ (Req) =\ 6937.5\ mm \rightarrow 6.9375\ m$$

For 3rd Floor ($n\ =\ 3$)

$3\ >\ 2 : n > Z$ and $3\ =\ 3 : n = \left(n_{Top} - Z + 1\right)$, Thus **Case 4**: Main Bar Diameter is **32 mm**

$$L_{B(a)}\ of\ Qty_3\ (Req) = \left[\sum_{n-Z+1}^{n} H_{C(n)}\right] + \left[\sum_{n-Z}^{n-1} L_{D(n)}\right] + E_{D(n-Z)} + S_{L(n-Z)} - E_{Dn}$$

$$L_{B(a)}\ of\ Qty_3\ (Req) = \left[\sum_{3-2+1}^{3} H_{C(n)}\right] + \left[\sum_{3-2}^{3-1} L_{D(n)}\right] + E_{D(3-2)} + S_{L(3-2)} - E_{D(3)}$$

$$L_{B(a)}\ of\ Qty_3\ (Req) = [2450\ +\ 2450] + [700\ +\ 700] + 937.5\ +\ 775\ -\ 837.5$$

$$L_{B(a)}\ of\ Qty_3\ (Req) =\ 7175\ mm \rightarrow 7.175\ mm$$

$$L_{B(b)}\ of\ Qty_3\ (Req) = \left[\sum_{n}^{n_{Top}} H_{C(n)}\right] + \left[\sum_{n}^{n_{Top}} L_{D(n)}\right] + E_{Dn} + S_{L(n)} - H_{C(n)}$$

$$L_{B(b)}\ of\ Qty_3\ (Req) = \left[\sum_{3}^{4} H_{C(n)}\right] + \left[\sum_{3}^{4} L_{D(n)}\right] + E_{D(3)} + S_{L(3)} - H_{C(3)}$$

$$L_{B(b)}\ of\ Qty_3\ (Req) = [2450\ +\ 4150] + [700\ +\ 114] + 837.5\ +\ 775\ -\ 2450$$

$$L_{B(b)}\ of\ Qty_3\ (Req) =\ 6576.5\ mm \rightarrow 6.5765\ m$$

Checking:

$$\left(L_{B(a)}\ of\ Qty_3\ (Req) + L_{B(a)}\ of\ Qty_3\ (Req) - S_{L(3)}\right) =\ 7175\ +\ 6576.5\ -\ (775)$$

$$\left(L_{B(a)}\ of\ Qty_3\ (Req) + L_{B(a)}\ of\ Qty_3\ (Req) - S_{L(3)}\right) =\ 12976.5\ mm \rightarrow 12.9765\ m$$

$$Largest\ Available\ L_M\ =\ 12\ m$$

Since $12.9765\ m\ >\ 12\ m$, thus $L_{B(c)}\ of\ Qty_3\ (Req)$ will not replace both $L_{B(a)}\ of\ Qty_3\ (Req)$ and $L_{B(b)}\ of\ Qty_3\ (Req)$

For 4th Floor ($n\ =\ 4$)

$3\ >\ 2 : n > Z$ and $4\ >\ 3 : n > \left(n_{Top} - Z + 1\right)$, Thus **Case 4**: Main Bar Diameter is **32 mm**

$$L_{B(a)}\ of\ Qty_4\ (Req) = \left[\sum_{n-Z+1}^{n} H_{C(n)}\right] + \left[\sum_{n-Z}^{n-1} L_{D(n)}\right] + E_{D(n-Z)} + S_{L(n-Z)} - E_{Dn}$$

$$L_{B(a)}\ of\ Qty_4\ (Req) = \left[\sum_{4-2+1}^{4} H_{C(n)}\right] + \left[\sum_{4-2}^{4-1} L_{D(n)}\right] + E_{D(4-2)} + S_{L(4-2)} - E_{D(4)}$$

$$L_{B(a)}\ of\ Qty_4\ (Req) = [2450\ +\ 4150] + [700\ +\ 700] + 837.5\ +\ 775\ -\ 1687.5$$

$$L_{B(a)}\ of\ Qty_4\ (Req) =\ 7925\ mm \rightarrow 7.925\ m$$

$$L_{B(b)}\ of\ Qty_4\ (Req) = \left[\sum_{n}^{n_{Top}} H_{C(n)}\right] + \left[\sum_{n}^{n_{Top}} L_{D(n)}\right] + E_{Dn} + S_{L(n)} - H_{C(n)}$$

$$L_{B(b)}\ of\ Qty_4\ (Req) = \left[\sum_4^4 H_{C(n)}\right] + \left[\sum_4^4 L_{D(n)}\right] + E_{D(4)} + S_{L(4)} - H_{C(4)}$$

$$L_{B(b)}\ of\ Qty_4\ (Req) = [4150] + [114] + 1687.5 + 775 - 4150$$

$$L_{B(b)}\ of\ Qty_4\ (Req) = 2576.5\ mm \rightarrow 2.5765$$

Checking:

$$\left(L_{B(a)}\ of\ Qty_3\ (Req) + L_{B(a)}\ of\ Qty_3\ (Req) - S_{L(3)}\right) = 7925 + 2576.5 - (775)$$

$$\left(L_{B(a)}\ of\ Qty_3\ (Req) + L_{B(a)}\ of\ Qty_3\ (Req) - S_{L(3)}\right) = 9726.5\ mm \rightarrow 9.7265\ m$$

$$Largest\ Available\ L_M = 12\ m$$

Since $9.7265\ m < 12\ m$, thus $L_{B(c)}\ of\ Qty_3\ (Req)$ will replace both $L_{B(a)}\ of\ Qty_3\ (Req)$ and $L_{B(b)}\ of\ Qty_3\ (Req)$, where

$$L_{B(c)}\ of\ Qty_3\ (Req) = L_{B(a)}\ of\ Qty_3\ (Req) + L_{B(a)}\ of\ Qty_3\ (Req) - S_{L(3)} = 9.7265\ m$$

13. The program will determine the length of extra bars

Legend: [must be based on the table in the parameters   And Total number of floors above the current floor that have the same as the floor

For $Qty_{G(n)}\ (Req)$ will use the equation

If $Qty_{G(n)}\ (Req) \leq 0$

$$L_B\ of\ Qty_{G(n)}\ (Req) = 0$$

If $Qty_{G(n)}\ (Req) > 0$

If the $Splice\ Alternating\ is$ **Enable**

- Case 1: $n < Z$

$$L_B\ of\ Qty_{G(n)}\ (Req) = H_n + \left[\sum_0^{n-1} H_{C(n)}\right] + \left[\sum_0^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} - d_{bs} - d_{bl} - CC_F - CC_{CW}$$

- Case 2: $n = Z$

$$L_B\ of\ Qty_{G(n)}\ (Req) = \left[\sum_0^{n} H_{C(n)}\right] + \left[\sum_0^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} - E_{Dn} - d_{bs} - d_{bl} - CC_F$$

If the $Splice\ Alternating\ is$ **Disable**

- Case 1: $n < Z$

$$L_B\ of\ Qty_{G(n)}\ (Req) = H_n + \left[\sum_0^{n-1} H_{C(n)}\right] + \left[\sum_0^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} - d_{bs} - d_{bl} - CC_F - CC_{CW}$$

- Case 2: $n = Z$

$$L_{B(a)}\ of\ Qty_{G(na)}\ (Req) = \left[\sum_0^{n} H_{C(n)}\right] + \left[\sum_0^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} - E_{Dn} - d_{bs} - d_{bl} - CC_F$$

$$L_{B(b)}\ of\ Qty_{G(nb)}\ (Req) = \left[\sum_0^{n} H_{C(n)}\right] + \left[\sum_0^{n-1} L_{D(n)}\right] + D_F + L_{H(90°)} + S_{Ln} + D_A - E_{Dn} - d_{bs} - d_{bl} - CC_F$$

For $Qty_{A(nx)}\ (Req)$ will use the equation

If $Qty_{A(nx)}\ (Req) \leq 0$

$$L_B\ of\ Qty_{A(nx)}\ (Req) = 0$$

If $Qty_{A(nx)}\ (Req) > 0$

If the $Splice\ Alternating\ is$ **Enable**

- Case 1: $(n + Z - m) = n$ & $(n + Z - m) < (n + Z)$

$$L_B\ of\ Qty_{A(nx)}\ (Req) = Dim_{Beam(n)} + E_{Dn} + S_{Ln} - CC_{CW}$$

- Case 2: $(n + Z - m) > n$ & $(n + Z - m) < (n + Z)$

$$L_B\ of\ Qty_{A(nx)}\ (Req) = \left[\sum_{n+1}^{n+Z-m} H_{C(n)}\right] + \left[\sum_{n}^{n+Z-m-1} L_{D(n)}\right] + Dim_{Beam(n+Z-m)} + E_{Dn} + S_{Ln} - CC_{CW}$$

- Case 3: $(n + Z - m) > n$ & $(n + Z - m) = (n + Z)$

$$L_B\ of\ Qty_{A(nx)}\ (Req) = \left[\sum_{n+1}^{n+Z-m} H_{C(n)}\right] + \left[\sum_{n}^{n+Z-m-1} L_{D(n)}\right] + E_{Dn} + S_{Ln} - E_{D(n+Z-m)}$$

If the $Splice\ Alternating\ is$ **Disable**

- Case 1: $(n + Z - m) = n$ & $(n + Z - m) < (n + Z)$

$$L_{B(a)}\ of\ Qty_{A(nx)}\ (Req) = Dim_{Beam(n)} + E_{Dn} + S_{Ln} - CC_{CW}$$

$$L_{B(b)}\ of\ Qty_{A(nx)}\ (Req) = Dim_{Beam(n)} + E_{Dn} - D_A - CC_{CW}$$

- Case 2: $(n + Z - m) > n$ & $(n + Z - m) < (n + Z)$

$$L_{B(a)}\ of\ Qty_{A(nx)}\ (Req) = \left[\sum_{n+1}^{n+Z-m} H_{C(n)}\right] + \left[\sum_{n}^{n+Z-m-1} L_{D(n)}\right] + Dim_{Beam(n+Z-m)} + E_{Dn} + S_{Ln} - CC_{CW}$$

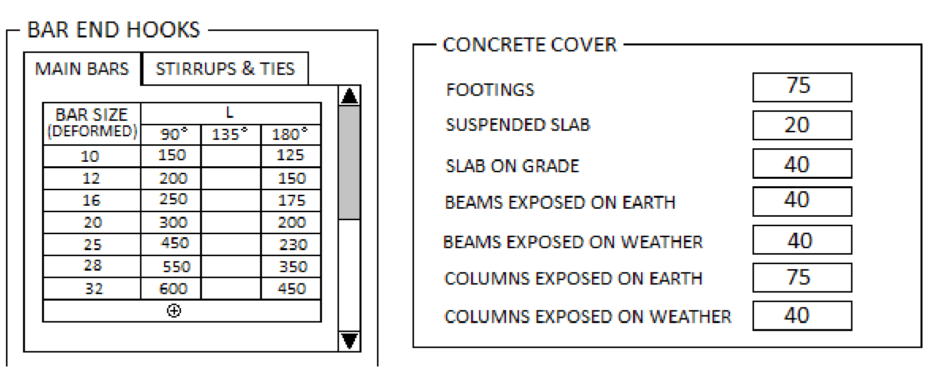
$$L_{B(b)}\ of\ Qty_{A(nx)}\ (Req) = \left[\sum_{n+1}^{n+Z-m} H_{C(n)}\right] + \left[\sum_{n}^{n+Z-m-1} L_{D(n)}\right] + Dim_{Beam(n+Z-m)} + E_{Dn} + D_A - CC_{CW}$$

- Case 3: $(n + Z - m) > n$ & $(n + Z - m) = (n + Z)$

$$L_{B(a)}\ of\ Qty_{A(nx)}\ (Req) = \left[\sum_{n+1}^{n+Z-m} H_{C(n)}\right] + \left[\sum_{n}^{n+Z-m-1} L_{D(n)}\right] + E_{Dn} + S_{Ln} - E_{D(n+Z-m)}$$

$$L_{B(b)}\ of\ Qty_{A(nx)}\ (Req) = \left[\sum_{n+1}^{n+Z-m} H_{C(n)}\right] + \left[\sum_{n}^{n+Z-m-1} L_{D(n)}\right] + E_{Dn} + S_{Ln} - E_{D(n+Z-m)}$$

Example:



- @ Ground Floor: $Splice\ Alternating\ is$ **Enable**, and $1 < 2 \therefore n < Z$

For $Qty_{G(n)}\ (Req) > 0$,

$$L_B\ of\ Qty_{G(1)}\ (Req) = H_1 + \left[\sum_{0}^{1-1} H_{C(n)}\right] + \left[\sum_{0}^{1-1} L_{D(n)}\right] + D_F + L_{H(90°)} - d_{bs} - d_{bl} - CC_F - CC_{CW}$$

$$L_B\ of\ Qty_{G(1)}\ (Req) = 3350 + [0] + [0] + 1500 + 600 - 25 - 25 - 75 - 40$$

$$L_B\ of\ Qty_{G(1)}\ (Req) = 5285\ mm \rightarrow 5.285\ m$$

For $Qty_{A(1a)}\ (Req) = 2 > 0$, $(1 + 2 - 0) = (1 + 2)$ & $(1 + 2 - 0) > 2$, thus Case 3.

$$L_B \; of \; Qty_{A(1a)} \; (Req) = \left[\sum_{1+1}^{1+2-0} H_{C(n)}\right] + \left[\sum_{1}^{1+2-0-1} L_{D(n)}\right] + E_{D1} + S_{L1} - E_{D(1+2-0)}$$

$$L_B \; of \; Qty_{A(1a)} \; (Req) = \left[\sum_{2}^{3} H_{C(n)}\right] + \left[\sum_{1}^{2} L_{D(n)}\right] + E_{D1} + S_{L1} - E_{D(3)}$$

$$L_B \; of \; Qty_{A(1a)} \; (Req) = [2450 + 2450] + [700 + 700] + 937.5 + 775 - 837.5$$

$$L_B \; of \; Qty_{A(1a)} \; (Req) = 7175 \; mm \rightarrow 7.175 \; m$$

For $Qty_{A(1b)} \; (Req) = 0 = 0$, thus $L_B \; of \; Qty_{A(1b)} \; (Req) = 0 \; m$

For $Qty_{A(1c)} \; (Req) = 0 = 0$, thus $L_B \; of \; Qty_{A(1c)} \; (Req) = 0 \; m$

- @ 2nd Floor: $Splice \; Alternating \; is$ **Enable**, and $2 = 2 \therefore n = Z$
  For $Qty_{G(2)}(Req) = 0$, thus $L_B \; of \; Qty_{G(2)} \; (Req) = 0 \; m$

  For $Qty_{A(2a)} \; (Req) = 0$, thus $L_B \; of \; Qty_{A(2a)} \; (Req) = 0 \; m$

  For $Qty_{A(2b)} \; (Req) = 2 > 0$, $(2 + 2 - 1) < (2 + 2)$ & $(2 + 2 - 1) > 2$, thus Case 2.

$$L_B \; of \; Qty_{A(2b)} \; (Req) = \left[\sum_{2+1}^{2+2-1} H_{C(n)}\right] + \left[\sum_{2}^{2+2-1-1} L_{D(n)}\right] + Dim_{Beam(2+2-1)} + E_{D2} + S_{L2} - CC_{CW}$$

$$L_B \; of \; Qty_{A(2b)} \; (Req) = \left[\sum_{3}^{3} H_{C(n)}\right] + \left[\sum_{2}^{2} L_{D(n)}\right] + Dim_{Beam(3)} + E_{D2} + S_{L2} - CC_{CW}$$

$$L_B \; of \; Qty_{A(2b)} \; (Req) = [2450] + [700] + 700 + 837.5 + 775 - 40$$

$$L_B \; of \; Qty_{A(2b)} \; (Req) = 5422.5 \; mm \rightarrow 5.4225 \; m$$

  For $Qty_{A(2c)} \; (Req) = 0$, thus $L_B \; of \; Qty_{A(2c)} \; (Req) = 0 \; m$

- @3rd Floor: $Splice \; Alternating \; is$ **Enable**, and $3 > 2 \therefore n > Z$
  For $Qty_{A(3a)} \; (Req) = 0$, thus $L_B \; of \; Qty_{A(3a)} \; (Req) = 0 \; m$

  For $Qty_{A(3b)} \; (Req) = 0$, thus $L_B \; of \; Qty_{A(3b)} \; (Req) = 0 \; m$

  For $Qty_{A(3c)} \; (Req) = 2 > 0$, $(2 + 2 - 2) < (2 + 2)$ & $(2 + 2 - 2) = 2$, thus Case 1.

$$L_B \; of \; Qty_{A(3c)} \; (Req) = Dim_{Beam(3)} + E_{D3} + S_{L3} - CC_{CW}$$

$$L_B \; of \; Qty_{A(3c)} \; (Req) = 700 + 837.5 + 775 - 40$$

$$L_B \; of \; Qty_{A(3c)} \; (Req) = 2272.5 \; mm \rightarrow 2.2725 \; m$$

- @4th Floor: $Splice \; Alternating \; is$ **Enable**, and $4 > 2 \therefore n > Z$
  For $Qty_{A(4a)} \; (Req) = 0$, thus $L_B \; of \; Qty_{A(4a)} \; (Req) = 0 \; m$

  For $Qty_{A(4b)} \; (Req) = 0$, thus $L_B \; of \; Qty_{A(4b)} \; (Req) = 0 \; m$

  For $Qty_{A(4c)} \; (Req) = 0$, thus $L_B \; of \; Qty_{A(4c)} \; (Req) = 0 \; m$

14. After determining the quantities of main reinforcement and their respective required bar length, the program will determine their respective manufactured bars and no. of manufactured pcs

LEGEND:

- For Qty_n

If the $Qty_n\ (Req)\ or\ its\ L_B\ is\ equal\ to\ ZERO\ then,$

$$Qty_{Mn} = 0\ pcs$$

$$L_{CBn} = 0\ m$$

If $Qty_n\ (Req)\ or\ its\ L_B$ is greater than $ZERO\ then,$

The program will compute.

$$Difference = \left|L_B - L_M\right|$$

Note:

$m = 1{:}If\ the\ Splice\ Alternating\ is\ Enable$

$m = 0.5{:}If\ the\ Splice\ Alternating\ is\ Disable$

a) Case 1: $Difference \leq 150\ mm\ or\ 0.15\ m\ then,$

$$Qty_{Mn} = m \cdot Qty_n\ (Req) \bullet Qty_{Cn}$$

$$L_{CBn} = L_M$$

b) Case 2: $Difference > 150\ mm\ or\ 0.15\ m\ then$

$$Qty_{Pn} = \frac{L_M}{L_B\ of\ Qty_n\ (Req)}$$

$$L_W = \left[Qty_{Pn} - Qty_{Pn}\ (round\ down\ into\ whole\ number)\right] \times L_B$$

$$Qty_{Mn} = m \cdot \frac{Qty_n\ (Req)}{Qty_{Pn}} \bullet Qty_{Cn}$$

$$L_E\ (m) = \left[Qty_{Mn}(round\ up) - Qty_{Mn}\right] \times L_M$$

And

$$Total\ Wastage = L_E + L_W\left[Qty_{Mn}\ (round\ down\ into\ whole\ number)\right]$$

Then the program will choose the manufactured bar length with the lowest $Total\ wastage$,

- For Qty_{Gn}

If $Qty_{Gn}\ (Req)\ or\ its\ L_B\ is\ equal\ to\ ZERO\ then,$

$$Qty_{Mn} = 0\ pcs$$

$$L_{CBn} = 0\ m$$

If $Qty_{Gn}\ (Req)\ or\ its\ L_B$ is greater than $ZERO\ then,$

The program will compute.

$$Difference = \left|L_B - L_M\right|$$

Note:

$m = 0.5{:}If\ the\ n = Z\ and\ Splice\ Alternating\ is\ Disable$

$m = 1.0{:}Else$

a) Case 1: $Difference \leq 150\ mm\ or\ 0.15\ m\ then,$

$$Qty_{Mn} = m \cdot Qty_{Gn}\ (Req) \bullet Qty_{Cn}$$

$$L_{CBn} = L_M$$

b) Case 2: $Difference > 150\ mm\ or\ 0.15\ m\ then$

$$Qty_{Pn} = \frac{L_M}{L_B\ of\ Qty_{Gn}\ (Req)}$$

$$Qty_{Mn} = m \cdot \frac{Qty_G\,(Req)}{Qty_{Pn}} \bullet Qty_{Cn}$$

$$L_W = \left[Qty_{Pn} - Qty_{Pn}\,(round\ down\ into\ whole\ number)\right] \times L_B$$

$$L_E\,(m) = \left[Qty_{Mn}(round\ up) - Qty_{Mn}\right] \times L_M$$

And

$$Total\ Wastage\ = L_E + L_W\left[Qty_{Mn}\,(round\ down\ into\ whole\ number)\right]$$

Then the program will choose the manufactured bar length with the lowest $Total\ wastage$

- For Qty_{An}

If $Qty_{A(nx)}\,(Req)\ or\ its\ L_B\ is\ equal\ to\ ZERO\ then,$

$$Qty_{Mn}\ = 0\ pcs$$

$$L_{CBn} = 0\ m$$

If $Qty_{A(nx)}\,(Req)\ or\ its\ L_B$ is greater than $ZERO\ then,$

The program will compute.

$$Difference\ = \left|L_B - L_M\right|$$

Note:

$m\ = 0.5$:$If\ Splice\ Alternating\ is\ Disable$

$m\ = 1.0$:$If\ Splice\ Alternating\ is\ Enable$

a) Case 1: $Difference \leq 150\ mm\ or\ 0.15\ m\ then,$

$$Qty_{Pn} = m \cdot Qty_{(An)}\,(Req) \bullet Qty_{Cn}$$

$$L_{CBn} = L_M$$

b) Case 2: $Difference\ >\ 150\ mm\ or\ 0.15\ m\ then$

$$Qty_{Pn} = \frac{L_M}{L_B\ of\ Qty_{An}\,(Req)}$$

$$Qty_{Mn} = m \cdot \frac{Qty_{An}\,(Req)}{Qty_{Pn}} \bullet Qty_{Cn}$$

$$L_W = \left[Qty_{Pn} - Qty_{Pn}\,(round\ down\ into\ whole\ number)\right] \times L_B$$

$$L_E\,(m) = \left[Qty_{Mn}(round\ up) - Qty_{Mn}\right] \times L_M$$

And

$$Total\ Wastage\ = L_E + L_W\left[Qty_{Mn}\,(round\ down\ into\ whole\ number)\right]$$

Then the program will choose the manufactured bar length with the lowest $Total\ wastage$

Example:

The available manufactured bar lengths are **6**, **7.5**, **10.5**, and **12** meters

- @Ground Floor $Qty_{C1}\ = 13$

  a) For $Qty_1\,(Req)$; Where $Qty_1\,(Req)\ = 8\,pcs$ & $L_B\ of\ Qty_1\,(Req) = 3.6875$

  Compute

L [m]	Difference
6	2.313
7.5	3.813
10.5	6.813
12.5	8.813

Since the $Lowest\ Difference\ =\ 2.313\ m\ >\ 0.15\ m$ Thus,

L [M]	Qty [1]	L [B]	Qty (Column)	m	Qty [P]		Qty [M]		L [W]	L [E]	Total Wastage
6					1.63	1	104	104	2.313	0	240.500
7.5					2.03	2	52	52	0.125	0	6.500
10.5	8	3.6875	13	1	2.85	2	52	52	3.125	0	162.500
12					3.25	3	34.67	35	0.938	4	35.875

The Lowest $Average\ L$ Manufactured Bar Length is 7.5 m. Thus,

$L_{CB(1a)}\ =\ 7.5\ m$ with $Qty_{M(1a)}\ =\ 52\ pcs.$

b) For $Qty_{G1}\ (Req)$; Where $Qty_{G1}\ (Req)\ =\ 4\ pcs$ & $L_B\ of\ Qty_{G1}\ (Req) = 5.285\ m$

L [m]	Difference
6	0.715
7.5	2.215
10.5	5.215
12.5	7.215

Since the $Lowest\ Difference\ =\ 0.715\ m\ >\ 0.15\ m$

L [M]	Qty [G(1)]	L [B]	Qty (Column)	m	Qty [P]		Qty [M]		L [W]	L [E]	Total Wastage
6					1.14	1	52	52	0.715	0	37.180
7.5	4	5.285	13	1	1.42	1	52	52	2.215	0	115.180
10.5					1.99	1	52	52	5.215	0	271.180
12					2.27	2	26	26	1.430	0	37.180

The Lowest $Average\ L$ Manufactured Bar Length is 6 m. Thus,

$L_{CB(1b)}\ =\ 6\ m$ with $Qty_{M(1b)}\ =\ 52\ pcs.$

c) For $Qty_{A(1a)}\ (Req)$; Where $Qty_{A(1a)}\ (Req) = 2\ pcs$ & $L_B\ of\ Qty_{A(1a)}\ (Req) = 5.285\ m$

Compute

L [m]	Difference
6	1.175
7.5	0.325
10.5	3.325
12.5	5.325

Since the $Lowest\ Difference\ =\ 0.325\ m\ >\ 0.15\ m$

L [M]	Qty [A(1a)]	L [B]	Qty (Column)	m	Qty [P]		Qty [M]		L [W]	L [E]	Total Wastage
6					0.84	0	#####	#####	0.000	#DIV/0!	#DIV/0!
7.5	2	7.175	13	1	1.05	1	26	26	0.325	0	8.450

10.5					1.46	1	26	26	3.325	0	86.450
12					1.67	1	26	26	4.825	0	125.450

The Lowest $Average\ L$ Manufactured Bar Length is 7.5 m. Thus,

$L_{CB(1c)} = 7.5\ m$ with $Qty_{M(1c)} = 26\ pcs.$

d) For $Qty_{A(1b)}\ (Req)$; Where $Qty_{A(1b)}\ (Req) = 0\ pcs$ & $L_B\ of\ Qty_{A(1a)}\ (Req) = 0\ m$

$$Qty_{M(1d)} = 0\ pcs$$

$$L_{CB(1d)} = 0\ m$$

e) For $Qty_{A(1c)}\ (Req)$; Where $Qty_{A(1c)}\ (Req) = 0\ pcs$ & $L_B\ of\ Qty_{A(1a)}\ (Req) = 0\ m$

$$Qty_{M(1e)} = 0\ pcs$$

$$L_{CB(1e)} = 0\ m$$

- @ 2nd Floor $Qty_{C2} = 13$

a) For $Qty_2\ (Req)$; Where $Qty_2\ (Req) = 8\ pcs$ & $L_B\ of\ Qty_2\ (Req) = 6.9375\ m$

L [m]	Difference
6	0.938
7.5	0.563
10.5	3.563
12.5	5.563

Since the $Lowest\ Difference = 0.563\ m > 0.15\ m$

L [M]	Qty [2]	L [B]	Qty (Column)	m	Qty [P]		Qty [M]		L [W]	L [E]	Total Wastage
6	8	6.9375	13	1	0.86	0	#####	#####	0.000	#DIV/0!	#DIV/0!
7.5					1.08	1	104	104	0.563	0	58.500
10.5					1.51	1	104	104	3.563	0	370.500
12					1.73	1	104	104	5.063	0	526.500

The Lowest $Average\ L$ Manufactured Bar Length is 7.5 m. Thus,

$L_{CB(2a)} = 7.5\ m$ with $Qty_{M(2a)} = 104\ pcs.$

b) For $Qty_{G2}\ (Req)$; Where $Qty_{G2}\ (Req) = 0\ pcs$ & $L_B\ of\ Qty_{G2}\ (Req) = 0\ m$

$$Qty_{M(2b)} = 0\ pcs$$

$$L_{CB(2b)} = 0\ m$$

c) For $Qty_{A(2a)}\ (Req)$; Where $Qty_{A(2a)}\ (Req) = 0\ pcs$ & $L_B\ of\ Qty_{A(2a)}\ (Req) = 0\ m$

$$Qty_{M(2c)} = 0\ pcs$$

$$L_{CB(2c)} = 0\ m$$

d) For $Qty_{A(2b)}\ (Req)$; Where $Qty_{A(2b)}\ (Req) = 2\ pcs$ & $L_B\ of\ Qty_{A(2b)}\ (Req) = 5.4225$

Compute:

L [m]	Difference
6	0.578
7.5	2.078
10.5	5.078
12.5	7.078

Since the $Lowest\ Difference = 0.578\ m > 0.15\ m$

L [M]	Qty [A(2b)]	L [B]	Qty (Column)	m	Qty [P]		Qty [M]		L [W]	L [E]	Total Wastage
6	2	5.4225	13	1	1.11	1	26	26	0.578	0	15.015
7.5					1.38	1	26	26	2.078	0	54.015
10.5					1.94	1	26	26	5.078	0	132.015
12					2.21	2	13	13	1.155	0	15.015

The Lowest $Average\ L$ Manufactured Bar Length is 6 m. Thus,

$L_{CB(2d)} = 6\ m$ with $Qty_{M(2d)} = 26\ pcs.$

e) For $Qty_{A(2c)}\ (Req)$; Where $Qty_{A(2c)}\ (Req) = 0\ pcs$ & $L_B\ of\ Qty_{A(2c)}\ (Req) = 0\ m$

$$Qty_{M(2e)} = 0\ pcs$$

$$L_{CB(2e)} = 0\ m$$

- @ 3rd Floor $Qty_{C3} = 13$

a) For $Qty_3\ (Req)$; Where $Qty_3\ (Req) = 6\ pcs,$ & $L_{B(a)}\ of\ Qty_3\ (Req) = 7.175\ m$

Compute

L [m]	Difference
6	1.175
7.5	0.325
10.5	3.325
12.5	5.325

Since the $Lowest\ Difference = 0.325\ m > 0.15\ m$

L [M]	Qty [3]	L [B(a)]	Qty (Column)	m	Qty [P]		Qty [M]		L [W]	L [E]	Total Wastage
6	6	7.175	13	1	0.84	0	#####	#####	0.000	#DIV/0!	#DIV/0!
7.5					1.05	1	78	78	0.325	0	25.350
10.5					1.46	1	78	78	3.325	0	259.350
12					1.67	1	78	78	4.825	0	376.350

The Lowest $Average\ L$ Manufactured Bar Length is 7.5 m. Thus,

$L_{CB(3a)} = 7.5\ m$ with $Qty_{M(3a)} = 78\ pcs.$

b) For $Qty_3\ (Req)$; Where $Qty_3\ (Req) = 6\ pcs,$ & $L_{B(b)}\ of\ Qty_3\ (Req) = 6.5765\ m$

Compute

L [m]	Difference
6	0.577
7.5	0.924
10.5	3.924
12.5	5.924

Since the $Lowest\ Difference = 0.577\ m > 0.15\ m$

L [M]	Qty [3]	L [B(b)]	Qty (Column)	m	Qty [P]		Qty [M]		L [W]	L [E]	Total Wastage
6	6	6.5765	13	1	0.91	0	#####	#####	0.000	#DIV/0!	#DIV/0!
7.5					1.14	1	78	78	0.924	0	72.033
10.5					1.60	1	78	78	3.924	0	306.033
12					1.82	1	78	78	5.424	0	423.033

The Lowest $Average\ L$ Manufactured Bar Length is 7.5 m. Thus,

$L_{CB(3b)} = 7.5\ m$ with $Qty_{M(3b)} = 78\ pcs.$

c) For $Qty_{A(3a)}\ (Req)$; Where $Qty_{A(3a)}\ (Req) = 0\ pcs$, &$L_B\ of\ Qty_{A(3a)}\ (Req) = 0\ m$

$$Qty_{M(3c)} = 0\ pcs$$

$$L_{CB(3c)} = 0\ m$$

d) For $Qty_{A(3b)}\ (Req)$; Where $Qty_{A(3b)}\ (Req) = 0\ pcs$, &$L_B\ of\ Qty_{A(3b)}\ (Req) = 0\ m$

$$Qty_{M(3d)} = 0\ pcs$$

$$L_{CB(3d)} = 0\ m$$

e) For $Qty_{A(3c)}\ (Req)$; Where $Qty_{A(3c)}\ (Req) = 2\ pcs$, &$L_B\ of\ Qty_{A(3c)}\ (Req) = 2.2725\ m$

Compute

L [m]	Difference
6	3.728
7.5	5.228
10.5	8.228
12.5	10.228

Since the $Lowest\ Difference = 3.728\ m > 0.15\ m$

L [M]	Qty A[3c]	L [B]	Qty (Column)	m	Qty [P]		Qty [M]		L [W]	L [E]	Total Wastage
6	2	2.2725	13	1	2.64	2	13	13	1.455	0	18.915
7.5					3.30	3	8.667	9	0.683	2.5	7.960
10.5					4.62	4	6.5	7	1.410	5.25	13.710
12					5.28	5	5.2	6	0.637	9.6	12.788

The Lowest $Average\ L$ Manufactured Bar Length is 6 m. Thus,

$L_{CB(3e)} = 7.5\ m$ with $Qty_{M(3e)} = 9\ pcs.$

- @ 4th Floor $Qty_{C4} = 13$

a) For $Qty_4\ (Req)$; Where $Qty_4\ (Req) = 6\ pcs$, & $L_{B(c)}\ of\ Qty_4\ (Req) = 9.7265\ m$

Compute

L [m]	Difference
6	2.952
7.5	1.452
10.5	1.549
12.5	3.549

Since the $Lowest\ Difference = 1.452\ m > 0.15\ m$

L [M]	Qty [4]	L [B]	Qty (Column)	m	Qty [P]		Qty [M]		L [W]	L [E]	Total Wastage
6	6	9.7265	13	1	0.67	0	#####	#####	0.000	#DIV/0!	#DIV/0!
7.5					0.84	0	#####	#####	0.000	#DIV/0!	#DIV/0!
10.5					1.08	1	78	78	0.738	0	60.333
12					1.34	1	78	78	3.049	0	177.333

The Lowest $Average\ L$ Manufactured Bar Length is 7.5 m. Thus,

$L_{CB(4a)} = 10.5\,m$ with $Qty_{M(4a)} = 78\,pcs.$

b) For $Qty_{A(4a)}\,(Req)$; Where $Qty_{A(4a)}\,(Req) = 6\,pcs$, & $L_{B(a)}\,of\,Qty_{A(4a)}\,(Req) = 0\,m$

$$Qty_{M(4b)} = 0\,pcs$$

$$L_{CB(4b)} = 0\,m$$

c) For $Qty_{A(4a)}\,(Req)$; Where $Qty_{A(4a)}\,(Req) = 6\,pcs$, & $L_{B(a)}\,of\,Qty_{A(4a)}\,(Req) = 0\,m$

$$Qty_{M(4c)} = 0\,pcs$$

$$L_{CB(4c)} = 0\,m$$

d) For $Qty_{A(4a)}\,(Req)$; Where $Qty_{A(4a)}\,(Req) = 6\,pcs$, & $L_{B(a)}\,of\,Qty_{A(4a)}\,(Req) = 0\,m$

$$Qty_{M(4d)} = 0\,pcs$$

$$L_{CB(4d)} = 0\,m$$

15. The program will then compute the weight of the main reinforcement of each floor of the column.

$$W_n = \left(\sum L_{CBn} Qty_{Mn}\right) W_{D(n)}$$

Where:

$W_D = Weight\ based\ of\ the\ cdiameter\ of\ the\ main\ reinforcement.$

Example:

WEIGHT

BAR SIZE (Diameter)	kg / m
6 mm	0.222
8 mm	0.395
10 mm	0.616
12 mm	0.888
16 mm	1.597
20 mm	2.466
25 mm	3.854
28 mm	4.833
32 mm	6.313
36 mm	7.991
40 mm	9.864
44 mm	11.926
50 mm	15.413
56 mm	19.318

a) Ground Floor: Main rebar diameter is 32 mm

$$W_1 = \left(\sum_{x=a}^{e} L_{CB(1x)} Qty_{M(1x)}\right) W_{D(1)}$$

$$W_1 = [7.5(52) + 6(52) + 7.5(26) + 0(0) + 0(0)] \times 6.313 = 5662.761\,kg$$

b) 2nd Floor: Main rebar diameter is 32 mm

$$W_2 = \left(\sum_{x=a}^{e} L_{CB(2x)} Qty_{M(2x)}\right) W_{D(2)}$$

$$W_2 = [7.5(104) + 0(0) + 0(0) + 6(26) + 0(0)] \times 6.313 = 5908.968\,kg$$

c) 3rd Floor: Main rebar diameter is 32 mm

$$W_3 = \left(\sum_{x=a}^{e} L_{CB(3x)} Qty_{M(3x)}\right) W_{D(3)}$$

$$W_3 = [7.5(78) + 7.5(78) + 0(0) + 0(0) + 7.5(9)] \times 6.313 = 7812.3375\,kg$$

d) 4th Floor: Main rebar diameter is 32 mm

$$W_4 = \left(\sum_{x=a}^{d} L_{CB(4x)} Qty_{M(4x)}\right) W_{D(4)}$$

$$W_4 = [10.5(78) + 0(0) + 0(0) + 0(0)] \times 6.313 = 5170.347\,kg$$

16. The program will compute the total weight of the column.

$$W_{Total} = \sum_{1}^{n_{TOP}} W_{n}$$

Example:

$$W_{Total} = \sum_{1}^{n_{TOP}} W_{n}$$

$$W_{Total} = \sum_{1}^{4} W_{n}$$

$$W_{Total} = 5662.761 + 5908.968 + 7812.3375 + 5170.347$$

$$W_{Total} = 24554.4135\ kg$$