REFERENCE

ADD STRUCTURAL MEMBER

STRUCURAL MEMBER: FOOTING (WALL)

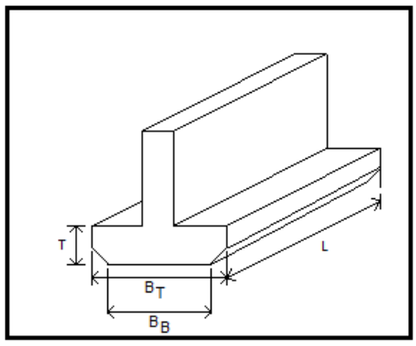
NAME: WF-1

FOOTING TYPE: WALL FOOTING (Trapezoidal)

UNIT: mm

DIMENSIONS

L	30440
L_{F-F}	22190
B_T	500
B_U	300
T	200
D	200
QUANTITY	1



LONGITUDINAL REINFORCEMENT		TRANSVERSE REINFORCEMENT	
DIAMETER	10	DIAMETER	10
QUANTITY	5	QUANTITY	
SPACING		SPACING	300
HOOK TYPE	0	HOOK TYPE	0

Parameters

Unit: Meter

Earthworks | Formworks | Concrete | Reinforcements | Paint | Tiles

CONCRETE MIX

FOOTINGS
COLUMNS
BEAMS
SLABS
WALLS

CONCRETE GRADE
GRAVEL TYPE

READY MIX: 4000 PSI @ 28 Days

CONCRETE COVER

FOOTINGS	75
SUSPENDED SLAB	20
SLAB ON GRADE	40
BEAMS EXPOSED ON EARTH	40
BEAMS EXPOSED ON WEATHER	40
COLUMNS EXPOSED ON EARTH	75
COLUMNS EXPOSED ON WEATHER	40

Parameters

Unit: Millimeter

Earthworks | Formworks | Concrete | Reinforcements | Paint | Tiles

LAP SPLICES LENGTH

TENSION BARS | COMPRESSION BARS

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	550	500
25	800	750
28	1000	850
32	1300	1100

SPLICING

COLUMN | BEAM | SLAB | WALLS | STAIRS

SPLICE LOCATION	1/2	of clear height
SPLICE ZONE	1/2	of clear height
ALLOWABLE PERCENTAGE	50	
MINIMUM VERTICAL DISTANCE OF ADJACENT BARS	600	

BAR END HOOKS

MAIN BARS | STIRRUPS & TIES

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

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

REINFORCEMENT GRADE

COLUMNS	FOOTINGS	BEAMS
STAIRS	WALLS	SLABS

MANUFACTURED LENGTH

COLUMN FOOTING	6.0	7.5	9.0	10.5	12.0	13.5	15.0
WALL FOOTING	6.0	7.5	9.0	10.5	12.0	13.5	15.0
COLUMN	6.0	7.5	9.0	10.5	12.0	13.5	15.0
BEAM/GIRDER	6.0	7.5	9.0	10.5	12.0	13.5	15.0
WALL	6.0	7.5	9.0	10.5	12.0	13.5	15.0
SLAB ON GRADE	6.0	7.5	9.0	10.5	12.0	13.5	15.0
SUSPENDED SLAB	6.0	7.5	9.0	10.5	12.0	13.5	15.0
STAIRS	6.0	7.5	9.0	10.5	12.0	13.5	15.0

AVAILABLE
NOT-AVAILABLE

STEPS

1. Determine the quantity of bars of the footing.

LEGEND:

If there is no input on the quantity box, but only on the spacing.

$$Qty_L = Qty_F\left[Round\ up\ to\ whole\ number\left(\frac{\left(F_B\ or\ F_{B_T}\right)-2CC_F}{S_L}+1\right)\right]$$

$$Qty_T = Qty_F\left[Round\ up\ to\ whole\ number\left(\frac{F_L-2CC_F}{S_T}+1\right)\right]$$

If there is an input on the quantity box.

$$Qty_L = Qty_F \bullet Qty_{L(input)}$$

$$Qty_T = Qty_F \bullet Qty_{T(input)}$$

Example:

Since there is an input on the quantity box on the longitudinal reinforcement. Thus,

$$Qty_L = Qty_F \bullet Qty_{L(input)} = 1{\cdot}5 = 10\ pcs$$

Since there is no input on the quantity box on the transverse reinforcement. Thus,

$$Qty_T = Qty_F\left(\frac{F_L-2CC_F}{S_T}+1\right) = 1\left(\frac{30440-2(75)}{300}+1\right) = 1(101.97) = 1(102) = 102\ pcs$$

2. The program will compute the required length of each quantity. (The answer must be converted to meters)

LEGEND: Note: If the hook type is 0 then,

For Longitudinal Reinforcement

$$L_B\ of\ Qty_L = F_L - 2CC_F + 2H_L$$

For Transverse Reinforcement

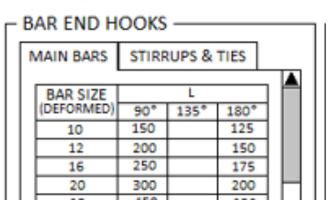
If the Wall Footing is Regular

$$L_B\ of\ Qty_T = F_W - 2CC_F + 2H_L$$

If the Wall Footing is Trapezoidal

$$L_B\ of\ Qty_T = \left[F_{B_B} - 2CC_F \tan tan\ (22.5)\right] + 600 + \frac{\left[F_{B_T}-F_{B_B}+2CC_F(\tan tan\ (22.5)-\cos cos\ (45))\right]}{\cos cos\ (45)} + 2H_L$$

Example:



$$L_B\ of\ Qty_L = F_L - 2CC_F + 2H_L$$

$$L_B\ of\ Qty_L = 30440 - 2(75) + 2(0)$$

$$L_B\ of\ Qty_L = 30290\ mm = 30.29\ m$$

$$L_B\ of\ Qty_T = F_{B_B} + 2CC_F[\cos cos\ (45) - \tan tan\ (22.5)\ ] + \frac{\left[F_{B_T} - F_{B_B} + 2CC_F(\tan tan\ (22.5) - \cos cos\ (45)\ )\right]}{\cos cos\ (45)} + 2H_L$$

$$L_B\ of\ Qty_T = [300 - 2(75)\tan tan\ (22.5)\ ] + 600 + \frac{[500 - 300 + 2(75)(\tan tan\ (22.5) - \cos cos\ (45)\ )]}{\cos cos\ (45)} + 2(0)$$

$$L_B\ of\ Qty_T = 1058.579\ mm = 1.059\ m$$

3. The program will check the available manufactured bar lengths. And will compute the following equations to determine the manufactured bar length and its corresponding manufactured quantity.

LEGEND:

For Longitudinal Reinforcement

- If $L_B\ of\ \ Qty_L < Largest\ L_M$

$$Qty_P = \frac{L_M}{L_B\ of\ Qty_L}$$

$$Qty_M = \frac{Qty_L}{Qty_P(round\ down\ to\ whole\ number)}$$

$$L_E = \left[Qty_M(round\ up\ to\ whole\ number) - Qty_M\right] \bullet L_M$$

And

$$Total\ Wastage = L_E + L_W\left[Qty_M(round\ down\ to\ whole\ number)\right]$$

The manufactured bar length that has the smallest total wastage will be the chosen manufactured bar length and its corresponding manufactured quantity

- If $L_B\ of\ \ Qty_L > Largest\ L_M$

$$Qty_M = \frac{L_B\ of\ Qty_L}{L_M - S_L}$$

$$L_X = \left[Qty_M - Qty_M(round\ down\ into\ whole\ number)\right]\left(L_M - S_L\right)$$

Note: Splice Length (S_L)

- If there is no Splice Length in the table. Thus,

$$L_E = L_M - L_X$$

And

$$Total\ Wastage = L_E \bullet Qty_L$$

The manufactured bar length that has the smallest total waste will be the chosen manufactured bar length and its corresponding manufactured quantity

$$Qty_{CM} = Qty_L \bullet Qty_M(round\ up\ into\ whole\ number)$$

For **Transverse Reinforcement**

$$Qty_P = \frac{L_M}{L_B\ of\ Qty_T}$$

$$Qty_M = \frac{Qty_T}{Qty_P(round\ down\ to\ whole\ number)}$$

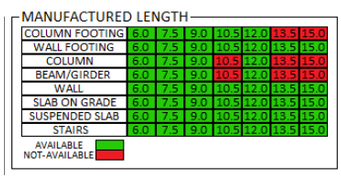
$$L_E = \left[Qty_M(round\ up\ to\ whole\ number) - Qty_M\right] \bullet L_M$$

And

$$Total\ Wastage = L_E + L_W\left[Qty_M(round\ down\ to\ whole\ number)\right]$$

The manufactured bar length that has the smallest total wastage will be the chosen manufactured bar length and its corresponding manufactured quantity

Example:



Based on the reference the available manufactured lengths are **6**, **7.5**, **9**, **10.5**, **12**, **13.5**, and **15** meters.

- For Longitudinal Reinforcement

Since $\left(L_B\ of\ Qty_L = 30.29\right) > \left(Largest\ L_M = 15\right)$. Thus,

@ $L_M = 6\ m$

$$Qty_M = \frac{L_B\ of\ Qty_L}{L_M - S_L} = \frac{30.29}{6-0.300} = 5.314$$

$$L_X = \left[Qty_M - Qty_M(round\ down\ into\ whole\ number)\right]\left(L_M - S_L\right) = (5.314 - 5)(6 - 0.3) = 1.79\ m$$

$$L_E = L_M - L_X = 6 - 1.79 = 4.21\ m$$

$$Total\ Wastage = L_E \bullet Qty_L = 4.21 \cdot 5 = 21.05$$

$$Qty_{CM} = Qty_L \bullet Qty_M(round\ up\ into\ whole\ number) = 5 \cdot 6 = 30$$

The results of the computations of other L_M

L [M]	Qty [T]	L [B] of Qty [T]	Splice Length	Qty [M]		L [x]	L [E]	Qty [CM]	Total Waste
6	5	30.29	0.30	5.31	6	1.790	4.210	30	21.050
7.5				4.21	5	1.490	6.010	25	30.050
9				3.48	4	4.190	4.810	20	24.050
10.5				2.97	3	9.890	0.610	15	3.050
12				2.59	3	6.890	5.110	15	25.550
13.5				2.29	3	3.890	9.610	15	48.050
15				2.06	3	0.890	14.110	15	70.550

The smallest average is $L_M = 10.5\ m$. Thus, $L_{M(chosen)} = 10.5\ m$ and $Qty_{P(chosen)} = 15$

- For Transverse Reinforcement

@ $L_M = 6\ m$

$$Qty_P = \frac{L_M}{L_B\ of\ Qty_T} = \frac{6}{0.565} = 10.62$$

Since $Qty_P > 1$. Thus,

$$L_W = \cdot L_M - \left(L_B\ of\ Qty_T\right) \bullet Qty_P(round\ down\ into\ whole\ number) = 6 - 0.565(10) = 0.35\ m$$

$$Qty_M = \frac{Qty_T}{Qty_P(round\ down\ to\ whole\ number)} = \frac{102}{10} = 10.2$$

$$L_E = \left[Qty_M(round\ up\ to\ whole\ number) - Qty_M\right] \bullet L_M = [11 - 10.2] \cdot 6 = 4.8\ m$$

$$Total\ Wastage = L_E + L_W\left[Qty_M(round\ down\ to\ whole\ number)\right] = 4.8 + 0.35[10] = 8.3$$

The results of the computations of other L_M

L [M]	Qty [T]	L [B] of Qty [T]	Qty [P]		Qty [M]		L [W]	L [E]	Total Wastage
6	102	1.059	5.67	5	20.40	21	0.705	3.600	17.700
7.5			7.08	7	14.57	15	0.087	3.214	1.651
9			8.50	8	12.75	13	0.528	2.250	1.389
10.5			9.92	9	11.33	12	0.969	7.000	3.985
12			11.33	11	9.27	10	0.351	8.727	4.539
13.5			12.75	12	8.50	9	0.792	6.750	3.771
15			14.16	14	7.29	8	0.174	10.714	5.444

The smallest average is $L_M = 9\,m$. Thus, $L_{M(chosen)} = 9\,m$ and $Qty_{P(chosen)} = 13$

4. The program will compute the weight of the chosen manufactured bar length in transverse and longitudinal reinforcement of the footing.

$$Weight = L_{M(chosen)} \bullet Qty_{M(chosen)} \bullet W_D$$

Where:

$W_D = corresponding\ weight\ of\ the\ reinforcement\ diameter\ (Table\ in\ the\ Parameters)$

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

WF-1

@ Longitudinal Reinforcement: $diameter = 10\,mm$, thus $W_D = 0.616$

@ Transverse Reinforcement: $diameter = 10\,mm$, thus $W_D = 0.616$

For WF-1

@ Longitudinal Reinforcement

$$Weight_L = L_{M(chosen)} \bullet Qty_{M(chosen)} \bullet W_D = (10.5) \bullet (15) \bullet (0.616) = 97.02\,kg$$

@ Transverse Reinforcement

$$Weight_U = L_{M(chosen)} \bullet Qty_{M(chosen)} \bullet W_D = (9) \bullet (13) \bullet (0.616) = 72.072\,kg$$

5. The program will compute the total weight of reinforcements on each footing.

$$Weight_{TOTAL} = Weight_L + Weight_T$$

Example:

For WF-1

$$Weight_{TOTAL} = Weight_L + Weight_T = 97.02 + 72.072 = 169.092\,kg$$