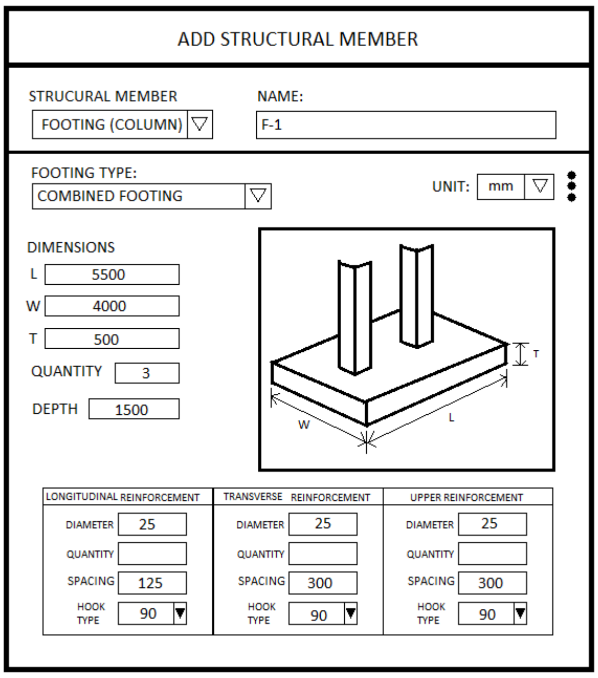
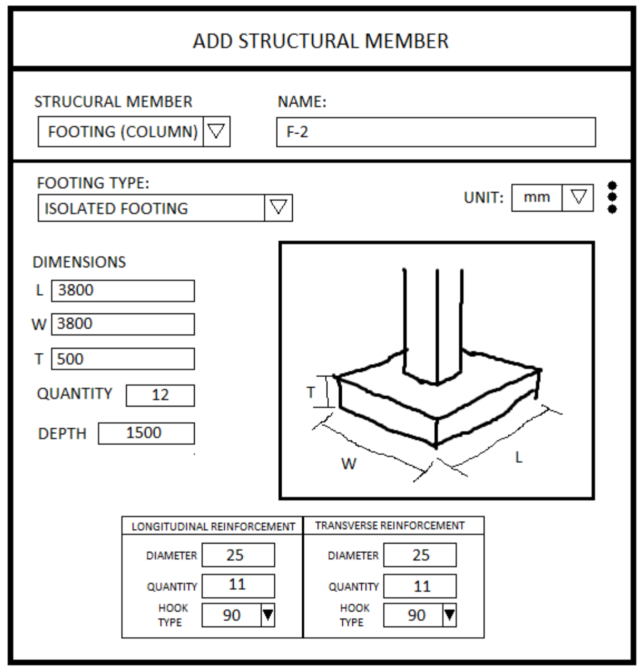
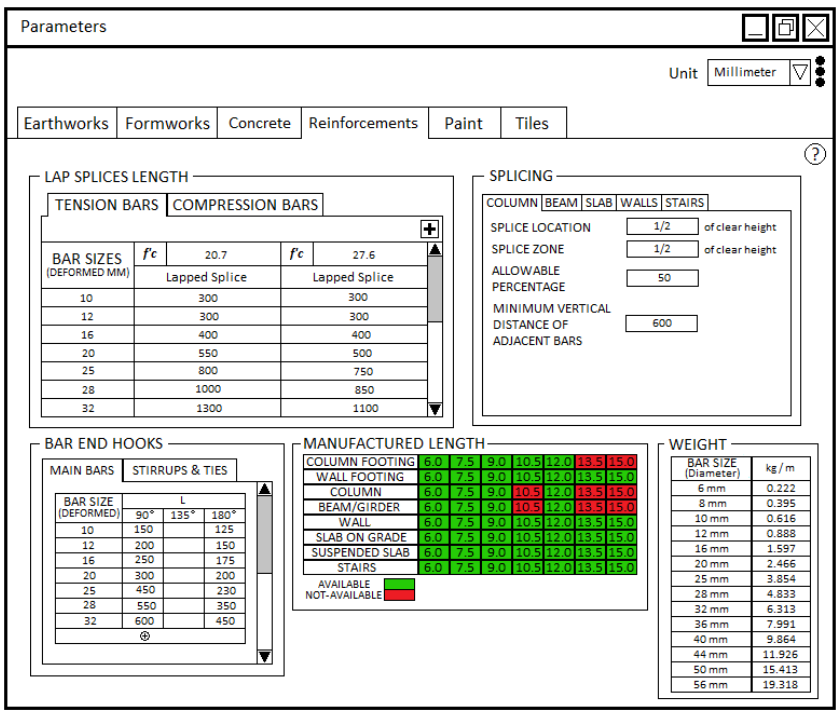
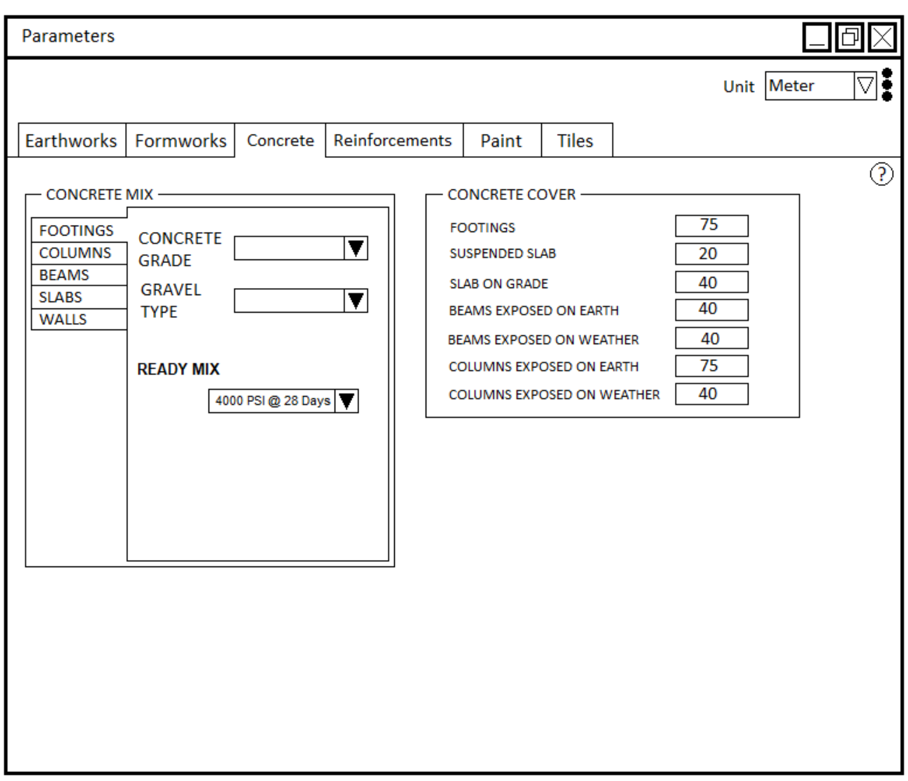
REFERENCE


ADD STRUCTURAL MEMBER
STRUCURAL MEMBER
FOOTING (COLUMN)
NAME:
F-1
FOOTING TYPE:
COMBINED FOOTING
UNIT:
mm
DIMENSIONS
L 5500
W 4000
T 500
QUANTITY 3
DEPTH 1500
T
W
L
LONGITUDINAL REINFORCEMENT
DIAMETER 25
QUANTITY
SPACING 125
HOOK TYPE 90
TRANSVERSE REINFORCEMENT
DIAMETER 25
QUANTITY
SPACING 300
HOOK TYPE 90
UPPER REINFORCEMENT
DIAMETER 25
QUANTITY
SPACING 300
HOOK TYPE 90


ADD STRUCTURAL MEMBER
STRUCURAL MEMBER
FOOTING (COLUMN)
NAME:
F-2
FOOTING TYPE:
ISOLATED FOOTING
UNIT:
mm
DIMENSIONS
L 3800
W 3800
T 500
QUANTITY 12
DEPTH 1500
T
W
L
LONGITUDINAL REINFORCEMENT
DIAMETER 25
QUANTITY 11
HOOK TYPE 90
TRANSVERSE REINFORCEMENT
DIAMETER 25
QUANTITY 11
HOOK TYPE 90


Parameters
Unit
Millimeter
Earthworks
Formworks
Concrete
Reinforcements
Paint
Tiles
LAP SPLICES LENGTH
TENSION BARS
COMPRESSION BARS
BAR SIZES (DEFORMED MM)
f'c 20.7
f'c 27.6
Lapped Splice
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
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
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


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

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.

$$Qty_L = Qty_F\left[rounded\ up\ to\ whole\ number\left(\frac{F_W - 2CC_F}{S_L} + 1\right)\right]$$

$$Qty_U = Qty_F\left[rounded\ up\ to\ whole\ number\left(\frac{F_W - 2CC_F}{S_U} + 1\right)\right]$$

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

If there is an input on the quantity box.

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

$$Qty_U = Qty_F \bullet Qty_{U(input)}$$

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

Example

For F-1

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

$$Qty_L = 3\left(\frac{4000-2(75)}{125} + 1\right) = 3(31.8) = 3(32) = 96\ pcs.$$

$$Qty_U = 3\left(\frac{4000-2(75)}{300} + 1\right) = 3(13.8) = 3(14) = 42\ pcs.$$

$$Qty_T = 3\left(\frac{5500-2(75)}{300} + 1\right) = 3(18.8) = 3(19) = 57\ pcs.$$

For F-2

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

$$Qty_L = 12 \cdot 11 = 132\ pcs.$$

$$Qty_T = 12 \cdot 11 = 132\ pcs.$$

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

LEGEND:

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

$$L_B \, of \, Qty_U = F_L - 2CC_F + 2H_L$$

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

Example:

For F-1

$L_B \, of \, Qty_L = 5500 - 2(75) + 2(450) = 6250 \, mm = 6.25 \, m$

$L_B \, of \, Qty_U = 5500 - 2(75) + 2(450) = 6250 \, mm = 6.25 \, m$

$L_B \, of \, Qty_T = 4000 - 2(75) + 2(450) = 4750 \, mm = 4.75 \, m$

For F-2

$L_B \, of \, Qty_L = 3800 - 2(75) + 2(450) = 4550 \, mm = 4.55 \, m$

$L_B \, of \, Qty_T = 3800 - 2(75) + 2(450) = 4550 \, mm = 4.55 \, m$

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 Combined Footing
  a) If $\left(L_B \, of \, Qty_L + L_B \, of \, Qty_T\right) \le Largest \, L_M$ and $db_L = db_U = db_T$
     I. Case 1: $\left(Qty_L + Qty_U\right) < Qty_T$
       For $\left(Qty_L + Qty_U\right)$

$$Qty_P = \frac{L_M}{L_B \, of \, Qty_L + L_B \, of \, Qty_T}$$

$$Qty_{M(a)} = \frac{Qty_L + Qty_U}{Qty_p(round \, down \, to \, whole \, number)}$$

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

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

For Qty_T

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

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

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

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

II. Case 2: $\left(Qty_L + Qty_U\right) \geq Qty_T$

For Qty_T

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

$$Qty_{M(a)} = \frac{Qty_T}{Qty_P(round\ down\ to\ whole\ number)}$$

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

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

For $\left(Qty_L + Qty_U\right)$

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

$$Qty_M = \frac{Qty_L + Qty_U - Qty_T}{Qty_p(round\ down\ to\ whole\ number)}$$

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

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

b) If $\left(L_B\, of\ \ Qty_L + L_B\, of\ \ Qty_T\right) > Largest\, L_M$ or $db_L \neq db_U \neq db_T$

Note x is either **L** for Longitudinal, **U** for Upper, and **T** for Transverse

$$Qty_P = \frac{L_M}{L_B\, of\ \ Qty_x}$$

$$Qty_M = \frac{Qty_x}{Qty_p(round\ down\ to\ whole\ number)}$$

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

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

- For Isolated Footing

Note x is either **L** for Longitudinal, **U** for Upper, and **T** for Transverse

$$Qty_P = \frac{L_M}{L_B\, of\ \ Qty_x}$$

$$Qty_M = \frac{Qty_x}{Qty_p(round\ down\ to\ whole\ number)}$$

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

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 bars for the column footing are **6**, **7.5**, **9**, **10.5**, and **12** meters

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

For F-1

Check Conditions

$$\left(L_B \, of \;\; Qty_L + L_B \, of \;\; Qty_T\right) = (6.25 \,+\, 4.75) = 11\, m$$

$$Largest\; L_M \,=\, 12\, m$$

Thus,

$$\left(L_B \, of \;\; Qty_L + L_B \, of \;\; Qty_T\right) < Largest\; L_M$$

And

$$\left(Qty_L \,+\, Qty_U\right) = (96 \,+\, 42) = 120$$

$$Qty_T \,=\, 57$$

Thus,

$$\left(Qty_L \,+\, Qty_U\right) > Qty_T \therefore Case\; 2$$

For Qty_T

@ $L_M \,=\, 6\, m$

$$Qty_P \,=\, \frac{L_M}{L_B \, of\; Qty_L + L_B \, of\; Qty_L} \,=\, \frac{6}{6.25+4.75} \,=\, 0.5454$$

$$L_{W(6)} \,=\, 0{:}Since\; Qty_{P(6)} \,<\, 1$$

$$Qty_{M(6)} \,=\, \frac{57}{0} \,=\, Undefined$$

$$L_{E(6)} \,=\, [Undefined \,-\, Undefined]{\cdot}6 \,=\, Undefined$$

$$Total \,=\, Undefined \,+\, 0(Undefined) = Undefined$$

You can see the answers in the table

L [M]	Qty [Total]	L [B] of Qty [L] + L [B] of Qty [T	Qty [P]		Qty [M]		L [W]	L [E]	Total Waste
6	57	11	0.55	0	#####	#DIV/0!	0.000	#DIV/0!	#DIV/0!
7.5			0.68	0	#####	#DIV/0!	0.000	#DIV/0!	#DIV/0!
9			0.82	0	#####	#DIV/0!	0.000	#DIV/0!	#DIV/0!
10.5			0.95	0	#####	#DIV/0!	0.000	#DIV/0!	#DIV/0!
12			1.09	1	57	57	1.000	0	57.000

Thus,

$L_{MC(a)} \,=\, 12\, m$ and $Qty_{MC(a)} \,=\, 57\; pcs.$

For $Qty_L \,+\, Qty_U$

$$Qty_P \,=\, \frac{L_M}{L_B \, of\; Qty_L + L_B \, of\; Qty_L} \,=\, \frac{6}{6.25} \,=\, 0.96$$

$$L_{W(6)} \,=\, 0{:}Since\; Qty_{P(6)} \,<\, 1$$

$$Qty_{M(6)} \,=\, \frac{96+42-57}{0} \,=\, \frac{81}{0} \,=\, Undefined$$

$$L_{E(6)} = [Undefined\ -\ Undefined]\cdot 6\ =\ Undefined$$

$$Average\ =\ \frac{Undefined+0}{2}\ =\ Undefined$$

L [M]	Qty [L] + Qty [U] - Qty [U]	L [B] of Qty [L]	Qty [P]		Qty [M]		L [W]	L [E]	Total Waste
6			0.96	0	#####	#DIV/0!	0.000	#DIV/0!	#DIV/0!
7.5			**1.20**	**1**	**81**	**81**	**1.250**	**0**	**101.250**
9	81	6.25	1.44	1	81	81	2.750	0	222.750
10.5			1.68	1	81	81	4.250	0	344.250
12			1.92	1	81	81	5.750	0	465.750

Thus,

$L_{MC(b)}\ =\ 7.5\ m$ and $Qty_{MC(b)}\ =\ 81\ pcs.$

For F-2

@Longitudinal Reinforcement

L [M]	Qty [Total]	L [B] of Qty [L]	Qty [P]		Qty [M]		L [W]	L [E]	Total Waste
6			1.32	1	132	132	1.450	0	191.400
7.5			1.65	1	132	132	2.950	0	389.400
9	132	4.55	1.98	1	132	132	4.450	0	587.400
10.5			**2.31**	**2**	**66**	**66**	**1.400**	**0**	**92.400**
12			2.64	2	66	66	2.900	0	191.400

Thus the

$L_{MC(a)}\ =\ 10.5\ m$ and $Qty_{MC(a)}\ =\ 66\ pcs.$

@Transverse Reinforcement

L [M]	Qty [T]	L [B] of Qty [T]	Qty [P]		Qty [M]		L [W]	L [E]	Total Waste
6			1.32	1	132	132	1.450	0	191.400
7.5			1.65	1	132	132	2.950	0	389.400
9	132	4.55	1.98	1	132	132	4.450	0	587.400
10.5			**2.31**	**2**	**66**	**66**	**1.400**	**0**	**92.400**
12			2.64	2	66	66	2.9	0	191.400

Thus the

$L_{MC(b)}\ =\ 10.5\ m$ and $Qty_{MC(b)}\ =\ 66\ pcs.$

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

   For Combined Footing

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

   For Isolated Footing

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

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

F-1

Since $\left(L_B\ of\ \ Qty_L + L_B\ of\ \ Qty_T\right) \leq Largest\ L_M$ and $db_L = db_U = db_T$. Thus,

$@\ Qty_T$: $diameter = 25\ mm$, thus $W_D = 3.854$

$$Weight_{1(a)} = L_{MC(y)} \bullet Qty_{M(y)} \bullet W_D$$

$$Weight_{1(a)} = 12(57) \cdot 3.854$$

$$Weight_{1(a)} = 2636.136\ kg$$

$@\ Qty_L + Qty_U$: $diameter = 25\ mm$, thus $W_D = 3.854$

$$Weight_{1(b)} = L_{MC(y)} \bullet Qty_{M(y)} \bullet W_D$$

$$Weight_{1(b)} = 7.5(81) \cdot 3.854$$

$$Weight_{1(b)} = 2341.305\ kg$$

F-2

$@\ Qty_L$: $diameter = 25\ mm$, thus $W_D = 3.854$

$$Weight_{2(a)} = L_{M(chosen)} \bullet Qty_{M(chosen)} \bullet W_D =$$

$$Weight_{2(a)} = (10.5) \bullet (66) \bullet (3.854)$$

$$Weight_{2(a)} = 2670.822\ kg$$

$@\ Qty_T$: $diameter = 25\ mm$, thus $W_D = 3.854$

$$Weight_{2(b)} = L_{M(chosen)} \bullet Qty_{M(chosen)} \bullet W_D =$$

$$Weight_{2(b)} = (10.5) \bullet (66) \bullet (3.854)$$

$$Weight_{2(b)} = 2670.822\ kg$$

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

$$Weight_{TOTAL(n)} = \varphi\cdot \sum_{y=a}^{y} \left(Weight_{ny}\right)$$

Where:

$$\varphi = just\ a\ factor$$

$$\varphi = 1$$

Example:

For F-1

$$Weight_{TOTAL(1)} = \varphi\cdot \sum_{y=a}^{b} \left(Weight_{ny}\right) = 1\cdot(2636.136 + 2341.305)$$

$$Weight_{TOTAL(1)} = 4977.441\ kg$$

For F-2

$$Weight_{TOTAL} = \varphi\cdot \sum_{y=a}^{b} \left(Weight_{ny}\right) = 1\cdot(2670.822 + 2670.822)$$

$$Weight_{TOTAL} = 5341.644\ kg$$