جامعة الإمام عبد الرحمن بن فيصل
IMAM ABDULRAHMAN BIN FAISAL UNIVERSITY

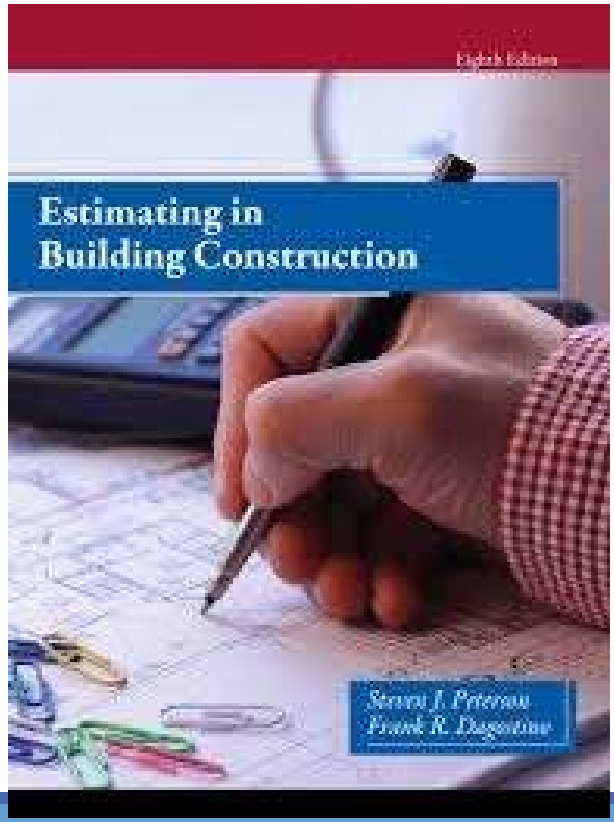
Cost Estimating

LECTURE 5: CONCRETE WORK

The Reference of this lecture

Estimating in Building Construction, 8/E

https://media.pearsoncmg.com/ph/chet/careersresources/resourcessite/products/series.html#series,series=Civil%20and%20Environmental%20Engineering



Lecture 5: Concrete

1. Continuous Footings
2. Spread Footings
3. Foundation Walls
4. Grade Beams
5. Concrete Slabs
6. Labor Costs
7. Foundation Reinforcing
8. Slab Reinforcing
9. Grade Reinforcing Beams

Cost Estimation Procedure for Concrete

1. Review the specification and list the following:
    - Type, strength, color, special curing or testing.
2. Review the drawings
3. List each of the concrete items .
4. Determine the quantities required from the drawings.

Notes to be considered

1. **Footing sizes:**
   - From the wall sections and foundation plans.
   - Watch for different size footings under different walls.
2. **Concrete slab information:**
   - From the wall sections, floor plans, and structural details.
3. **Exterior walks and driveways:**
   - From the plot (site) plan and in sections and details.

Example (1): Continuous Footings

- The continuous footings on the perimeter of the building are **3′ 2″** wide, and the ones found on the interior of the building are **3′ 0″** wide as shown in Figure (10.1).

1. Determine the linear feet of footing for each width.
2. Determine the cross-sectional area for each of the differing sizes.
3. the volume and convert into cubic foot.

Example (1): Continuous Footings

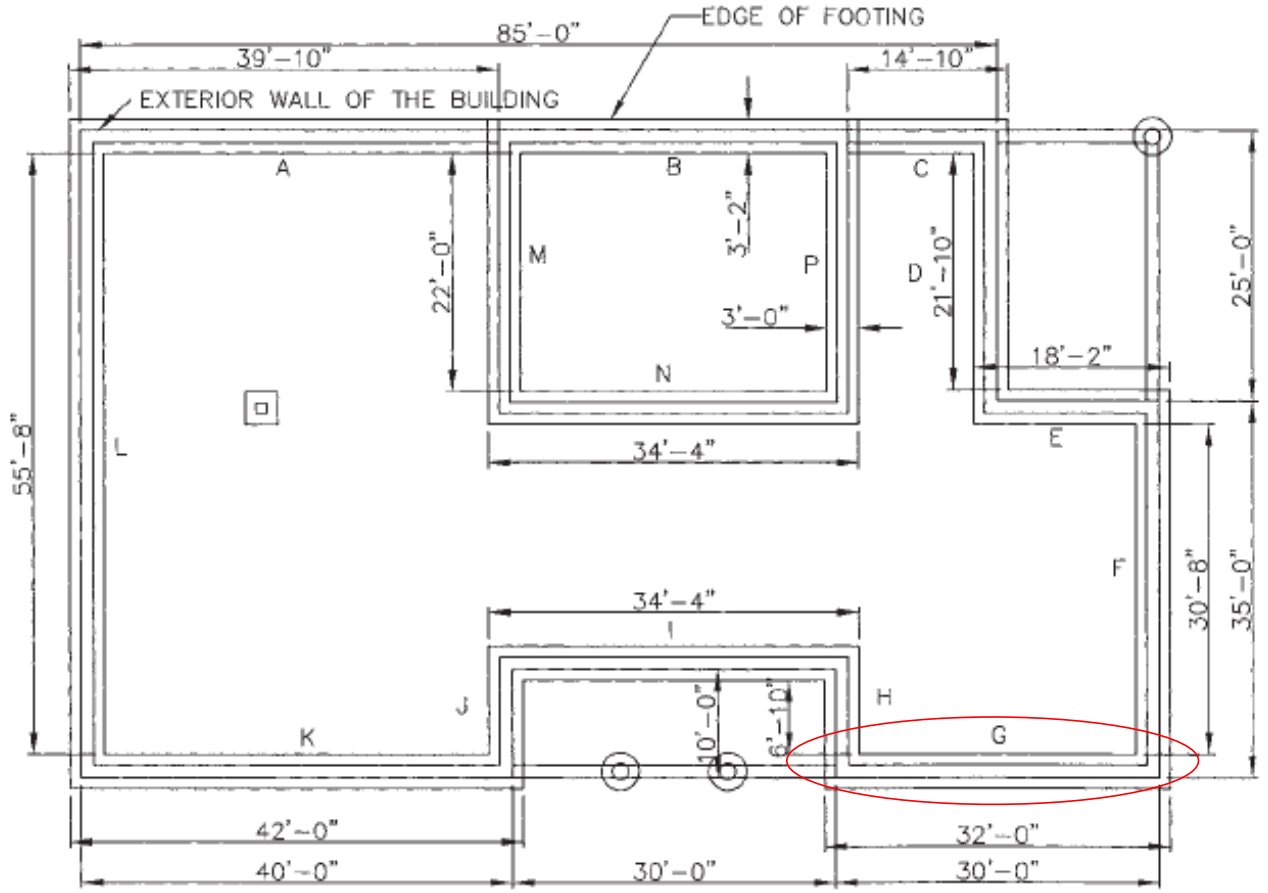


FIGURE 10.1. Foundation Layout.

Example (1): Continuous Footings

Side G:

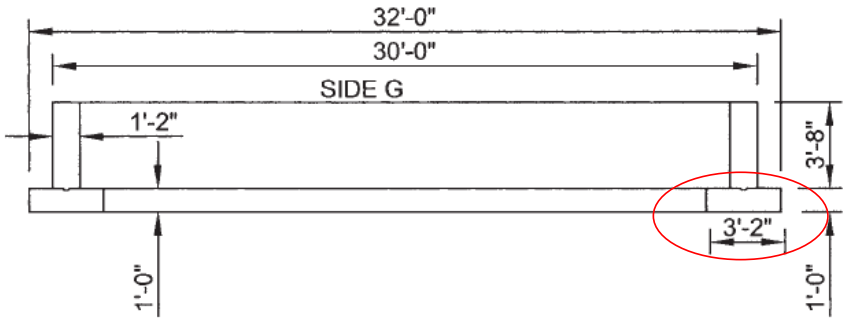


FIGURE 10.2. Footing and Foundation Wall Detail.

Side	Length
A	39'-10"
B	34'-4"
C	14'-10"
D	21'-10"
E	18'-2"
F	30'-8"
G	32'-0"
H	6'-10"
I	34'-4"
J	6'-10"
K	42'-0"
L	55'-8"
TOTAL	337'-4"

FIGURE 10.3. Linear Feet of 3′2″-Wide Continuous Footing.

Class Activity (1):

Determine concrete quantity of the interior continuous footings (side M,N, and P) :

Solution of Example (1):
Continuous Footings

$$\text{Cross-sectional area (sf)} = \text{Width (ft)} \times \text{Height (ft)}$$

$$\text{Cross-sectional area (sf)} = 3'2'' \times 1'0''$$

$$\text{Cross-sectional area (sf)} = 3.167' \times 1.0' = 3.167 \text{ sf}$$

$$\text{Volume of concrete (cf)} = \text{Cross-sectional area (sf)} \times \text{Length (ft)}$$

$$\text{Volume of concrete (cf)} = 3.167 \text{ sf} \times 337.3' = 1{,}068 \text{ cf}$$

$$\text{Volume of concrete (cy)} = \text{cubic feet}/27$$

$$\text{Volume of concrete (cy)} = 1{,}068/27 = 39.6 \text{ cy}$$

Add 5 percent for waste and round off

$$\text{Volume of concrete (cy)} = 39.6 \text{ cy} \times 1.05 = 42 \text{ cy}$$

Example (2): Spread Footings

- Figure 10.4 shows the small commercial building details the one spread footing. *The concrete contained in this footing is found in virtually the same fashion, as was the continuous footing*.

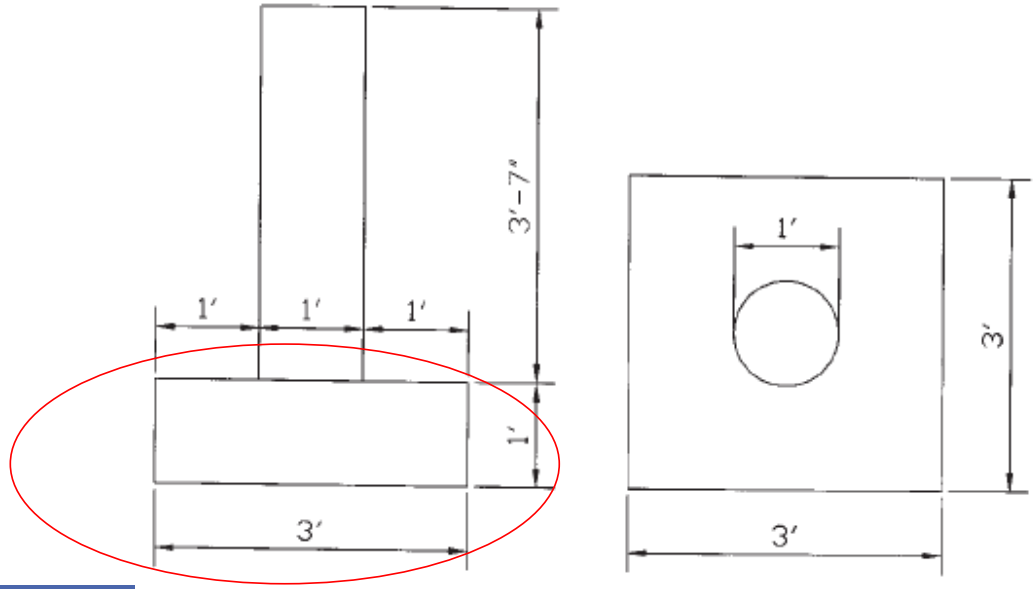


FIGURE 10.4. Spread Footing Detail.

Example (2): Spread Footings

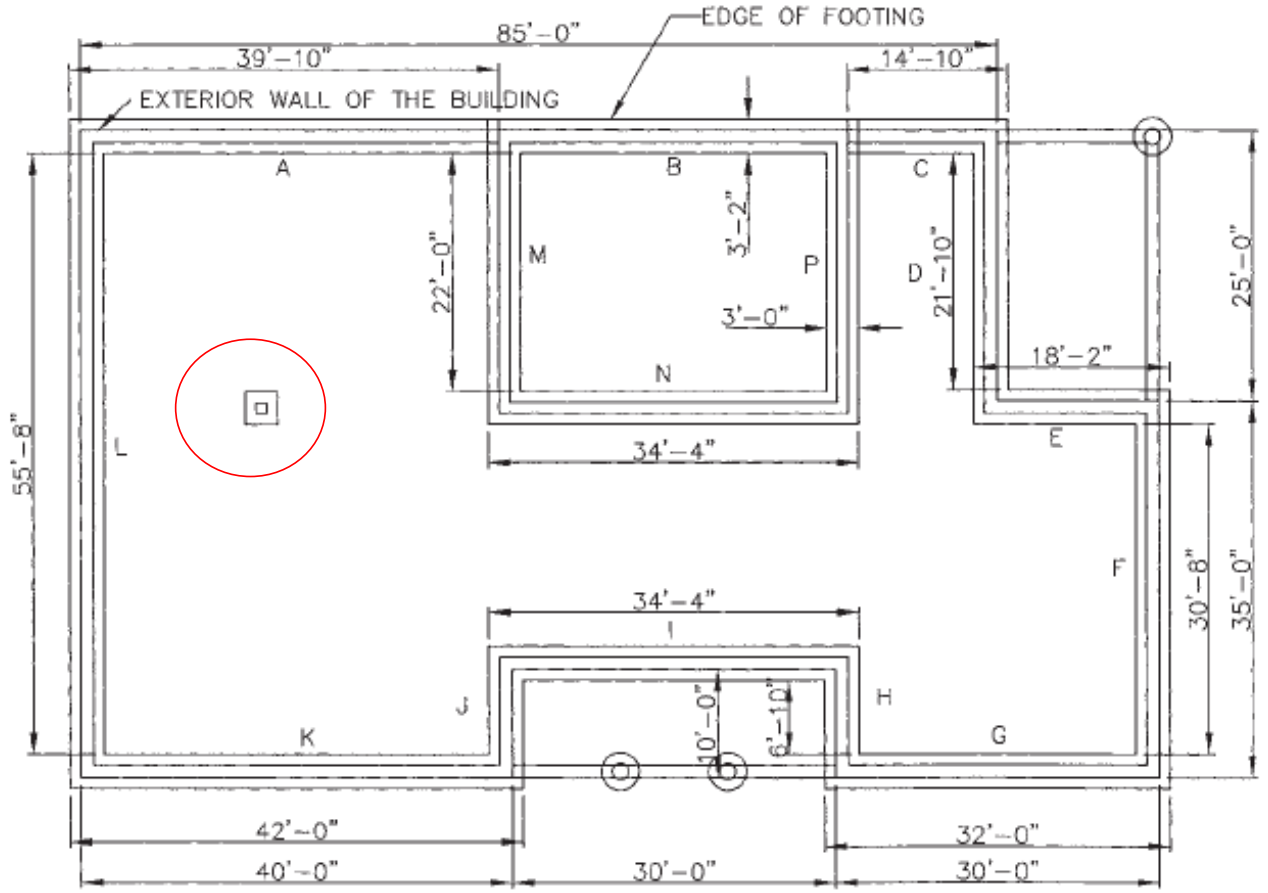


FIGURE 10.1. Foundation Layout.

Solution of Example (2):

Spread Footings

Volume of concrete (cf) = Length (ft) × Width (ft) × Height (ft)

Volume of concrete (cf) = 3′0″ × 3′0″ × 1′0″ = 9 cf

Volume of concrete (cy) = 9 cf/27 cf per cy = 0.33 cy

Add 5 percent for waste and round off

Volume of concrete (cy) = 0.33 cy × 1.05 = 0.35 cy

Use 1 cy

Concrete Footing Takeoff

ESTIMATE WORK SHEET

Project: *Little Office Building*
Location *Littleville, Tx*
Architect *U.R. Architects*
Items *Foundation Concrete*

FOOTING CONCRETE

Estimate No. *1234*
Sheet No. *1 of 1*
Date *11/11/20xx*
By *LHF* Checked *JBC*

Cost Code	Description	Dimensions Length Ft.	Length In.	Width Ft.	Width In.	Height Ft.	Height In.			Length Ft.	Width Ft.	Height Ft.	Volume C.F.	Quantity	Unit
	3-2" Wide Footing (2,800 psi)														
	Side A	39	10	3	2	1	0			39.83	3.17	1.00	126.14		
	Side B	34	4	3	2	1	0			34.33	3.17	1.00	108.72		
	Side C	14	10	3	2	1	0			14.83	3.17	1.00	46.97		
	Side D	21	10	3	2	1	0			21.83	3.17	1.00	69.14		
	Side E	18	2	3	2	1	0			18.17	3.17	1.00	57.53		
	Side F	30	8	3	2	1	0			30.67	3.17	1.00	97.11		
	Side G	32	0	3	2	1	0			32.00	3.17	1.00	101.33		
	Side H	6	10	3	2	1	0			6.83	3.17	1.00	21.64		
	Side I	34	4	3	2	1	0			34.33	3.17	1.00	108.72		
	Side J	6	10	3	2	1	0			6.83	3.17	1.00	21.64		
	Side K	42	0	3	2	1	0			42.00	3.17	1.00	133.00		
	Side L	55	8	3	2	1	0			55.67	3.17	1.00	176.28		
										337.33			1,068.22		
	Add 5 % for Waste												1,121.63		
	Total Concrete in 3'-2" Wide Footings													41.5	C.Y.
	3'-0" Wide Footing (2,800 psi)														
	Side M	22	0	3	0	1	0			22.00	3.00	1.00	66.00		
	Side N	34	4	3	0	1	0			34.33	3.00	1.00	103.00		
	Side O	22	0	3	0	1	0			22.00	3.00	1.00	66.00		
										78.33			235.00		
	Add 5 % for Waste												246.75		
	Total Concrete in 3'-2" Wide Footings													9.1	C.Y.
	Spread Footing								Quantity						
	3' Square Column Footings	3	0	3	0	1	0		1	3.00	3.00	1.00	9.00		
	Add 5 % for Waste												9.45		
	Total Concrete in 3' Square Sp. Ftg													1.0	C.Y.
	Use 1 C.Y.														

FIGURE 10.7. Concrete Footing Takeoff.

Example (3): Foundation Walls

- Figure 10.8 and Figure 10.9 depict the concrete for the foundation walls. The building perimeter foundation walls are **1′ 2″** thick and the interior walls are **1′ 0″** thick. The linear feet of **1′ 2″**-thick foundation walls is **3′ 8″** tall. In addition, side B is **8′ 4″** tall. This is why, side B is not included in Figure 10.9.

Example (3): Foundation Walls

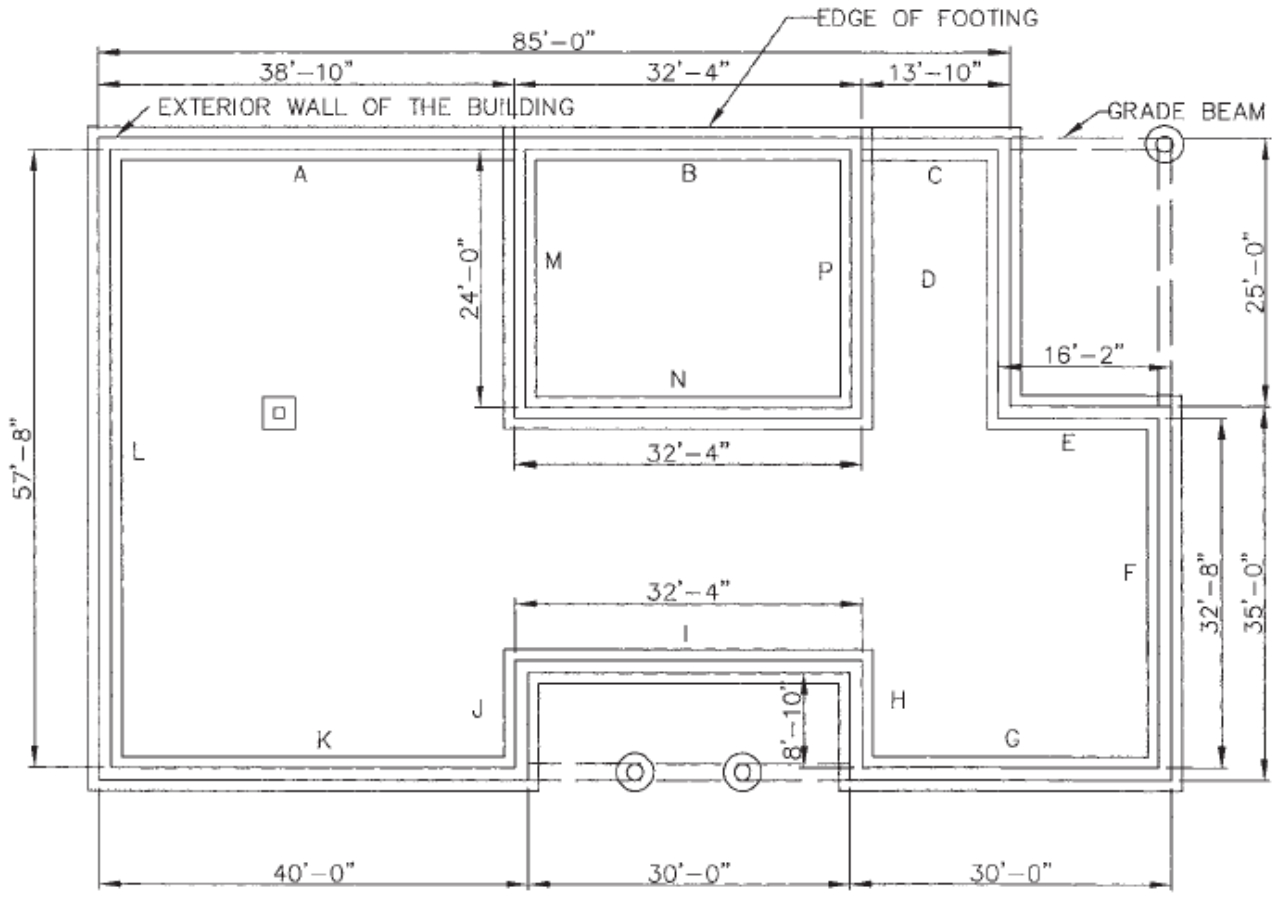


FIGURE 10.8. Foundation Wall Dimensions.

Solution of Example (3):
Foundation Walls

Class Activity (2):

Determine concrete quantity of the foundation walls (side M,N, and P) 8′ 4″ tall:

Side	Foundation Wall Length
A	38′-10″
C	13′-10″
D	23′-10″
E	16′-2″
F	32′-8″
G	30′-0″
H	8′-10″
I	32′-4″
J	8′-10″
K	40′-0″
L	57′-8″
TOTAL	303′-0″

FIGURE 10.9. Exterior Foundation Walls 3′8″ Tall.

Foundation wall concrete (cf)
= Linear feet (ft) × Height (ft) × Thickness (ft)

Solution of Example (3):

Foundation Walls

3′8″-high wall

Quantity of foundation wall concrete (cf) = 303′ × 3′8″ × 1′2″

Quantity of foundation wall concrete (cf) = 303′ × 3.67′ × 1.17′

Quantity of foundation wall concrete (cf) = 1,301 cf

8′4″-high wall

Quantity of concrete in foundation wall (cf)

= 32′4″ × 8′4″ × 1′2″

Quantity of concrete in tall foundation wall (cf)

= 32.33′ × 8.33′ × 1.17′

Quantity of concrete in tall foundation wall (cf) = 315 cf

Solution of Example (3):

Foundation Walls

Quantity of concrete in exterior foundation walls

$= (315 \text{ cf} + 1{,}301 \text{ cf})/27 \text{ cf per cy}$

Quantity of concrete in exterior foundation walls $= 59.9$ cy

Add 5 percent for waste and round off

Quantity of concrete in exterior foundation walls

$= 59.9 \text{ cy} \times 1.05$

Quantity of concrete in exterior foundation walls $= 62.9$ cy

Use 63 cy

Example (4): Grade Beams

- Figure 10.4 and 10.11 show Grade beams that are located in the front and right rear corner of the building.
- These grade beams are required to tie the drilled piers to the remainder of the building foundation.
- The volume of concrete in the grade beam is found by multiplying the cross-sectional area of the grade beams by their length.
- From Figure 10.10, it can be discerned that the grade beams have different cross-sectional areas.

Example (4): Grade Beams

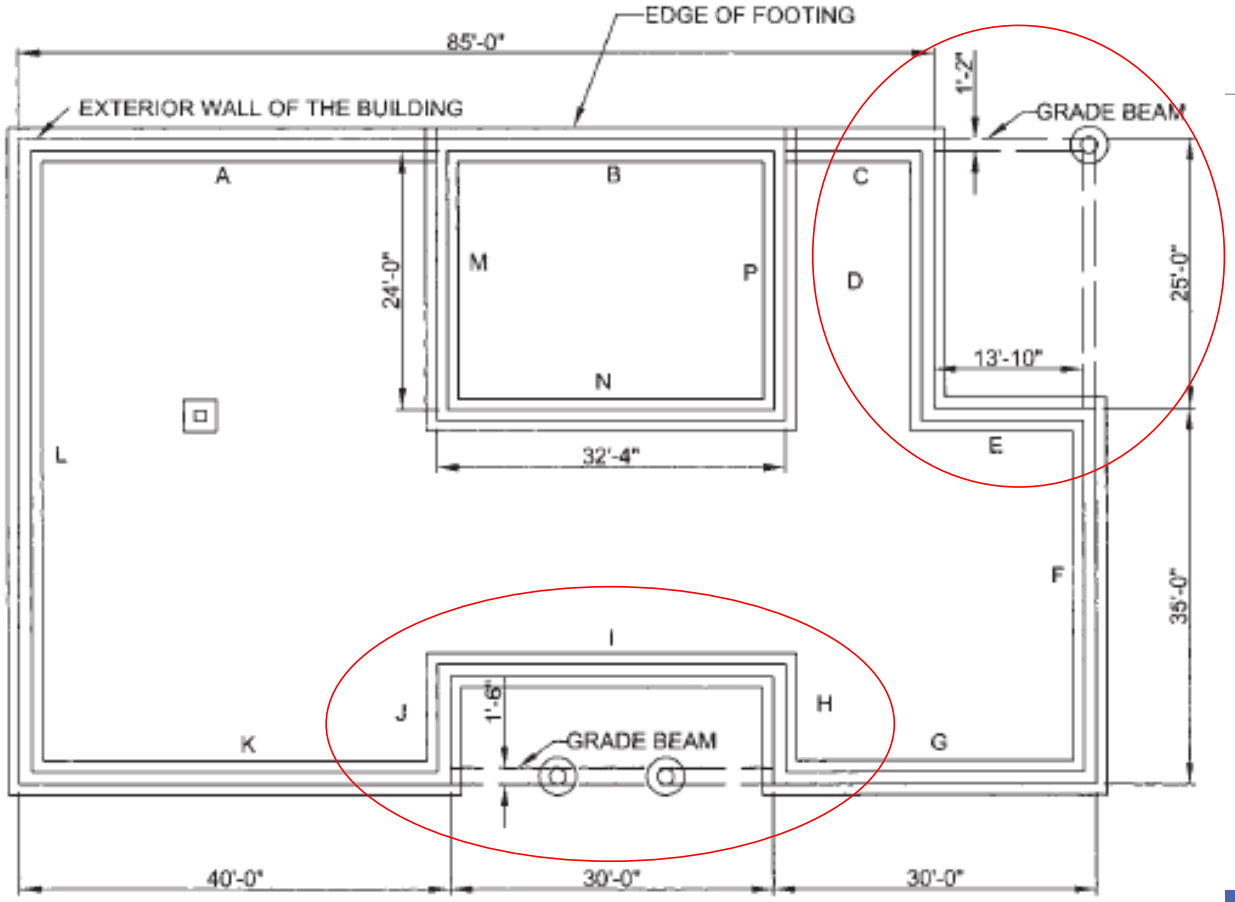


FIGURE 10.10. Grade Beam Location.

Example (4): Grade Beams

Cross Section Area:

$$= 1\left(\frac{2}{12}\right) \times 1\left(\frac{6}{12}\right) = 1.75\ ft^2$$

Length: 38′ 10″

Cross Section Area:

$$= 1\left(\frac{6}{12}\right) \times 1\left(\frac{6}{12}\right) = 2.25\ ft^2$$

Length: 30′ 0″

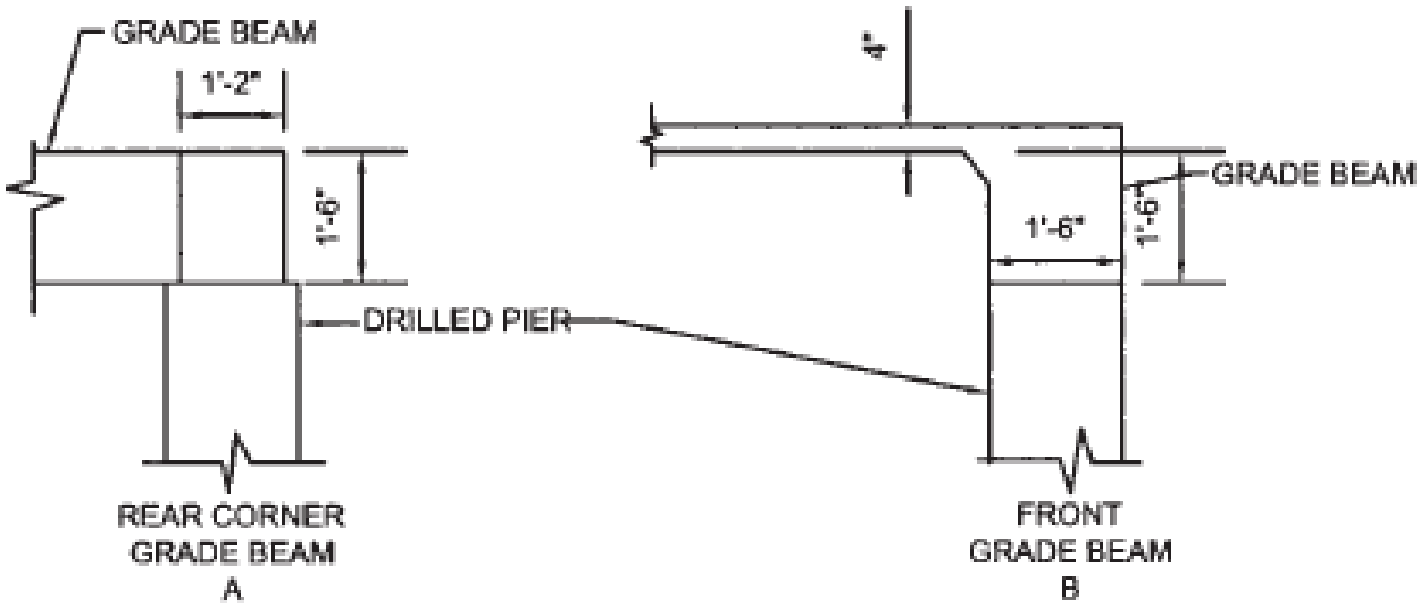


FIGURE 10.11. Grade Beam Details.

Solution of Example (4):

Grade Beams

38′10″ of 1′2″-wide grade beams (cross-sectional area = 1.75 sf)

30′0″ of 1′6″-wide grade beams (cross-sectional area = 2.25 sf)

Volume of concrete in 1′2″-wide grade beams

$$= 38.833' \times 1.75 \text{ sf} = 68 \text{ cf}$$

Volume of concrete in 1′6″-wide grade beams

$$= 30.0' \times 2.25 \text{ sf} = 68 \text{ cf}$$

Total concrete in grade beams (cf) = 68 cf + 68 cf = 136 cf

Total concrete in grade beams (cy) = 136 cf/27 cf per cy

Total concrete in grade beams (cf) = 5.04 cy

Add 8 percent for waste and round off

Total concrete in grade beams (cf) = 5.04 cy × 1.08 = 5.44 cy

Use 6 cy

Foundation Wall and Grade Beam Takeoff

ESTIMATE WORK SHEET

Project: *Little Office Building*
Location *Littleville, Tx*
Architect *U.R. Architects*
Items *Foundation Concrete*

Foundation Wall & Grade Beams

Estimate No. *1234*
Sheet No. *1 of 1*
Date *11/11/20xx*
By *LHF* Checked *JBC*

Cost Code	Description	Dimensions: Length Ft.	Length In.	Width Ft.	Width In.	Thickness Ft.	Thickness In.			Length Ft.	Width Ft.	Height Ft.	Volume C.F.	Quantity	Unit
	3'-8" Highe Foundation Walls														
	1'-2" Wide (2,800 psi)														
	Side A	38	10	1	2	3	8			38.83	1.17	3.67	166.12		
	Side C	13	10	1	2	3	8			13.83	1.17	3.67	59.18		
	Side D	23	10	1	2	3	8			23.83	1.17	3.67	101.95		
	Side E	16	2	1	2	3	8			16.17	1.17	3.67	69.16		
	Side F	32	8	1	2	3	8			32.67	1.17	3.67	139.74		
	Side G	30	0	1	2	3	8			30.00	1.17	3.67	128.33		
	Side H	8	10	1	2	3	8			8.83	1.17	3.67	37.79		
	Side I	32	4	1	2	3	8			32.33	1.17	3.67	138.31		
	Side J	8	10	1	2	3	8			8.83	1.17	3.67	37.79		
	Side K	40	0	1	2	3	8			40.00	1.17	3.67	171.11		
	Side L	57	8	1	2	3	8			57.67	1.17	3.67	246.69		
	8'-4" High Founfation Wall														
	1'-2" Wide (2,800 psi)														
	Side B	32	4	1	2	8	4			32.33	1.17	8.33	314.35		
	8'-4" High Foundation Wall														
	1'-0" Wide (2,800 psi)														
	Side M	24	0	1	0	8	4			24.00	1.00	8.33	200.00		
	Side N	32	4	1	0	8	4			32.33	1.00	8.33	269.44		
	Side P	24	0	1	0	8	4			24.00	1.00	8.33	200.00		
	Total Foundation Walls												2,279.96		
	Add 5% for Waste												88.67	89	C.Y.
	Grade Beams														
	1'-2" X 1'-6" Rear of Building	25	0	1	2	1	6			25.00	1.17	1.50	43.75		
	1'-2" X 1'-6" Rear of Building	13	10	1	2	1	6			13.83	1.17	1.50	24.21		
	1'-6" X 1'-6" Front of Building	30	0	1	6	1	6			30.00	1.50	1.50	67.50		
	Total Grade Beams												135.46		
	Add 8% to Waste												5.42	6	C.Y.
	1 Only Formed Pier	1	0	1	0	4	0			1.00	1.00	4.00	4.00		
	Add 5 % for Waste												0.16	1	C.Y.

FIGURE 10.12. Foundation Wall and Grade Beam Takeoff.

Example (5): Concrete Slab

- Determine the volume of a reinforced slab that is found by taking the square footage and by multiplying it by the depth of the slab.
- From Figures 10.13, 10.14, and 10.15, there are four unique types of slabs.

Description	Dimensions	Square Feet
Whole Building Area	99'-4" X 59'-4"	5,893
Covered Patio	25' X 15'	-375
2" Topping		-791
4" Slab On Grade (Front)		-300
Total		4,427

FIGURE 10.13. Slab Areas.

Example (5): Concrete Slab

Third Area (all)

First Area (Top)

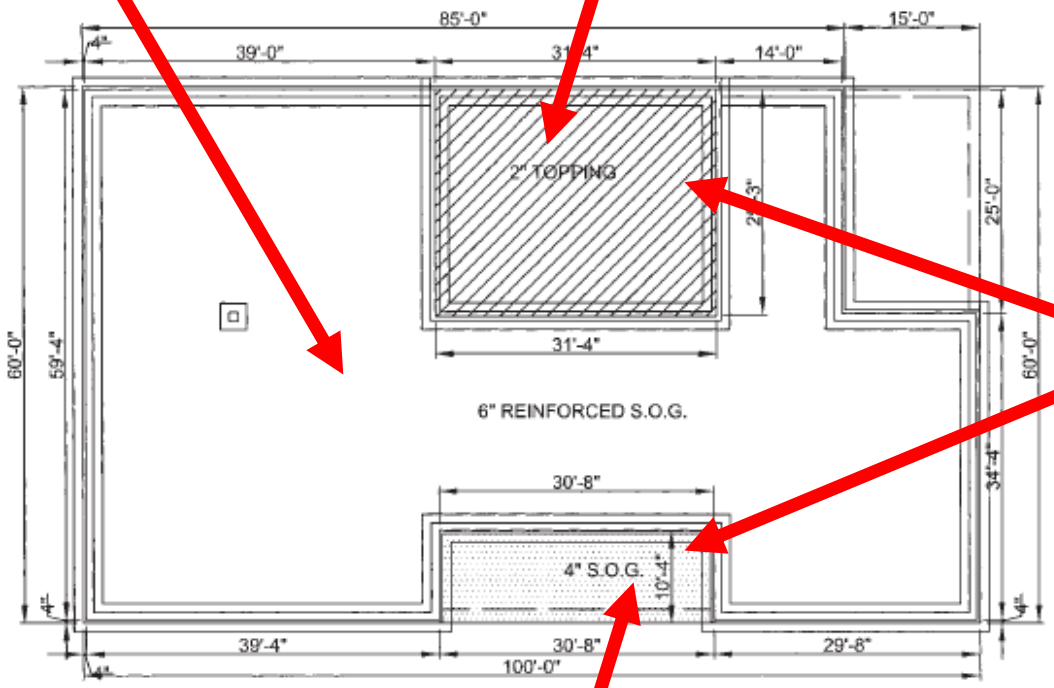


FIGURE 10.15. Slab Area.

Fourth Area (Bottom- on grade)

Second Area (Top)

Example (5): Concrete Slab

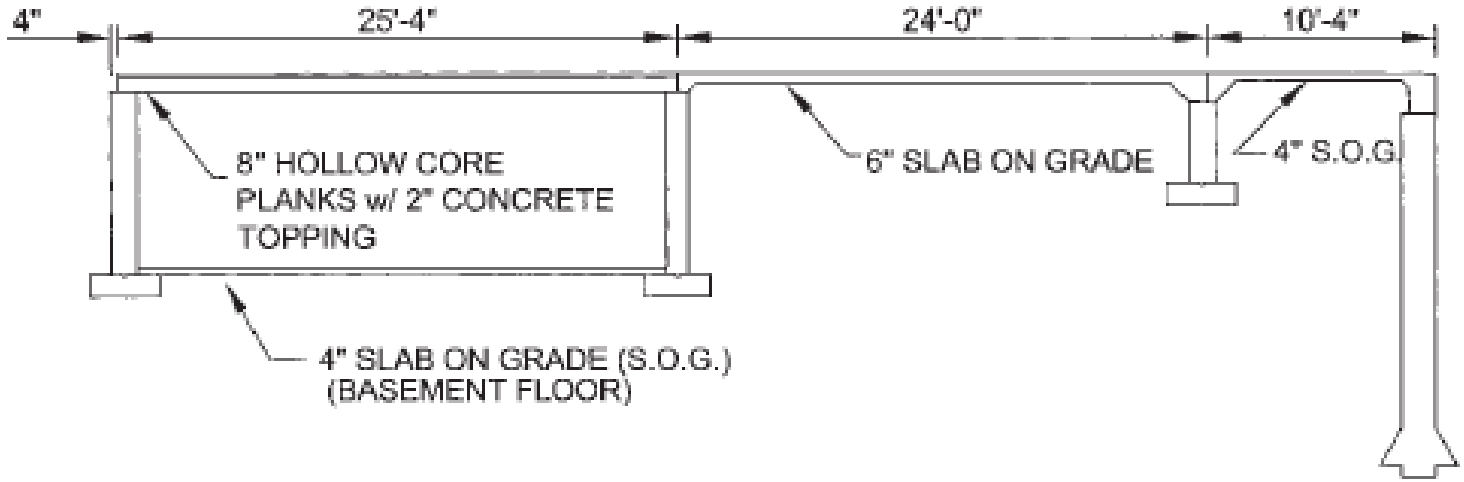


FIGURE 10.14. Foundation Wall and Slab Detail.

Solution of Example (5):
Concrete Slab

- First, there is the 745 sf (**25′ 3″** X **31′ 4″** less 46 sf for stair opening) of 2-inch-thick topping.

$$\text{Quantity of concrete (cf)} = 745 \text{ sf} \times 0.17' = 127 \text{ cf}$$

$$\text{Quantity of concrete (cy)} = 127 \text{ cf}/27 \text{ cf per cy} = 4.7 \text{ cy}$$

$$\text{Add 5\% waste} - \text{Use 5 cy}$$

Solution of Example (5):

Concrete Slab

- The second slab is the 4-inch-thick slab that is in the front of the building. This slab is on grade and is 300 sf (30 feet X 10 feet) and 4 inches thick. Because the edges of this slab are thickened and it is on grade, a larger waste factor will be used to compensate for this situation.

$$\text{Quantity of concrete (cf)} = 300 \text{ sf} \times 4''$$

$$\text{Quantity of concrete (cf)} = 300 \text{ sf} \times 0.333' = 100 \text{ cf}$$

$$\text{Quantity of concrete (cy)} = 100 \text{ cf}/27 \text{ cf per cy} = 3.7 \text{ cy}$$

$$\text{Add 8 percent waste} - \text{Use 4 cy}$$

Solution of Example (5):

Concrete Slab

- Third is the slab on grade for the remaining portion of the building that is at grade. This area is found by determining the area for the whole slab and by subtracting the 2-inch topping and 4-inch slab by the front entrance, as shown in Figure 10.13.

$$\text{Quantity of concrete (cf)} = 4{,}427 \text{ sf} \times 0.5' = 2{,}214 \text{ cf}$$

$$\text{Quantity of concrete (cy)} = 2{,}214 \text{ cf}/27 \text{ cf per cy} = 82 \text{ cy}$$

$$\text{Add 8 percent waste} - \text{Use 89 cy}$$

Slab Takeoff

- The other remaining slab is the floor for the portion of the building that is below grade. That takeoff is similar to the three previous examples and can be found in Figure 10.16 with all the slab takeoffs.

ESTIMATE WORK SHEET

Project: *Little Office Building* — Estimate No. *1234*
Location *Littleville, Tx* — Sheet No. *1 of 1*
Architect *U.R. Architects* — Slabs — Date *11/11/20xx*
Items *Foundation Concrete* — By *LHF* Checked *JBC*

Cost Code	Description	Dimensions Length Ft.	Length In.	Width Ft.	Width In.	Thickness Ft.	Thickness In.			Length Ft.	Width Ft.	Height Ft.	Volume C.F.	Quantity	Unit
	All Concrete is 2,800 psi														
	2" Thick Topping Over (2,800 psi)														
	Pre-Cast Hollow Core Planks	25	3	31	4	0	2			25.25	31.33	0.17	131.86		
	Add 5 % for Waste												138.45	5	C.Y.
	4" Thick Slab On Grade By The														
	Front Enterance	30	0	10	0	0	4			30.00	10.00	0.33	100.00		
	Add 8 % For Waste & Thickening												108.00	4	C.Y.
	6" Thick Slab On Grade (Whole Area)	99	4	59	4	0	6			99.33	59.33	0.50	2,946.89		
	Less Front Entrance	-30	0	10	0	0	6			-30.00	10.00	0.50	-150.00		
	Less 2" Topping	-25	3	31	4	0	6			-24.75	31.33	0.50	-387.75		
	Less Covered Patio	-25	0	15	0	0	6			-25.00	15.00	0.50	-187.50		
	Total Volume												2,221.64		
	Add 8% for Waste & Thickening												2,399.37	89	C.Y.
	4" Slab on Grade														
	(below Finish Floor)	22	0	28	4	0	4			22.00	28.33	0.33	207.78		
	Add 8% for Waste & Thickening												224.40	9	C.Y.

FIGURE 10.16. Slab Takeoff.

Example (6):
Labor Costs

- Find the labor cost for placing concrete in the **3′ 2″** -wide continuous footings.
- From the concrete takeoff in Figure 10.7, there are 42 cy of concrete. Using that quantity and the labor productivity information from Figure 10.17, the following calculations can be performed.

Type of Placement	Productivity Rate (Labor Hours/c.y)
Continuous Footing—Direct Chute	0.4
Spread Footing—Direct Chute	0.873
Drilled Piers	0.320
Formed Piers	0.873
Foundation Walls—Direct Chute	0.5
Grade Beams	0.4
Slab—Direct Chute	0.32

FIGURE 10.17. Labor Productivity Rates—Placing Concrete.

Example (6): Labor Cost

ESTIMATE WORK SHEET

Project: *Little Office Building* | Estimate No. *1234*
Location: *Littleville, Tx* | Sheet No. *1 of 1*
Architect: *U.R. Architects* | Date *11/11/20xx*
Items: *Foundation Concrete* | By *LHF* Checked *JBC*

FOOTING CONCRETE

Cost Code	Description	Dimensions Length Ft.	Length In.	Width Ft.	Width In.	Height Ft.	Height In.			Length Ft.	Width Ft.	Height Ft.	Volume C.F.	Quantity	Unit
	3-2" Wide Footing (2,800 psi)														
	Side A	39	10	3	2	1	0			39.83	3.17	1.00	126.14		
	Side B	34	4	3	2	1	0			34.33	3.17	1.00	108.72		
	Side C	14	10	3	2	1	0			14.83	3.17	1.00	46.97		
	Side D	21	10	3	2	1	0			21.83	3.17	1.00	69.14		
	Side E	18	2	3	2	1	0			18.17	3.17	1.00	57.53		
	Side F	30	8	3	2	1	0			30.67	3.17	1.00	97.11		
	Side G	32	0	3	2	1	0			32.00	3.17	1.00	101.33		
	Side H	6	10	3	2	1	0			6.83	3.17	1.00	21.64		
	Side I	34	4	3	2	1	0			34.33	3.17	1.00	108.72		
	Side J	6	10	3	2	1	0			6.83	3.17	1.00	21.64		
	Side K	42	0	3	2	1	0			42.00	3.17	1.00	133.00		
	Side L	55	8	3	2	1	0			55.67	3.17	1.00	176.28		
										337.33			1,068.22		
	Add 5 % for Waste												1,121.63		
	Total Concrete in 3'-2" Wide Footings													41.5	C.Y.
	3'-0" Wide Footing (2,800 psi)														
	Side M	22	0	3	0	1	0			22.00	3.00	1.00	66.00		
	Side N	34	4	3	0	1	0			34.33	3.00	1.00	103.00		
	Side O	22	0	3	0	1	0			22.00	3.00	1.00	66.00		
										78.33			235.00		
	Add 5 % for Waste												246.75		
	Total Concrete in 3'-2" Wide Footings													9.1	C.Y.
	Spread Footing								Quantity						
	3' Square Column Footings	3	0	3	0	1	0		1	3.00	3.00	1.00	9.00		
	Add 5 % for Waste												9.45		
	Total Concrete in 3' Square Sp. Ftg													1.0	C.Y.
	Use 1 C.Y.														

FIGURE 10.7. Concrete Footing Takeoff.

Solution of Example (6):

Labor Costs

$$\text{Labor hours} = \text{Quantity (cy)} \times \text{Productivity rate (labor hours/cy)}$$

$$\text{Labor hours} = 42 \text{ cy} \times 0.4 \text{ labor hours/cy}$$

$$\text{Labor hours} = 17 \text{ hours}$$

$$\text{Labor costs (\$)} = \text{Hours} \times \text{Wage rate}$$

$$\text{Labor costs (\$)} = 17 \text{ hours} \times \$13.50/\text{hour}$$

$$\text{Labor costs (\$)} = \$229.50$$

Cast-In-Place Concrete Estimate Summary

ESTIMATE SUMMARY SHEET

Project: *Little Office Building* | Estimate No.: 1234
Location: *Littleville, Tx* | Sheet No.: *1 of 1*
Architect: *U.R. Architects, Inc.* | Date: *11/15/20xx*
Items: *Foundation Concrete* | By: *LHF* Checked: *JBC*

Cost Code	Description	Q.T.O.	Waste Factor	Purch. Quan.	Unit	Crew	Prod. Rate	Wage Rate	Labor Hours	Unit Cost Labor	Unit Cost Material	Unit Cost Equipment	Labor	Material	Equipment	Total
	Continuous Footings 2800 psi															$0
	3'-2" Wide	40	5.00%	42	C.Y.		0.4	$13.50	15.8	$5.40	$52.50		$224	$2,181	$0	$2,405
	3'-0" Wide	9	5.00%	9	C.Y.		0.4	$13.50	3.5	$5.40	$52.50		$49	$480	$0	$529
	Spread Footing 2800 psi	1	0.00%	1	C.Y.		0.4	$13.50	0.4	$5.40	$52.50		$5	$53	$0	$58
	Drilled Piers - 2800 psi	4	10.00%	4	C.Y.		0.32	$13.50	1.2	$4.32	$52.50		$18	$225	$0	$243
	Foundation Walls - 2800 psi	84	5.00%	89	C.Y.		0.5	$13.50	42.2	$6.75	$52.50		$598	$4,655	$0	$5,253
	Grade Beams - 2800 psi	5	0.00%	5	C.Y.		0.4	$13.50	2.0	$5.40	$52.50		$29	$264	$0	$314
	Formed Pier - 2800 psi	1	0.00%	1	C.Y.		0.873	$13.50	0.9	$11.79	$52.50		$12	$53	$0	$64
	2" Topping - 2800 psi	5	5.00%	5	C.Y.		0.32	$13.50	1.6	$4.32	$52.50		$23	$283	$0	$306
	Slabs on Grade - 2800 psi															$0
	4" Thick at Front Entrance	4	5.00%	4	C.Y.		0.32	$13.50	1.3	$4.32	$52.50		$19	$227	$0	$245
	6" Slab (main level)	82	5.00%	89	C.Y.		0.32	$13.50	26.3	$4.32	$52.50		$364	$4,685	$0	$5,049
	4" Basement floor	8	5.00%	8	C.Y.		0.32	$13.50	2.5	$4.32	$52.50		$36	$436	$0	$472
																$0
																$0
																$0
																$0
																$0
																$0
																$0
																$0
																$0
																$0
																$0
																$0
																$0
																$0
																$0
																$0
																$0
									97.77				$1,399	$13,541	$0	$14,940

FIGURE 10.18. Cast-In-Place Concrete Estimate Summary.

Reinforcing

- **The reinforcing used in concrete may be:**
  - **reinforcing bars,**
  - **welded wire mesh (WWF), or**
  - **a combination of the two.**

Bar Designation	Nominal Diameter	Cross-Sectional Area (sq. in.)	Weight Pounds / Foot
2	¼"	.015	.167
3	3/8"	.11	.376
4	½"	.20	.668
5	5/8"	.31	1.043
6	¾"	.44	1.502
7	7/8"	.60	2.044
8	1"	.79	2.670
9	1.13"	1.00	3.400
10	1.27"	1.27	4.303
11	1.41"	1.56	5.313

FIGURE 10.19. Weights and Areas of Reinforcing Bars.

Example (7):

Foundation Reinforcing

- Determine the quantity of reinforcing steel required for the **side A** continuous footing of the building found in Figure 10.3, which was used to quantify the concrete.

- Side A is **39′ 10″** (Figure 10.3). This footing has reinforcing bars that run both the long and short dimensions (Figure 10.21).

Example (7):
Foundation Reinforcing

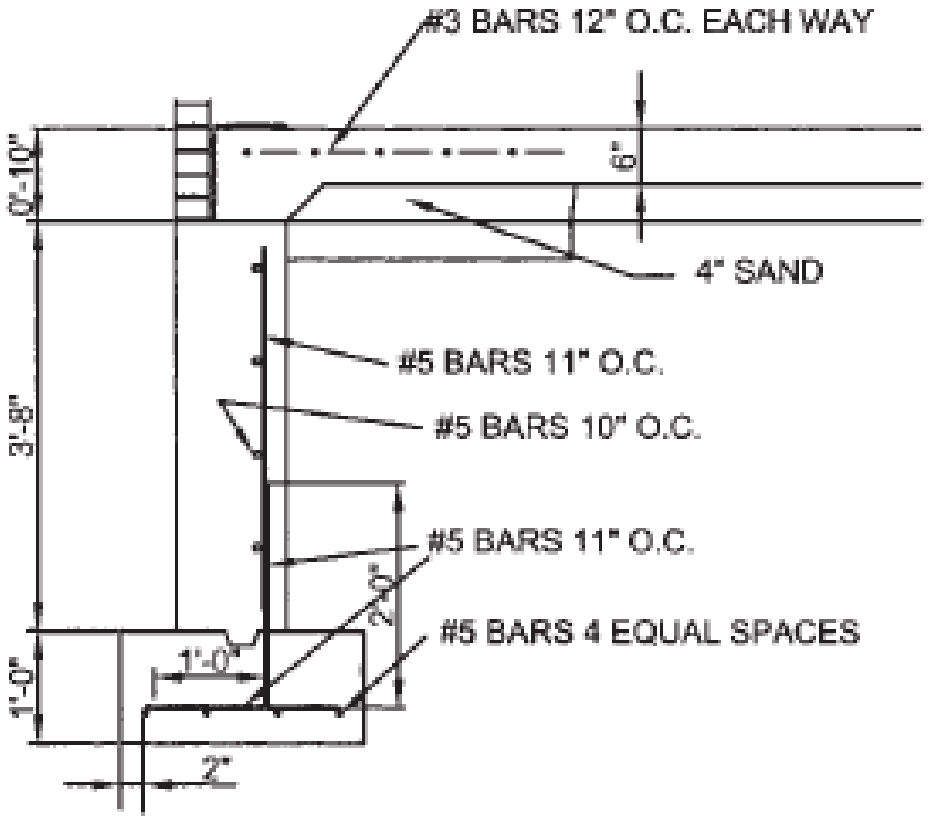


FIGURE 10.21. Footing Detail.

Solution of Example (7):

Foundation Reinforcing

Continuous Footing Short Bars

Number of short bar spaces = 39′10″/11″spacing

Number of short bars = 39.833′/0.9167 = 44 spaces

Add 1 to get the number of bars — Use 45 bars

The bar length is 2′10″, which is derived by subtracting the cover-age distance (2″ × 2) from the footing width (3′2″).

Total bar length (lf) = Number of bars
× Length of individual bars

Solution of Example (7):
Foundation Reinforcing

$$\text{Total bar length (lf)} = 45 \text{ bars} \times 2'10'' \text{ per bar}$$

$$\text{Total bar length (lf)} = 45 \text{ bars} \times 2.833' \text{ per bar} = 127.5 \text{ lf}$$

$$\text{No. 5 bar weighs } 1.043 \text{ pounds per lf}$$

$$\text{Total weight (pounds)} = 127.5 \text{ lf} \times 1.043 \text{ pounds per lf}$$
$$= 133 \text{ pounds}$$

Solution of Example (7):
Foundation Reinforcing

Continuous Footing Long Bars

Length of long bars = 39′6″

Total bar length (lf) = 39′6″ × 4 bars

Total bar length (lf) = 39.5′ × 4 bars = 158 lf

Total weight (pounds) = 158 lf × 1.043 pounds per lf
= 165 pounds

Total actual weight = 165 pounds + 133 pounds = 298 pounds

Add 10 percent for waste and lap – Use 328 pounds

Solution of Example (7):
Foundation Reinforcing

Foundation Wall Vertical Bars (Side A)

Number of vertical bar spaces = 38′10″/11″

Number of vertical bar spaces = 38.833′/0.9167′ = 42 spaces

Add 1 to get the number of bars − Use 43 bars

Bar length = Wall height − Bar coverage

Bar length = 3′8″ − 4″ = 3′4″ bar length

Solution of Example (7):

Foundation Reinforcing

Total bar length (lf) = Bar count × Length of individual bars (ft)

Total bar length (lf) = 43 bars × 3′4″

Total bar length (lf) = 43 bars × 3.33′ = 143 lf

Total weight (pounds) = 143 lf

× 1.043 pounds per lf = 149 pounds

Add 10 percent for waste and lap − Use 164 pounds

Number of horizontal spaces = 3′8″/10 inches

Number of horizontal spaces = 3.667′/0.833′

= 4.4 spaces − use 5

Solution of Example (7):

Foundation Reinforcing

$$\text{Number of bars} = \text{Spaces} + 1 = \text{Use 6 bars}$$

$$\text{Bar length} = 38'10'' - 4'' = 38'6''$$

$$\text{Total bar length (lf)} = 38'6'' \times 6$$

$$\text{Total bar length (lf)} = 38.5' \times 6 = 231 \text{ lf}$$

$$\text{Total weight (pounds)} = 231 \text{ lf} \times 1.043 \text{ pounds per lf} = 241 \text{ pounds}$$

$$\text{Add 10 percent for waste and lap} - \text{Use 265 pounds}$$

Solution of Example (7):

Foundation Reinforcing

Dowels

lf of each dowel = 3′

Number of dowels = 43

Total length of dowels = 43′ × 3′ = 129 feet

Total weight (pounds) = 129 feet × 1.043 pounds per foot
= 135 pounds

Add 5 percent for lap and waste — Use 142 pounds

Example (8): Slab Reinforcing

- Determine the quantity of reinforcing bars of the slab in Figure 10.22
- Using area A as an example, the long bars will be (**39′ 0″ - 2″**) or (**38′ 10″**) and the short bars would be (**25′ 4″ - 2″**) or (**25′ 2″**).

Example (8): Slab Reinforcing

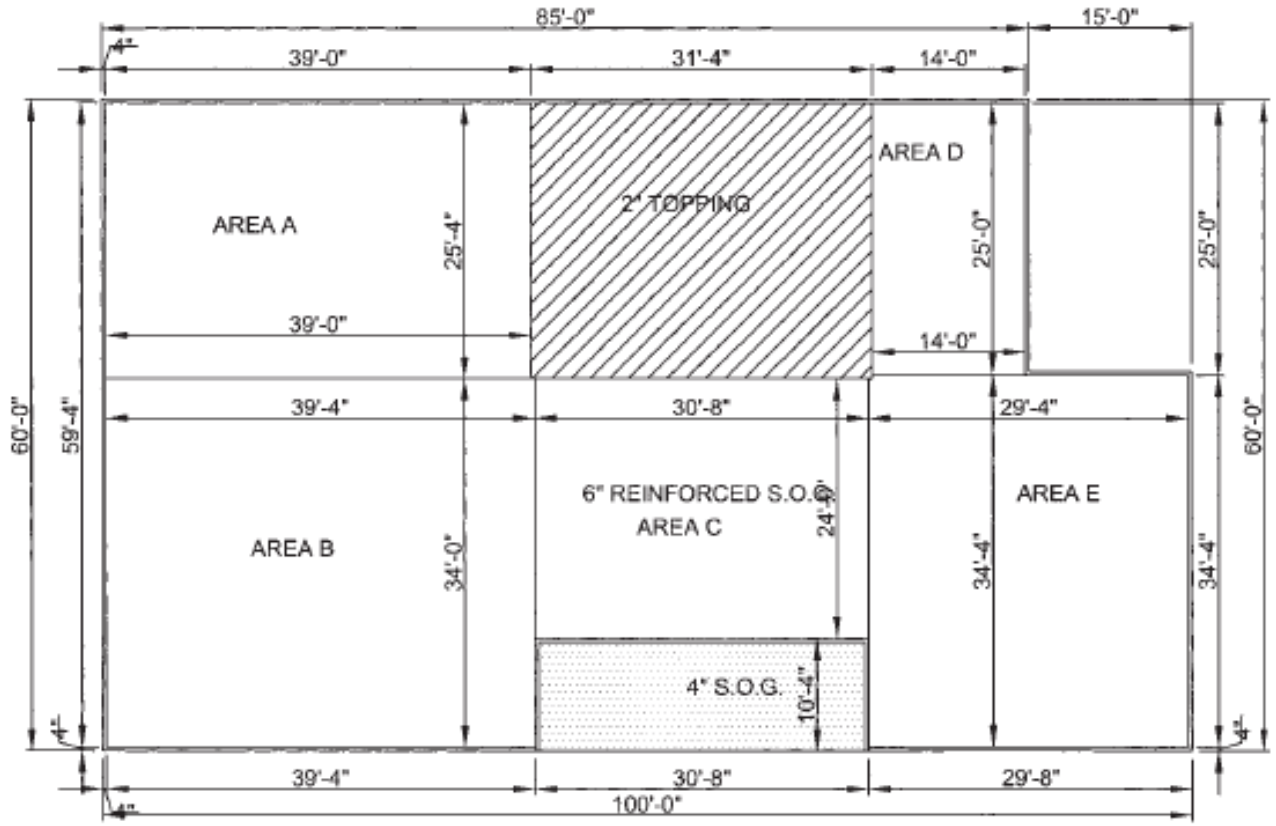


FIGURE 10.22. Reinforcing Steel Layout.

Solution of Example (8):

Slab Reinforcing

$$\text{Long bar spaces} = 25'4''/12''$$

$$\text{Long bar spaces} = 25.33'/1' - \text{Use 26 spaces}$$

$$\text{Add 1 to convert to bar count} - \text{Use 27 bars}$$

$$\text{Short bar spaces} = 39'0''/12''$$

$$\text{Short bar spaces} = 39'/1' = 39 \text{ spaces}$$

$$\text{Add 1 to convert to bar count} - \text{Use 40 bars}$$

Solution of Example (8):

Slab Reinforcing

Total length of long bars (lf) = 38′10″ × 27 bars

Total length of long bars (lf) = 38.833′ × 27 bars = 1,049 lf

Total length of short bars (lf) = 25′2″ × 40 bars

Total length of short bars = 25.167 × 40 bars = 1,007 lf

Total length of bars (lf) = 1,049 lf + 1,007 lf = 2,056 lf

Total weight of bars (pounds) = 2,056 lf × 0.376 pounds per foot

Total weight = 773 pounds

Add 10 percent for lap and waste – Use 850 pounds

Example (9): Grade Beam Reinforcing

- Determine the grade beam in the front of the building (30 feet long). The specifics of this grade beam are found in Figure 10.24.
- There are four No. 5 horizontal bars and No. 3 bars used for stirrups at 12 inches on center (o.c.).

Example (9): Grade Beam Reinforcing

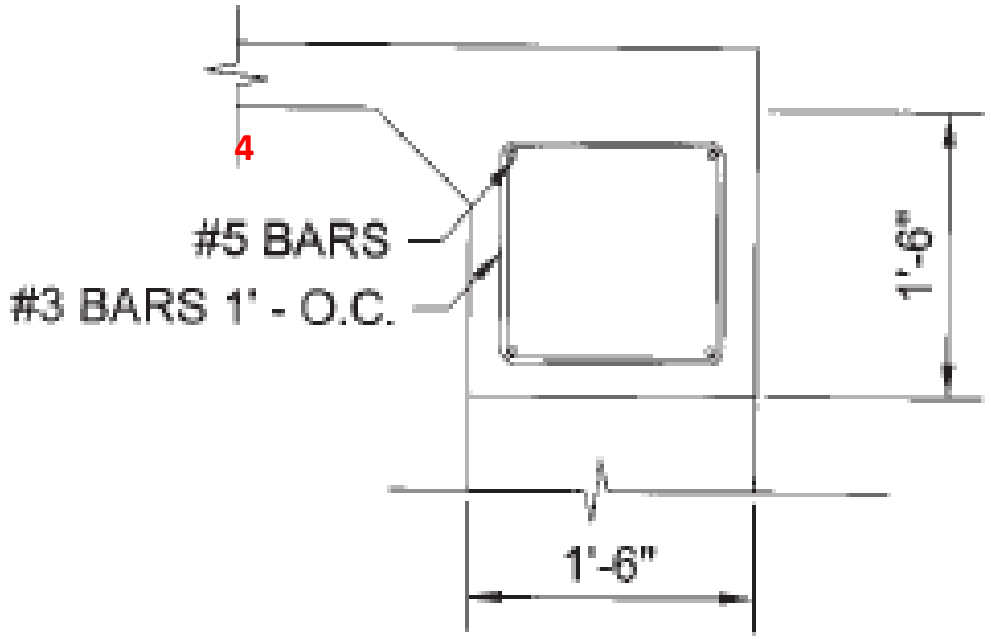


FIGURE 10.24. Grade Beam Details.

Solution of Example (9):
Grade Beam Reinforcing

Total quantity of bars No. 5 (lf) = 4 bars × 30′ per bar = 120 lf

Total weight of bars (pounds) = 120 lf × 1.043 pounds per foot

Total weight = 125 pounds

Add 10 percent for lap and waste – Use 138 pounds

Solution of Example (8):

Grade Beam Reinforcing

$$\text{Stirrup length} = 1'2'' \times 4$$

$$\text{Stirrup length (lf)} = 1.167' \times 4 = 4.7' \text{ per stirrup}$$

$$\text{Stirrup spaces} = 30'/1' \text{ stirrup spacing}$$

$$= 30 \text{ spaces} - \text{Use } 31 \text{ stirrups}$$

$$\text{Total length of No. 3 stirrups} = 31 \text{ stirrups} \times 4.7' = 146 \text{ lf}$$

$$\text{Total weight of stirrups (pounds)} = 146 \text{ lf} \times 0.376 \text{ pounds per foot}$$

$$\text{Total weight} = 55 \text{ pounds}$$

$$\text{Add 10 percent for lap and waste} - \text{Use } 61 \text{ pounds}$$

Reinforcing Steel Quantity Takeoff

ESTIMATE WORK SHEET

Project: *Little Office Building* | Estimate No. *1234*
Location: *Littleville, Tx* | Sheet No. *1 of 1*
Architect: *U.R. Architects* | Date *11/11/20XX*
Items: *Reinforcing Steel* | By *LHF* Checked *JBC*

Reinforcing Steel

Cost Code	Description	Slab Width Ft	Slab Width In	Bar Spacing In. -O.C.	Pcs	Slab Length Ft.	Slab Length In.	Cover age In.	Bar Length Ea	Bar Length Total	Bar Size 3	4	5	6	7	8	Bar Weight 3 (0.376)	4 (0.668)	5 (1.043)	6 (1.502)	7 (2.044)	8 (2.67)	Quantity	Unit
	Continuous Footing - Long Bars																							
	3'-2" Wide Footing	3	2	13	4	337	4	2	337.0	1348.0			X						1406					
	3'-0" Wide Footing	3	2	13	4	78	4	2	78.0	312.0			X						325					
	Continuous Footing - Short Bars																							
	3'-2" Wide Footing	337	4	11	369	3	2	2	2.8	1045.5			X						1090					
	3'0" Wide Footing	78	4	11	87	3	2	2	2.8	246.5			X						257					
	Continuous Footings - Dowels	337	4	11	369	3	2	0	3.2	1168.5			X						1219					
	Total Continuous Footings																						4286	Pounds
	Foundation Walls																							
	Short Walls (Short Bars)	303	8	11	332	3	8	2	3.3	1106.7			X						1154					
	Short Walls (Long Bars)	3	8	10	6	303	0	2	302.7	1816.0			X						1894					
	Foundation Walls																							
	Tall Walls (Short Bars)	112	8	11	124	8	4	2	8.0	992.0			X						1035					
	Tall Walls (Long Bars)	8	4	10	11	112	8	2	112.3	1235.7			X						1289					
	Total Foundation Walls																						5372	Pounds
	Grade Beams																							
	Front (Long Bars)				4	30		0	30.0	120.0			X						125					
	Stirrups	30	4	12	32	4	8	0	4.7	149.3	X						56							
	Back (Long Bars)				4	38	10	0	38.8	155.3			X						162					
	Stirrups	38	10	12	40	4	0	0	4.0	160.0	X						60							
	Total Grade Beams																						403	Pounds
	S.O.G.																							
	A Long Bars	39	0	12	40	25	4	2	25.0	1000.0	X						376							
	A Short Bars	25	4	12	27	39	0	2	38.7	1044.0	X						393							
	B Long Bars	39	4	12	41	34	0	2	33.7	1380.3	X						519							
	B Short Bars	34	0	12	35	39	4	2	39.0	1365.0	X						513							
	C Long Bars	30	8	12	32	24	0	2	23.7	757.3	X						285							
	C Short Bars	24	0	12	25	30	8	2	30.3	758.3	X						285							
	D Long Bars	25	0	12	26	14	0	2	13.7	355.3	X						134							
	D Short Bars	14	0	12	15	25	0	2	24.7	370.0	X						139							
	E Long Bars	34	4	12	36	29	4	2	29.0	1044.0	X						393							
	E Short Bars	29	4	12	31	34	4	2	34.0	1054.0	X						396							
	Total Slab On Grade																						3432	Pounds
	Total Weight																3549	0	9957	0	0	0.00		

FIGURE 10.25. Reinforcing Steel Quantity Takeoff.

Reinforcing Steel Quantity Takeoff

ESTIMATE WORK SHEET

Project: *Little Office Building*
Location: *Littleville, Tx*
Architect: *U.R. Architects*
Items: *Reinforcing Steel*

Reinforcing Steel

Estimate No. *1234*
Sheet No. *1 of 1*
Date *11/11/20XX*
By *LHF* Checked *JBC*

Cost Code	Description	Slab Width Ft	Slab Width In	Bar Spacing In. -O.C.	Pcs	Slab Length Ft.	Slab Length In.	Cover age In.	Bar Length Ea	Bar Length Total	Bar Size 3	4	5	6	7	8	Bar Weight 3 (0.376)	4 (0.668)	5 (1.043)	6 (1.502)	7 (2.044)	8 (2.67)	Quantity	Unit
	Reinforcing Piers Vertical Bars				12	16	0	3	15.5	186.0			X						194					
	Reinforcing Piers Dowels				12	3	7	0	3.6	43.0			X						45					
	Reinforcing Piers - Stirrups	48	0	12	49	8	3	0	8.3	404.3	X						152							
	Total Drilled Piers																						391	Pounds
	Spread Footing (Long Bars)	3	0	13	4	3	0	2	2.7	10.7			x						11					
	Spread Footing (Short Bars)	3	0	13	4	3	0	2	2.7	10.7			x						11					
	Dowel				4	3	2	0	3.2	12.7			x						13					
	Vertical Bars				4	3	8	2	3.3	13.3			x						14					
	Pier Stirrups	3	8	12	5	2	8	0	2.7	13.3	x						5							
	Total Spread Footings																						54	Pounds
	Front Entrance																							
	Long Bars	30	8	12	32	10	4	2	10.0	320.0	x						120							
	Short Bars	10	4	12	12	30	8	2	30.3	364.0	x						137							
	Exterior Slab On Grade																						257	Pounds
	Total Weight																414	0	288	0	0	0.00		

FIGURE 10.25. (*Continued*)

THE END OF LECTURE (5)