The author is Rick Scott, CPE, President of Rick Scott Construction, Inc., a General Contractor based in Ponca City, Oklahoma. Rick Scott formed the company in August of 1996. Prior to starting Rick Scott Construction, Inc. Rick had worked for another General Contractor for the previous 18 years. Prior to his career in construction, Rick earned an Associates Degree in Construction Technology at Northern Oklahoma College in Tonkawa, Oklahoma.

Rick acts as Chief Estimator for the company as well as General Manager. The company, with a branch office in Tulsa, Oklahoma, specializes in commercial construction projects such as schools, banks, churches, museums, and athletic facilities.

1) Introduction
   • Main CSI Division
   • CSI Division
   • Brief Description
2) Types and Methods of Measurement
3) Factors That May Affect Take-Off and Pricing
   • Effects of Small Project vs. Large Project
   • Effects of Short Length of Walls vs. Long Straight Walls
4) Overview of Measurement, Labor, Equipment, and Indirect Costs
   • Materials
   • Labor
   • Equipment
   • Indirect Costs
   • Markup
5) Special Risk Consideration
6) Ratios and Analysis
7) Miscellaneous Pertinent Information
8) Sample Project Sketch
9) Sample Project Take Off
The strengths and uses of mortar are classified as:
- Type N – used in general veneer masonry above grade
- Type S – used in structural applications and more durable veneer applications
- Type M – typically used only below grade
- Type O – very soft mortar usually only used in restoration projects where it is critical to match the existing mortar

The required strength of the mortar will be found either in the specifications or notes on the structural plan pages.

I will be using Type S mortar mix which is a 75 lb. sack of a proper mix of portland cement and lime. This sack yields one cubic foot. Approximately 2 1/2 cubic feet of sand (aggregate) is added to this portland cement and lime mix along with approximately 5 gallons of water to complete the batch. This batch of cement, lime, sand, and water mix will lay about (30) 8” x 8” x 16” block.

The grout used to reinforce the CMU can be mixed on site but in this example, we will be ordering redi-mixed grout from a concrete supplier.

This grout will be delivered to the job site via concrete truck and deposited either directly into the wall from the truck or through a grout pump to the higher or inaccessible areas of the wall. We will need to calculate the volume of grout needed in measurements of cubic yards. Again, the strength requirements of the grout will be found in the specifications or notes on the structural drawing. The strength will be described in compressive strength of pounds per square inch and for this paper I will be using 2500 PSI grout.

In the grout-filled blocks, I will need to find the size, length, and number of rebar pieces in each length of grout filled cell and beam. After I find the total length of each size rebar, I will convert that to tons of rebar.

In addition to the rebar reinforcing, most CMU walls are reinforced with 9 gauge wire ladder or truss shaped reinforcing called joint reinforcing. We must find the vertical spacing of this joint reinforcing, which is usually required at every other course or 16” on center vertically.

While performing the take off, the estimator must be aware of the different types of walls called out in the drawings. The plans will typically include a wall schedule which identifies the various wall types by using a lettering system. This schedule will provide a description of the wall construction material (drywall, CMU, wood frame, etc.), wall thickness, insulation required, and sometimes the top of wall elevations. The architectural and structural floor plan is where the lengths of the different types of walls as indicated by the designation from the wall schedule will be found. Either the wall schedule, elevations or wall sections will be where the wall heights are found. The Floor Plan and Elevations will also indicate openings in the walls, such as doors and windows. The estimator is also advised to review all drawings for items of work by others that may affect the construction of the CMU wall such as openings for mechanical systems.
The primary unit of measure that I prefer for this assembly is square footage of wall; other estimators may use the unit of measure “number of block”. Both measures are equally effective. The reason I prefer to look at the cost of a CMU wall per square foot rather than the cost per block is because the unit “cost per square foot” is more interchangeable or comparable to other framing systems unit of measure.

<table>
<thead>
<tr>
<th>The following measurements must be taken off the plans:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length wall</td>
<td>Lw</td>
</tr>
<tr>
<td>Height wall</td>
<td>Hw</td>
</tr>
<tr>
<td>Length of each opening*</td>
<td>Lop 1, Lop 2, etc.</td>
</tr>
<tr>
<td>Height of each opening*</td>
<td>Hop 1, Hop 2, etc.</td>
</tr>
<tr>
<td>Length of Horizontal Bond Beams: Including over openings</td>
<td>Lhbb</td>
</tr>
<tr>
<td>Total Length vertical grout-filled Block</td>
<td>Lve</td>
</tr>
<tr>
<td>Length each size rebar</td>
<td>Lrb1, Lrb2, etc.</td>
</tr>
<tr>
<td>Spacing of joint reinforcement</td>
<td>Sjr</td>
</tr>
</tbody>
</table>

*Openings the size of standard walk doors and smaller are sometimes not measured for the purpose of estimating the square footage of the wall, but for the purpose of this paper, I will measure the smaller openings and deduct the area from the total.

All of the above measurements need to be made in feet and/or decimals of a foot. From these measurements the following formulas are used to calculate the materials:

Area Wall = (Lw x Hw) – [(Lop 1 x Hop 1) + (Lop 2 x Hop 2) + (additional openings if any)]

Total # Block = Area Wall / .888

# Solid Bottom Bond Beams = (Lop 1 + 1.333⁴) + (Lop 2 + 1.333⁴) + (additional opening if any + 1.333⁴) / 1.333³

# Bond Beam Block = (Lhbb/1.333⁴) - # Solid Bottom Bond Beam Block

# Stretchers/Corners = Total # block – (# bond beam + # solid bottom bond beam)

Sacks of Cement = Total # block / 30⁴

Yards of Sand = (Sacks of cement x 2.5⁵) / 27⁶

Gallons of Water = Sacks of cement x 5⁷

Cubic Yards of Grout = [(Lhbb + Lve) / 157⁸

Tons of Rebar = (Lrb #1 x wt per ft) + (Lrb #2 x wt per ft) + (additional rebar x wt per ft) / 2000⁹

Length Joint Reinforcement = Area wall / Sjr

Waste quantities must be added to most all materials. This waste factor is for damaged and spoiled material. In the case of rebar I add an additional factor of 10% for overlaps. In the estimate at the end of this paper you will see how I account for waste.

1) .888 is the area in square feet for the face of a 16” x 8” block.
2) 1.333 is the 8” bearing length on each side of an opening for the solid bottom beam block.
3) 1.333 represents the length in feet of a 16” block.
4) 30 is the number of block one batch of mortar will lay.

5) 2.5 represents the cubic foot of sand required for each batch of mortar.
6) 27 represents the number of cubic feet in a yard.
7) 5 represents the gallons of water required for each batch of mortar.
8) Linear feet of horizontal & vertical grout-filled beams per cubic yard of grout
9) 2000 is the number of pounds per ton
ESTIMATE THE COST OF A CONCRETE MASONRY UNIT WALL

LABOR

Labor costs will be a function of the material quantity and in this case will be based only on the total number of block. The labor positions that can be required are: Masonry Superintendent, Lead Mason, Mason, Labor Foreman, and Laborer. The size of the job and the total number of masons that will be on a job determine the need for a masonry superintendent and labor foreman. Generally speaking, if there will be five or less masons on the job, there is really no need for a masonry superintendent. On smaller jobs, the lead mason can assume the role of superintendent and still lay block. If a job requires a superintendent, he will not be expected to lay block. The size of this small job will not require the masonry superintendent.

On most jobs, the mason to laborer ratio is one to one, so for every mason, I will figure having one laborer on the job. If the job is very small, then the ratio may go to two to one or two masons to one laborer.

If the amount of grout fill is larger than normal or if the building is tall, it may require you to add laborers for the increased work caused by the additional grout and/or height of wall.

On a normal job with standard grouting requirements that are less than 20 feet tall, a mason should be able to lay an average of 200 blocks per day. This will be used as the bases for estimating labor in my example.

EQUIPMENT

The basic equipment required for any masonry project will be: Mortar mixer, Block saw, Wheel barrow, Mortar tubs, Mortar stands, Mortar boards, and Mason’s hand tools.

As the job size increases, additional equipment required will be: Scaffolding, Skid loader with forks, High reach fork lifts, Self-climbing scaffolding.

For this estimate, I will be using the list of basic equipment, along with standard scaffolding and a skid loader with forks.

The cost of the equipment will be calculated by taking the total number of block divided by 200 (average number of block a mason can lay per day). Then, that number divided by the number of masons I intend on having work on that project simultaneously. This will give the number of days the equipment will be required, then multiplying that number by the daily equipment cost for each piece of equipment as prescribed by your company or a third party rental company.

INDIRECT COSTS

Costs that may need to be considered and included in the estimate are: Transportation costs of employees, Freight for materials, Enclosures (cold weather work), Temporary heat (cold weather work), and PPE (personal protection equipment).

These costs need to be considered on a job-by-job basis depending on the requirements of the job.

MARKUP

I prefer to have differing overhead markups for labor, material, and equipment, rather than one mark up for the total direct job costs. I prefer this method because the overhead costs and risks associated with labor are substantially higher than that of material and equipment. Therefore, it is my view that if a job is a proportionately high labor job, my overhead expense for that job is going to be higher than that of a job with a lower labor cost and a higher material cost.

For the purpose of this paper, I will be using: 15% overhead mark up for labor, 10% overhead mark up for material, 12% overhead mark up for equipment, and 5% profit mark up on all job costs excluding overhead.

SPECIAL RISK CONSIDERATIONS

At this time, one of the largest unforeseen variables is the cost of labor and materials. At this time (March 2009), costs have stabilized somewhat as compared to one year ago. For the preceding three years, the cost of cement, aggregates, and fuel were rising on a daily basis, resulting in a guessing game when bidding projects that would not start for six months. I think the lessons of the last three years have taught us that cost escalation can happen at any time and be quite rapid. Therefore, a close eye on the global economy is wise; the first sign of cost increases will appear when the economy is improving.

Another large variable when bidding a masonry project is the competence of the general contractor and his on-site superintendent. A good contractor and his superintendent can make the job a breeze. They will have gathered and coordinated all pertinent information for you prior to mobilization to the site, including anchor bolts and their locations, wall layout and rough opening sizes. By the time you arrive on the job, the walls will be laid out, door jambs set, and all items you have to build into the wall will be on site. If these things are not done in a timely manner and the masonry crew has to wait for these items or demobilize and remobilize, the production will decrease dramatically. My advice on this point is to know your contractor and if you don’t know them, ask for references. Other subcontractors will likely be willing to share with you their experiences, both good and bad.

RATIOS AND ANALYSIS

As we have discussed earlier, I prefer to analyze the job as a whole on the cost per square foot. Historical job cost and labor hour information will be invaluable to you particularly the production rate of units laid per day. Units laid per day is the biggest variable in the masonry estimate. The material amounts are relatively easy to pin down regardless of production, time of year, height, etc., and the cost of equipment is calculated by the number of days on the job, which is directly related to the labor production. So, if you have a good database of historical job-related costs and hours based on a number of parameters, such as job size, height, time of year, masonry superintendent, general contractor, and general contractor superintendent, the final bid amount should be accurate. These final bid amounts can be looked at and compared to past jobs to ensure...
they are within an acceptable range. Furthermore, in the value engineering stage of the job, the cost of the wall per square foot can easily be compared to other framing methods and materials.

MISCELLANEOUS PERTINENT INFORMATION

Be careful to review the specifications, particularly your division of work, but also the General and Supplementary Conditions. There may be pertinent information in these sections that may pertain to you, including working hours, lay down yard area, parking restrictions, and so on. Pay close attention to your particular specification sections and related sections for material and product requirements, quality requirements, extra stock, etc. Also, the specifications may require that certain items such as rebar may be provided by the general contractor and installed by the mason. So if this is the case, the inclusion of the rebar material in your bid costs will greatly reduce your chances of success in winning the bid.

Review all plans for items of work by others that may affect the final cost of work by you. There may be mechanical and electrical items built into your work that may adversely affect the production rates and thus, the cost of the masonry job.
HOW TO: ESTIMATE THE COST OF A CONCRETE MASONRY UNIT WALL

WAREHOUSE BUILDING

SCALE 1/4"=1'-0"

WALL SCHEDULE

1. 6" x 8" x 16" CMU
2. 2 x 4 WOOD STUCCO

DOOR SCHEDULE

1. 3'-0" H/DOOR FR/FRAME 3'-7" SINGLE OPENING
2. 4'-0" O/DOOR 16'-0" ROUGH OPENING
3. 18'-0" O/DOOR 16'-0" ROUGH OPENING
4. 3'-0" WOOD PANELED DOOR/FRAME 3'-7" X 6

STRUCTURAL NOTES

- CMU shall conform to ASTM C 90, Heavy Weight
- Mortar shall conform to ASTM C 270, Type S
- Gross shall be 2800 psi
- Vertical bond beam shall be at each corner, each joist well & at 4'-0"
- Horizontal bond beams shall have 2" @ 12" on center
- Vertical steel shall be #4 rebar grade 60
- Steel reinforcement shall be #4 rebar, 18" on center, to 18" G.C.

WALL SECTION 1-1

SCALE 3/4"=1'-0"
# Masonry Take Off

**Job:** Warehouse Building 3199  
**Type of Wall:** 8" Standard Masonry Wall

<table>
<thead>
<tr>
<th>Description</th>
<th>Abbreviation</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length Wall</td>
<td>LW</td>
<td>300.00'</td>
<td>IP</td>
</tr>
<tr>
<td>Height Wall</td>
<td>HW</td>
<td>10.00'</td>
<td>IP</td>
</tr>
<tr>
<td>Length Opening #1 X 4</td>
<td>LOP1</td>
<td>3.33'</td>
<td>IP</td>
</tr>
<tr>
<td>Height Opening #1</td>
<td>HOP1</td>
<td>7.333'</td>
<td>IP</td>
</tr>
<tr>
<td>Length Opening #2</td>
<td>LOP2</td>
<td>10.00'</td>
<td>IP</td>
</tr>
<tr>
<td>Height Opening #2</td>
<td>HOP2</td>
<td>10.00'</td>
<td>IP</td>
</tr>
<tr>
<td>Length Opening #3</td>
<td>LOP3</td>
<td>18.00'</td>
<td>IP</td>
</tr>
<tr>
<td>Height Opening #3</td>
<td>HOP3</td>
<td>18.00'</td>
<td>IP</td>
</tr>
<tr>
<td>Length Horizontal Bond Beam</td>
<td>LHB</td>
<td>1472.00'</td>
<td>IP</td>
</tr>
<tr>
<td>Length Vertical Grout Fill</td>
<td>LVG</td>
<td>1573.333'</td>
<td>IP</td>
</tr>
<tr>
<td>Length RRare 1</td>
<td>LRR1</td>
<td>33.44.000'</td>
<td>IP #5</td>
</tr>
<tr>
<td>Length RRare 2</td>
<td>LRR2</td>
<td>1573.333'</td>
<td>IP #4</td>
</tr>
<tr>
<td>Spacing Residential Soil Bearing Spec</td>
<td></td>
<td>1.25'</td>
<td>IP</td>
</tr>
</tbody>
</table>

*See Worksheet*

---

**Length Horizontal Bond Beam**

- 10 Courses @ 200' = 1800.00'
- 3 Courses @ 3.333' = (29.996') Walk Doors
- 3 Courses @ 10.000' = (48.000') 16' X 12' OH Door
- 4 Courses @ 18.000' = (72.000') 18' X 16' OH Door
- 4 Courses @ 5.000' = 18.000'

LHB = 1472.00'

**Length Vertical Grout Fill**

- 2 Walls @ (100 / 4) + 1 = 28
- 2 Walls @ (50 / 4) + 1 = 28

80

**Filler Cells**

<table>
<thead>
<tr>
<th>Filler Cells</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 20'</td>
<td>11,000'</td>
</tr>
<tr>
<td>@ 7.333'</td>
<td>29.333'</td>
</tr>
<tr>
<td>@ 10.000'</td>
<td>24.000'</td>
</tr>
<tr>
<td>@ 18.000'</td>
<td>24.000'</td>
</tr>
<tr>
<td>@ 18.000'</td>
<td>18.000'</td>
</tr>
<tr>
<td>LVC =</td>
<td>1573.333'</td>
</tr>
</tbody>
</table>

Note: May or May Not be Required Depending on Layout, For Estimating Purposes We Will Add It.
HOW TO: ESTIMATE THE COST OF A CONCRETE MASONRY UNIT WALL

MASONRY TAKE-OFF WORKSHEET
Job: Warehouse Building 3/09

LENGTH HORIZONTAL CONCRETE BEAM

- 16 courses @ 240" = 1,920.00
- 3 courses @ 2,333" = 2,199.99
- 3 courses @ 16,000" = 48,000.00
- 4 courses @ 11,000" = 44,000.00
+ 4 courses @ 4,400" = 18,400.00
--- Total: 117,720.00

LENGTH VERTICAL CONCRETE WALLS

- 2 walls @ (20" / 4) + 1 = 52
- 2 walls @ (20" / 4) + 1 = 28
--- Total: 80

TOTAL MATERIAL COST: 117,720.00

MATERIAL CALCULATIONS
Job: Warehouse Building 3/09

AREA WALL: (200 x 200) - ((333.3 x 733.3) x 9) + (19 x 12) + (18 x 16) = 5425.00

Total # Blocks: 5425 ÷ 333 = 16.27 + 10% waste = 18.71

# Sills/Bottom Beam Blocks: (333.3 + 333.3) x 4 + (19 x 1333) + (1333 x 2) = 6921.5
...بعد้าً على حسب الجدول...

# Door Block: (16 x 72,000 / 1,333) + 10% waste = 1234

# Sill Trench & Courses: 1718 ÷ (20 + 1333) = 6338

Sacks of Cement: 6338 ÷ 20 = 317

Yards of Sand: (924 x 2.5) ÷ 27 = 21

Gallons of Water: 224 x 5 = 1120

Cubic Yards of Grout: (171,600 + 157,333) ÷ 1,333 = 212.47 + 10% waste = 23

Tons Rebar: (157,333 x 1.88) + 0.00 x 1,000) ÷ 2,000 = 2.14 + 10% waste = 2

Length Joint Reinforcement: 5425.00 ÷ 1,333 = 4.08 + 10% waste = 4.475

ROUND UP ON ALL QUANTITIES TO THE NEAREST WHOLE NUMBER *
### Material Consolidation and Pricing

**York Warehouse Building 3/09**

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
<th>Unit</th>
<th>Price</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Bottom Beam Block</td>
<td>48</td>
<td>ea</td>
<td>$1.35</td>
<td>$71.30</td>
</tr>
<tr>
<td>Bond Beam Block</td>
<td>1384</td>
<td>ea</td>
<td>$1.54</td>
<td>$2,054.36</td>
</tr>
<tr>
<td>Stretchers/Corners Block</td>
<td>533.8</td>
<td>ea</td>
<td>$1.33</td>
<td>$714.64</td>
</tr>
<tr>
<td>Bags of Cement</td>
<td>224</td>
<td>ea</td>
<td>$7.35</td>
<td>$1,617.20</td>
</tr>
<tr>
<td>Yards Sand</td>
<td>21</td>
<td>cy</td>
<td>$10.00</td>
<td>$210.00</td>
</tr>
<tr>
<td>Gallons Water</td>
<td>885</td>
<td>gal</td>
<td>NC</td>
<td>NC</td>
</tr>
<tr>
<td>Yards Grout</td>
<td>23</td>
<td>cy</td>
<td>$4.05</td>
<td>$94.95</td>
</tr>
<tr>
<td>Tons Rebar</td>
<td>1.72</td>
<td>ton</td>
<td>$842</td>
<td>$1,490.24</td>
</tr>
<tr>
<td>Joint Reinforcement</td>
<td>475</td>
<td>if</td>
<td>$1.05</td>
<td>$499.75</td>
</tr>
<tr>
<td><strong>Total Material</strong></td>
<td></td>
<td></td>
<td></td>
<td>$17,835.57</td>
</tr>
</tbody>
</table>

### Labor Calculations

**York Warehouse Building 3/09**

**Total Block = 6718 ÷ 200 = 33.59 Mason Days**

- 33.59 x 8 hrs/day = 269 Mason hrs
- 269 Mason hrs @ $40.90 per hr (Mason) = $10,740

**269 hrs @ $28.00 per hr (laborer) = $7,532**

**Total Labor Cost = $18,272**

### Equipment Calculations

**York Warehouse Building 3/09**

269 Mason hrs ÷ 3 Mason Crew = 89.67 Equipment hrs

89.67 Equipment hrs ÷ 8 hrs/day = 11.20 or 12 Equipment Days

<table>
<thead>
<tr>
<th>Equipment</th>
<th>12 Days @ $40 per day</th>
<th>12 Days @ $5 per day</th>
<th>3 Per Month</th>
<th>12 Days @ $75 per day</th>
<th>Total Equipment Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortar Mixer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$480</td>
</tr>
<tr>
<td>Block Saw</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$60</td>
</tr>
<tr>
<td>Scaffolding</td>
<td>12 Days @ $350</td>
<td></td>
<td></td>
<td></td>
<td>$900</td>
</tr>
<tr>
<td>Skin Loader</td>
<td>12 Days @ $750</td>
<td></td>
<td></td>
<td></td>
<td>$1,830</td>
</tr>
<tr>
<td><strong>Total Equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>$3,870</strong></td>
</tr>
</tbody>
</table>
### Estimate the Cost of a Concrete Masonry Unit Wall

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Overhead</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labor Cost</strong></td>
<td>$18,242.60</td>
<td>$1743.80</td>
</tr>
<tr>
<td><strong>Material Cost</strong></td>
<td>$19,733.50</td>
<td>$1973.30</td>
</tr>
<tr>
<td><strong>Equipment Cost</strong></td>
<td>$1520.00</td>
<td>$219.60</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$39,956.09</td>
<td>$4,963.74</td>
</tr>
<tr>
<td><strong>Profit 6%</strong></td>
<td>$1,992.78</td>
<td></td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>$41,948.87</td>
<td></td>
</tr>
<tr>
<td><strong>Overhead</strong></td>
<td>$1,934.70</td>
<td></td>
</tr>
<tr>
<td><strong>Profit</strong></td>
<td>$1,992.78</td>
<td></td>
</tr>
<tr>
<td><strong>Bid Amount</strong></td>
<td>$46,835.30</td>
<td></td>
</tr>
</tbody>
</table>

**Per Square Foot Amount**: $46,835.30 / 540 sq. ft = $85.63 per square foot

---

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