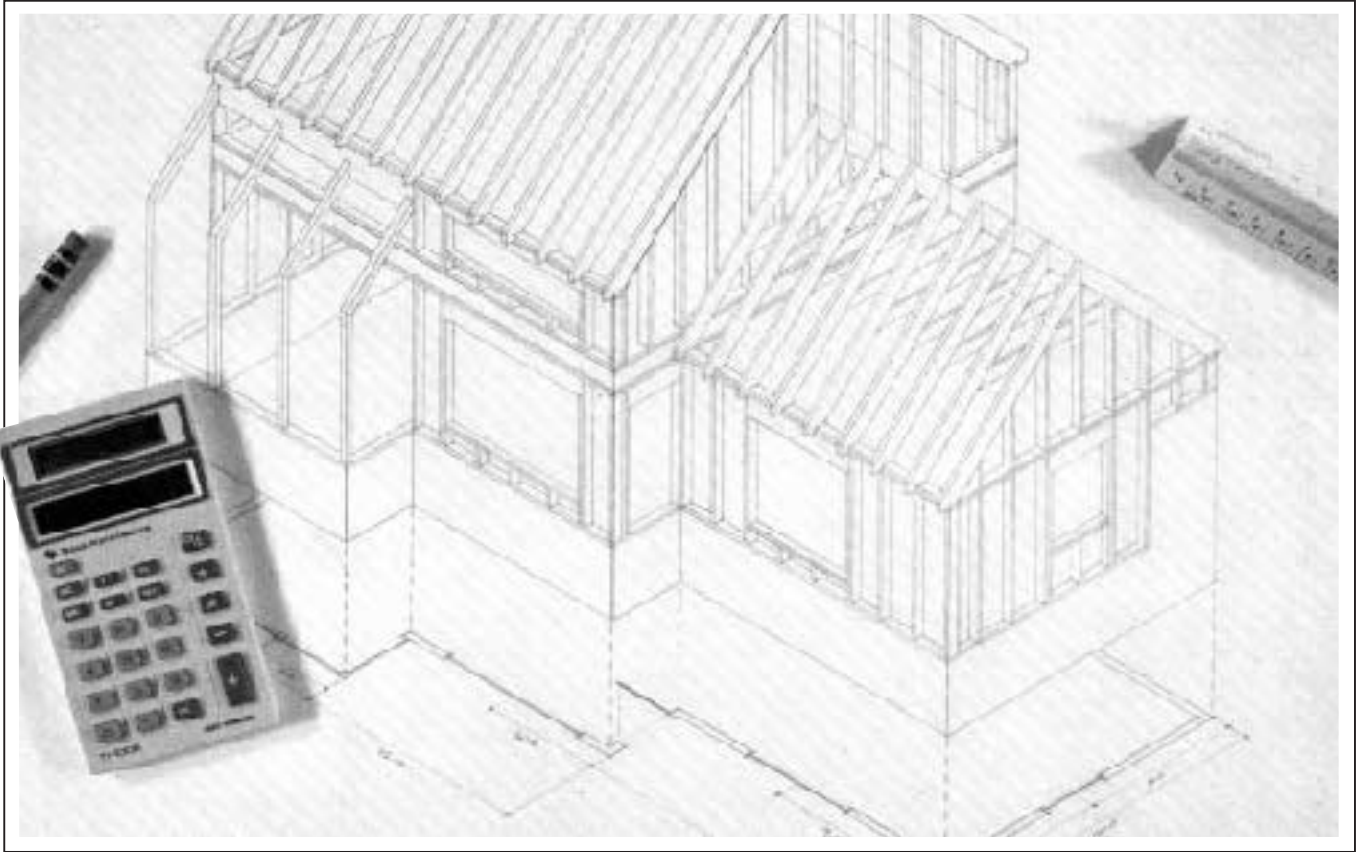


Case Study: Estimating by the Stick



by Clayton DeKorne

Few small builders find unit pricing feasible. Here's a look at how good records, good judgment, and a mental walk-through can yield an accurate estimate.

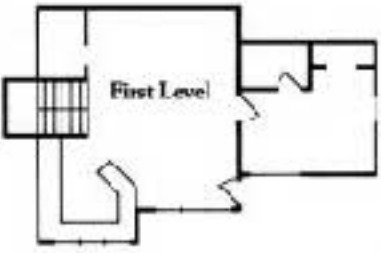
Wouldn't you love to have seen those other bids on that last project you estimated? Last spring, I had the opportunity to get a close look at three competing bids when I sat in on a meeting of builders here in Vermont. They met under the auspices of a local builder's group, which was planning to build and market an affordable, healthy, and energy-efficient house. Each builder worked up his own estimate to help the group accurately price the completed project. Instead of pre-

senting the bids in private to the client, the three builders discussed their bids openly — offering us the rare opportunity to dissect and compare the competing bids. The bids for framing, exterior trim, siding, and interior woodwork on the 1760-square-foot house came in closely spaced at \$34,421, \$34,499, and \$35,165. The bids did not include development costs, site work, foundation and slab, plumbing, heating, electrical, insulation, drywall, or cabinets, since these would be handled by subs. (A sum-

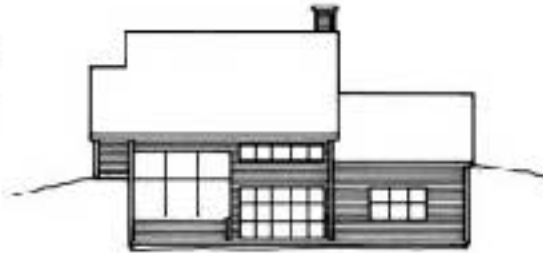
mary of these costs has been included at the end of this article for your comparison.)

Material Takeoffs

As is often the case on small projects, the builders had floorplans, elevations, and general specifications, but no framing plans or detailed specs. All of the builders were accustomed to bidding off rough plans since they often do their own design work. For them, the material takeoff provides an



Plans



Elevations

Specifications for General Contract

House is designed for a sloped site, and placed partially into the hillside. First floor is slab with walk-out on south side.

Framing: 2x6 walls, 16 inches o.c., vapor barrier between wall frame and horizontal 2x2 strapping, non-structural fiberboard sheathing, metal T-bracing, and house wrap. 2x12 joists, 16 inches o.c., steel girder. 2x10 rafters, 16 inches o.c., 2x4 purlins.

Ext. Trim, Siding, and Openings: 5/4, #2 pine trim. Cedar siding with stainless steel nails. Marvin low-e, gas-filled wood case-ments, double-hungs, and terrace door, Velux skylights, insulated steel entrance door.

Interior Woodwork: 4/4, #2 pine casing and baseboard, hardwood stairs, six-panel pine int. doors and bifolds.

Roofing: Pre-painted metal roof incl. ridge vent, end wall and valley flashing, drip edge, screws.

Specifications for Subs

Concrete: 8-inch poured concrete foundation walls, 4-inch slab.

Electrical: 200 amp, 220v service

Plumbing: Feeds, dwv, and standard fixtures for kitchen and 1 1/2 baths, w/d hookups in utility closet.

Heating and Ventilation: DEC ThermaVent integrated dhw, space heating and ventilation.

Insulation: Wet-spray cellulose in framed walls, compressed fiberglass over foundation and beneath slab.

Drywall: 1/2-inch, taped and finished

Masonry: Brick chimney and hearth for wood stove.

Cabinets: Stock kitchen cabinets and bath-room vanity incl. installation.

Finish Flooring: Tile over slab, hardwood upstairs.

Figure 1. The house up for bid, shown here in plans and elevations, is a 1760-square-foot modified cape set into a hill. The builders estimated the framing and interior work off the floorplans, and the roofing, exterior trim, and siding off the elevations, according to the specifications shown.

opportunity to think through the project, work out details, and identify problem areas and solutions.

All three builders use the same basic approach to estimating material costs: Each catalogs the materials by mentally walking through the job, room by room and level by level, in the order the building will go up. The builder works up, from foundation to roof while referring to the floorplans. He then works back down, from fascia to skirt, to figure the exterior trim and siding while referring to the elevations (see Figure 1). Each builder asserted that the more closely the job is broken down into distinct job phases, the less likely an error is to occur.

The numbers. To expedite the takeoff, each builder tallied these measurements beforehand:

- Total perimeter — to calculate the exterior wall and roof framing.
- Total square footage of floor area — to calculate the floor framing and decking materials.
- Total square footage of roof — to calculate the roof sheathing and covering.
- Total square footage of exterior walls — to calculate the siding.

These totals are usually written in at the head of the relevant category. One builder, however, puts all the measurements on a separate sheet he calls a "master sheet." While estimating, he continuously refers back to this sheet to calculate these and other

materials not included in these bids, such as finish floor material and dry-wall.

After each material item is listed, the unit cost, quantity, and total cost is calculated. Most of the builders keep on hand a computerized price list from

The material take-off serves as an estimate, a materials list, and a job schedule

their lumberyard to figure these costs. Window and door schedules are mailed directly to the yard for pricing.

At the end of each page, the total costs are subtotaled, and the subtotals are tallied at the end of the takeoff for a total materials cost. Table 1 (last page) gives a comparison of the total costs, including taxes and overhead (but not profit).

More than an estimate. Although stick-by-stick takeoffs are time consuming, these builders feel they ultimately save time, since the estimator is also the crew leader. When the takeoff is complete, it serves as a materials list, a job schedule, and an important first look at the project.

The general categories on the materials list serve as a breakdown for each purchase the builder will place with the lumberyard, in the order he wants them delivered. In addition, the take-off will go into a folder and be carried

on the job as a general reference for scheduling subs and supervising the work. Perhaps most important, this careful once-over enables the builder to identify problem areas. These appear as notes on the takeoff such as "need bigger header for kitchen window" and

"need extra staging this side." Finally, each builder noted that this step-by-step walk-through is the key to an accurate labor takeoff — the portion of the estimate which is inherently less certain.

Labor Estimate

The three bids I examined showed little variation in total estimated labor cost, despite the fact that each labor takeoff was done in a very different way.

The stick method. Builder #1, Chuck, does his labor takeoff based on a self-composed list of "job descriptions." On this job he used 55 items. Certain items that are repeated, such as "cleanup," appear in several places throughout the estimate in order to reduce the chance of error. Chuck continually revises and adds

to these divisions in order to make them better reflect the actual work. This list then serves as a check for subsequent estimates, so nothing is forgotten.

The labor divisions are organized in the sequence of construction, similar to the divisions on the materials estimate. However, Chuck aims for greater precision in the sequence on the labor estimate. This list then serves as his final job schedule which he refers to daily. He records such items as "work with electrician" and "work with mason," and schedules time to work with these subs.

After each division, Chuck lists the hours, number of workers, total man-hours, cost per hour, and total costs, as shown in the example in Figure 2. Note that the cost per hour varies with the specific job, since Chuck plans what he feels is the best combination of workers for each job.

To help evaluate the labor estimates, on each job Chuck uses detailed employee timesheets to record the actual time it takes his crew to complete each division. The actual hours are penciled in next to the estimated ones. This gives Chuck a number to refer to for later estimates, although he uses this only as a general guide.

While Chuck has developed a unit price for some items such as window installation — three hours per window including sealing and interior casing — he has resisted calculating a unit price for every item. His projects are so varied and his volume so small

Labor Estimate					
Job Description	Hrs.	# of workers	Total worker hrs.	Cost/hr.	Total cost
slab prep	4	2	8	28	112
first flr. wall frame	16	3	48	43	688
band joists	8	1	8	15	120
joists	8	3	48	43	344
deck	8	3	24	31	248
pick up materials	4	1	4	17	68
cleanup	1	4	4	48	48
second flr. knee wall	16	3	48	31	496
rafters (main)	16	4	64	48	768
rafters (bedrm.)	8	4	32	48	384
rafters (sunrm.)	6	3	18	43	258
subfascia	6	2	12	26	156
purlins	10	4	40	48	480
ceiling joists/ties	8	4	32	48	384
gable end & entrance	12	2	24	32	384
get materials/clean up	4	2	8	22	88
fascia & rake (main)	8	2	16	26	208
fascia & rake (bedrm.)	6	2	12	26	156
fascia & rake (sunrm.)	4	2	8	22	88
Subtotal	153		458		6601

Figure 2. Builder #1 does a labor takeoff based on his list of job descriptions. The costs per hour are based on the wages of the specific workers planned for each job.

LABOR ESTIMATE	
JOB DESCRIPTION	WORKER DAYS
LAY SILLS	2
FRAME LOWER LEVEL WALLS	4
FRAME POSTS AND BEARING PARTITIONS, INSTALL MAIN CARRYING BEAM, STRING & SQUARE	4
INSTALL BANDJOISTS, STRING & SQUARE, INSTALL JOISTS	4
INSTALL DECKING	2
SECOND STORY WALLS	4
RAFTERS, DORMER, AND SKYLIGHT OPENINGS	15
ROOF STRAPPING	2
FRAMING IN GABLES AND SHEATHING ALL WALLS	8
FASCIA INCLUDING OUTLOOKERS ON GABLES	9
ROOFING INCLUDING ALL FLASHING AND SETTING SKYLIGHTS	12
INSTALL WINDOWS AND DOORS	4
EXTERIOR TRIM AND SIDING	30
STRAPPING AND INTERIOR PARTITION WALLS	12
SUBTOTAL	112

Figure 3. Builder #2 uses large, general categories in his labor breakdown. He lists the estimated number of worker-days, based on the total hours and workers he thinks a job will take.

Labor Estimate 4/21/90								
Phase	Unit	Quantity	Productivity	Hours	Rate	Cost	Day/16 hr.	
06110 deck frame								
2x12/16 o.c. w/ Inner Seal	SF	864	0.0636	55	15	\$825	3.44	
06111 ext. wall								
2x6/16 o.c. std frame	SF	1,492	0.09	136	15	\$2,040	8.50	
2x2/16 o.c. over (strapping)	SF	1,492	0.03217	48	15	\$720	3.00	
06112 interior wall								
2x4/16 o.c. main frame	SF	1,140	0.055	62.7	15	\$941	3.92	
2x4/16 o.c. over concrete	SF	664	0.045	29.88	15	\$448	1.87	
06113 roof frame								
2x10/16 o.c. main roof	SF	1,300	0.064	83.2	15	\$1,248	5.20	
2x8/16 o.c. North gable	SF	100	0.08	8	15	\$120	0.50	
2x6/16 o.c. collar ties		included above				\$0		
2x4/16 o.c. purlins	SF	1,468	0.025	36.7	15	\$551	2.29	

Figure 4. Builder #3 used a commercial estimator to run a labor takeoff based on unit pricing according to CSI format. The heart of the estimate is the productivity factor — a rate of hours per quantity of units. The last column lists the number of days a two-man crew is expected to take to complete each phase.

that he doubts whether such numbers would be useful.

Still, the job costs do give him a good indication of where he stands on a particular job. He periodically reports these figures to his crew to let them know where they stand as well. If a job comes in as planned, his employees know they will receive a bonus.

Chuck's total labor cost equaled \$16,845. This figure includes 20% for overhead, which is composed of these costs:

- 7% of total labor for worker's comp
- 7½% of total labor for social security
- monthly payments for liability insurance
- monthly costs for group health insurance
- monthly payments for company truck

A double take. Builder #2, Tom, always runs through an itemized labor takeoff tallied in the order of construction, like Chuck. However, Tom's categories gang together more items (see Figure 3).

After each category, Tom records worker days (rounded up to the nearest day), based on the hours and number of workers he will need. The numbers are estimated by a step-by-step examination of the job and a general comparison to past jobs. Tom emphasizes the importance of keeping detailed notes — a log — on every job. The log gives him a record of all the factors that, at the time, were affecting the job. By evaluating these he gains a better sense of where money was actually spent. For example, on a recently completed job, Tom reported that much more time was spent setting up and moving staging than he had originally estimated, and he now gives more attention to such miscellaneous costs on his bids.

At the end of his labor breakdown, Tom totals the number of worker days. For the framing, exterior work, and interior finish, he figured on 142 worker days. Using an

average wage for his crew including 25% overhead he calculates a daily worker cost of \$112.50, and finally, a total labor cost. In this case the total cost equaled \$15,975.

Tom works with a partner, which he feels is essential to his estimating. Whether he or his partner works up the initial takeoff, the other partner always checks it over, playing devil's advocate by questioning potential problem areas. Often, this second "fresh look" uncovers additional costs missed the first time.

As a final check, Tom also runs through another calculation that uses a multiplier to estimate total labor cost: He multiplies the cost of "basic materials" by some number between 1.2 and 1.5, depending on the complexity of the job. Basic materials include framing materials, decking and sheathing, insulation, drywall, and interior trim,

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but does not include windows, siding, exterior trim, and roof covering. These latter materials fluctuate in price dramatically, depending on quality, but labor costs don't change in the same proportion. For example, the labor costs to install an expensive window are assumed to be the same as for a cheap one.

Generally Tom uses this multiplier only as a check. After several years of job costing, he has found that 1.5 is a safe figure to use for a quick estimate on a building shell, in lieu of a more time-consuming takeoff.

With a little help from a friend. Builder #3, Dave, works mostly in remodeling. Before estimating the project house with this group, he had completed only one new house on his own. He worked up a materials takeoff, but with little hard data to back him up, he was apprehensive about the labor bid. So for the labor estimate, he teamed up with a friend who for the past seven years had worked as a commercial estimator for a large firm. The friend ran the labor takeoff on the company's computer, basing it on that company's unit pricing for multi-million-dollar projects. Figure 4 shows an example of this takeoff. Afterwards, these numbers were increased slightly to conform to a smaller scale project.

The labor estimate is organized by CSI (Construction Specifications Institute) divisions. Dave rearranged his materials takeoff to match the order of the labor bid, making it easier to go back and forth between the two.

The very last column of the labor estimate — Division 01 — includes

Table 1. Comparison of Three Bids

Job Phase	Builder #1			Builder #2			Builder #3		
	Mat.	Labor (incl. 20% overhead)	Total	Mat.	Labor (incl. 25% overhead)	Total	Mat.	Labor (incl. 13% overhead)	Total
FRAMING	4,232	5,916	10,148	5,850	7,200	13,050	4,932	8,162	13,094
EXT. TRIM, SIDING, AND OPENINGS	9,013	4,949	13,962	8,800	4,836	13,636	7,737	4,580	12,317
INTERIOR WOODWORK	2,489	1,402	3,891	1,725	2,588	4,313	2,716	1,695	4,411
ROOFING	1,378	2,269	3,647	900	1,350	2,250	1,750	1,493	3,243
MISCELLANEOUS (incl. waste disposal, site clean-up, and rentals)	1,208	2,309	3,517	—	1,250	1,250	—	1,356	1,356
TOTALS	18,320	16,845	35,165	17,275	17,224	34,499	17,135	17,286	34,421

Note: Despite very different approaches, the three bids are all within 2% of each other. Job Phase descriptions shown in Specifications for General Contract, Figure 1.

several miscellaneous costs that don't fit neatly in any one division: clean-

The productivity factor is the key to this unit-cost labor estimate

up, waste disposal, staging and generator rentals, and subcontractor coordination. This number was figured independently of the commercial firm's data bank by mentally evaluating the job.

The "productivity" factor is the key to this unit-cost labor estimate. The figures in this column are multi-

plied by "quantity" to get "hours." The productivity factor is derived

from years of job costing, and reflects an average of time in manhours per units of work, or:

$$\frac{\text{manhours}}{\text{units of work}} = \text{productivity factor}$$

For example, from job records it might be found that it takes an aver-

age of 12.3 manhours to run 100 linear feet of fascia. This yields a productivity factor of .123, which can then be used to estimate any run of fascia.

With enough data to plug into this formula, a company can begin to accumulate an accurate productivity rate for each task. However, Dave feels that you have to analyze an enormous volume of work before these figures will be useful for estimating. And even then, these figures only serve as a gauge of a company's average performance. Each project must still be evaluated case-by-case.

Nevertheless, Dave thinks that the productivity formula presents an easy way to log in job cost figures and he

has since started keeping track of his costs in terms of "hours per quantity" for comparison on future estimates.

Job Summary

In addition to the costs shown in Figure 4, the costs to complete the project were estimated as follows:

Land:	\$35,000
Development (permits, lawyer, power, well, survey, engineers):	\$11,500
Excavation (driveway, site, septic, powerline, waterline):	\$22,350
Subs: (see specs, Fig.1)	
Concrete	\$7,200
Electrical	\$2,500
Plumbing	\$3,000
Heating and Ventilation	\$5,575
Insulation	\$2,000
Drywall	\$2,950
Masonry	\$2,500
Cabinets	\$3,700
Flooring	\$8,200

Average labor and

materials cost
(from Table 1) **\$34,695**

Total costs
(excluding profit) **\$141,170**

All the builders reported that they typically charge 15% profit on the labor and materials total, plus 10% profit on subs and excavation. Including this markup, the price was set at \$152,371.75, or about \$60 per square foot excluding land and development costs. ■

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