1921

Construction costs

W. W. Connor

Aberthaw Construction Company

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CONSTRUCTION COSTS

BY

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PAPERS AND DISCUSSIONS

CONSTRUCTION COSTS.

By W. N. Connor.*

(Presented February 16, 1921.)

Introduction.

There have been many books, pamphlets and papers published on cost accounting, but very few dealing with its application to construction work. One reason for this is that so few contractors keep a thoroughly accurate check on their costs or maintain a standard cost system. A majority rely on their bookkeeping department to furnish them cost data. This, to my mind, is doubtful practice, as a bookkeeper deals in absolutely accurate figures down to a penny, while the cost accountant's viewpoint is somewhat more liberal.

I do not mean by this that the cost accountant's figures need not check with the bookkeeper's ledger, for they must; but the training of the bookkeeper is such that he will naturally figure his costs in the same manner as he keeps his accounts, and thereby often lose the sense of proportion of costs. Costs are really tied up just as closely with the engineering and estimating departments as with the accounting department. The cost accountant should understand the physical side and be able to visualize the work itself — a thing which a bookkeeper is not trained to do.

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In the introduction to the book "How to Find Factory Costs," by C. B. Thompson, occurs the following:

"The Federal Trade Commission has called attention to the fact that less than 20 per cent. of the business concerns in this country have a cost system, and that a large proportion of the many failures recorded every year is due to the absence of an accurate knowledge of what it costs to manufacture and sell. The Commission is urging every business man to take this first step in the development of that primary effectiveness by means of which alone this country can be brought to an appropriate degree of industrial preparedness."

Mr. Thompson also says:

"The chief distinction between financial accounting and cost accounting is that the former deals exclusively with the money and credit transactions of a business, while the latter deals with these same transactions but with reference to the cost of products and operations. The unit of financial accounting is the unit of money, whether the dollar, the pound, or the franc, while the units of cost accounting are the units of *money plus the units of operations*, of sales, of product and of time."

The three functions of any cost accounting system are:

1. To aid in assuring the economical handling of the work while it is in progress.

2. To obtain figures to compare with the estimate.

3. To supply data for use in estimating future work.

These are given in order of their importance.

Costs must be available at once to be effective in aiding economical handling of the work. Delayed reports of costs are practically useless in effecting any savings while the work is in progress. Proper cost reports have been compared to a fire-alarm system, in that they should not alone be able to give notice of some unusual condition but equally lead the investigation to the seat of the trouble.

Each morning the labor costs of the previous day should be known. This is not necessary or feasible on all items of work, but on such as concrete, excavation, brickwork, etc., it is possible and extremely important that the superintendent of a job should know the daily labor unit costs. If he has them he can take up with the foremen at once any variations between estimates and

actual performance, and endeavor to equalize disproportionate costs of any unit before it is too late. Prompt cost reports enable him to comment intelligently on various items before they become past history, and to be certain that both he and his foremen understand just what constitutes matters of major importance from the costs standpoint.

Only the direct labor on any operation should be included in these cost figures: that is, plant, overhead, etc., should be reported separately and not included with the direct labor charges.

By regular comparison between the actual costs obtained and the estimate, and by means of comparative statements made weekly and monthly, overruns or savings on the estimate may be discussed with the owner at once and he may be kept informed as to just how the job stands financially. This is particularly important on percentage work, as it permits the contractor and the owner to get together and talk over the progress of costs, and, if necessary, to make intelligent changes of plan while the work is under complete control and the financial bearing of changes is understood.

It used to be the custom, and I'm afraid it is yet in a good many companies, to regard costs as something to be kept secret and locked up tight, never letting the foreman know what his costs were, but always suggesting that they were excessive. How can a man be held responsible for his costs unless he is given full information regarding them while his work is in progress? And what makes for better work and loyalty then telling a man when his costs are good and commending him for the fact?

A few years ago a paper was read before this Society entitled, "Cost Accounting on Construction Work." This well-written pamphlet explained fully the system then used by the Aberthaw Construction Company for keeping costs. Since then, some changes have been made, the principal ones consisting of a change of forms, the placing of actual tabulating of the costs with the job, and the establishing of a separate cost accounting department, where before cost accounting had been a function of the estimating department.

It is difficult to make a paper interesting in which one is dealing almost entirely with figures, and I have decided that perhaps the best method is to show the various forms and explain their use and functions.

It is my intention to start with the making of an estimate and to follow through the various steps taken with an explanation of the forms used to record these cost data. I shall take up, first, the labor costs.

SECTION I.

LABOR COSTS.

1. *Summary of Estimate.*

At the start of a job an estimate is made in the usual manner. This shows the actual take-off from the plans, with the items, quantities, units and amounts. These units include the labor, material, overhead and plant costs.

FORM I.

ABERTHAW CONSTRUCTION COMPANY, BOSTON.

Job No. 1175. November 4, 1919.

SUMMARY OF ESTIMATE.

MFG. BUILDING, TORRINGTON MANUFACTURING CO., TORRINGTON, CONN.

Concrete:			
Footings, 6+13	19 c. y.	$11.00	$209
Footings, 73+126	199 c. y.	12.75	2 540
Columns, 101+29+50+13+27	220 c. y.	12.75	2 795
Stairs	464 f. l.	1.50	696
Paving	748 s. f.	.22	165
Carbo. rub	8 000 s. f.	.08	640
Forms:			
Exterior and interior footings	2 886 s f	.19½	563
Walls below grade	4 828 s. f.	.19½	990
Exterior columns	9 417 s. f.	.22½	2 120
Interior columns, metal forms	48 #	21.00	1 005
Floor and roof slab	32 042 s. f.	.17	5 450
Wall beams	4 212 s. f.	.23	970
Interior floor beams	967 s. f.	.23	222

Reinforcement	110 ton	100.00	11 000
Spirals	1 ton	120.00	120
Excavation:			
Wall footings and int.	660 c. y.	2.00	1 320
Backfill:			
Cinders	75 c. y.	2.50	188
Earth around footings	600 c. y.	.60	360
Steel windows:			
Sash, including glazing	6 300 s. f.	.69	4 342
Masonry			
Terra-cotta partitions			
4-in. plastered both sides	5 400 s. f.	.50	2 700
6-in. {Plastered one side / Stucco one side}	413 s. f.	.65	268
Carpentry:			
Laying floor on tar rok	74 sqs.	8.00	592
2-in. spruce plank	16M	100.00	1.600
1-in. maple or spruce	9½M	90.00	855
Laying same	74 sqs.	.25	240
Roof over platform	250 s. f.	.50	125
Roofing:			
Laying tar paper	10 800 s. f.	.03	324
3-ply tar and gravel	108 sqs.	13.00	1 405
3-ply tar and gravel	2½ sqs.	11.00	28
Toncan metal bases and cap flashing	500 f. l.	.45	225
4-in. conductor boxes	5 #	20.00	100
Galvanized iron gutter	23 f. l.	1.50	35
Flooring:			
Mastic floor	1 140 s. f.	.45	514

Quantities by R. L. A. Extension by R. L. A. Checked by R. L. A.

2. *Analysis of Estimate — Labor.*

This estimate is then split into a labor and a material analysis. In the labor analysis these various items will show only the direct labor, with plant labor and overhead separated.

Opposite each item in the labor analysis is shown the symbol under which the working time is to be reported. This analysis is sent to the job, where it becomes the standard for labor cost comparisons on all operations of the job, and the estimate is not referred to.

One can readily see that, by separating labor and material, the work for the job superintendent in following his costs has been made much easier. He knows by the labor analysis just

what figure the Estimating Department has set for the unit on each item. He is able to study his labor costs without being obliged to figure out his material, for the cost of which he is very often not responsible, as a great deal of the purchasing may have been done at the home office. He has condensed for him now those units for which he is responsible. If he thinks any of them too low, he can take up the case at once with the Estimating Department — and I must confess that this is done quite often.

FORM II.

ABERTHAW CONSTRUCTION COMPANY.

Job No. 1175. January 8, 1920.

ANALYSIS OF ESTIMATE.

LABOR.

Code					
	EXCAVATION.				
Di	Pumping				$200
Das	Clear site				100
Dad	Excavate for footings		800 c. y.	$1.70	1 360
	PLANT				
Pel	Towers and hoists	415			
Pen	Temporary buildings	415			
Pem	Mixer, motor and pits	205			
F Pes	Sawmill	130			1 895
Per	Access runs and staging	250			75T
Pe	Miscellaneous plant	130			
Pu-T	Teaming plant	75T			
Pu	Unload	245			
Peb	Boiler and shack	105			
	FORMS.				
Fac	Exterior columns	Make	31 sqs.	4.95	154
Fec		Erect	62 sqs.	10.65	660
Fic		Strip	62 sqs.	2.30	143
Fawb	Wall beams and pilastered	Make	20 sqs.	3.20	64
Fewb	parapet	Erect	42 sqs.	12.50	525
Fiwb		Strip	42 sqs.	2.30	97
	STEEL.				
Ru	Unload reinforcement		114 tons	2.30	262
Ru-T	Team		114 tons	.55	63T
Rac	Cut and bend col. steel		27 tons	3.55	96
Rec	Place col. steel		30 tons	8.55	257

CONCRETE. — Mix and Place.

Med	Footings, piers and pipe supports	306 c. y.	1.45	444
Mep	Paving	12 c. y.	1.80	22
Mef	Exterior and interior columns, floor and roof slabs, wall beams and interior floor beams, including patch and first rub	1 020 c. y.	2.05	2 095
Mecw	Curtain walls	100 c. y.	6.70	670
Mux	Unload and handle cement	3 400 bbls.	.16	544
Mux-T	Team cement	3 400 bbls.	.11	374T
Muy	Trim sand stock pile	850 c. y.	.085	72
Muz	Trim stone stock pile	2 020 tons	.085	172

OTHER TRADES.

Sew	Set and point steel sash	6 800 s. f.	.62	422
Tef	Lay Tar Rok floor 1 in. thick	76 sqs.	4.40	334
Ced	Setting doors and hardware	# 26	9.75	253
Glew	Glazing sash	3 200 lts.	.0975	312
W	Watchman			500
O	Job overhead			1 700
Mh	Cold weather expense			2 500

3. *Timekeeping Symbols.*

Most contractors use a series of numbers for reporting their labor operations, but Aberthaw uses a mnenomic code.

In the Aberthaw system the first letter is always a capital and indicates the kind of work to be done. For instance, —

F stands for Forms,
R for Reinforcement,
B for Brick,
D for Digging, etc.,

in so far as possible the first letter of the item represented being used. The second letter is always a vowel and explains the class of the work.

a stands for making items,
e for erecting or setting up,
i for tearing down or dismantling,
o for repairing,
u for unloading.

The third letter, which is always a consonant, indicates the part of the building in which the work is being executed, as —

f floor,
w walls,
c columns,
s stairs.

As the code is the same on all jobs, our timekeepers and cost men quickly adapt themselves to any requirements of the work. If some work comes up not included in the code, a timekeeper can very quickly make up his symbol to cover it, and it can usually be interpreted by the cost man. If necessary, an explanation may be written opposite the item the first time it is reported.

A real feature of this code is the manner in which it helps visualize the work. For instance, with numbers one might have 21.1 as a symbol for erecting brick walls. How much better is the symbol Bew, — " B " brick, " e " erect, " w " walls.

FORM III.

STANDARD SYMBOLS

Flat Slab	Make	Erect	Strip	Report
Floor and roof slab panels, wood	Fafw	Fefw	Fif	Square feet
Floor and roof slab girts	Fafg	Fafg	Fif	Lineal feet
Floor and roof slab joists	Fafj	Fefj	Fif	Lineal feet
Floor and roof slab panels, metal	Fafm	Fefm	Fifm	Square feet
Plinths	Fafp	Fefp	Fifp	No. and sq. feet
Floor and roof slab mud sills	Fafs	Fefs	Fif	Lineal feet
Floor and roof slab posts	Fafv	Fefv	Fif	Number
Flat slab, inclusive	Faf	Fef	Fif	Square feet
Beam and Girder				
Floor beams and panels, inclusive	Fafb	Fefb	Fifb	Square feet
Gutters and open drains	Fag	Feg	Fig	Square feet
Cornice, coping and belt course	Fak	Fek	Fik	Lineal feet
Stairs	Fas	Fes	Fis	Lin. ft. of stairs and sq. ft. of landings.
Tunnel walls and ceilings	Fat	Fet	Fit	Square feet
Walls	Faw	Few	Fiw	Square feet
Walls erected between slabs, columns or walls previously poured	Fawp	Fewp	Fiwp	Square feet

Wall beams, erected with slabs
and columns..... **Fawb** **Fewb** **Fiwb** Square feet

Threading and rethreading bolts to be charged to "e" symbol on which used.

4. *Timekeeper's Field Sheet.*

To report the time and distribution of the men, the timekeeper uses a field sheet which shows each man's number in the left-hand column.

These sheets are in two series, one running from 0 to 50, and the other from 51 to 100, and the numbers are printed on the sheets, so that if a job has a series of checks numbered from 1 200 on, the timekeeper needs only to write in the number 12. The next columns show the time at which the men reported for work and the time at which they quit work.

Then there are eleven columns, each one representing one hour's work, and headed 7–8, 8–9, 9–10, etc., up to 5–6. In these spaces, after each man's number is written the symbol for the type of work performed. If one man is erecting forms from 7 to 12 continuously, the symbol "Fef" would appear in the first hour column and a dash in each succeeding column up to 12 o'clock. Then he might change and work at erecting wall forms to 5 o'clock. In such case the symbol "Few" would show. The timekeeper makes four checks a day, and if the men have changed their class of work between checks, he confers with their foremen as to the hour when changes have been made. The remaining columns show the rate, then the amount earned and the actual hours worked divided into regular and overtime.

We have, therefore, on this timekeeper's field sheet a complete record of each man's daily time and class of work performed.

This field sheet is the same length and ruled the same as is the pay-roll sheet. We can, therefore, in transferring the time from this field sheet to our pay roll, simply lay it down on the pay-roll sheet and copy the figures on the lines which coincide. This offers a great saving of time and is much more accurate than calling the time off, or transferring it by comparing the men's numbers.

The type of ruling on forms is a very important item. Those forms which are to be used together should be, in so far as

FORM IV.

ABERTHAW CONSTRUCTION COMPANY.

Job No. 1175. Date, 12-27-19.

TIMEKEEPER'S FIELD SHEET.

AT TORRINGTON, CONN. Timekeeper's Name, H. W. Murdick. Sheet No. 1.

MAN'S NO.		IN A.M.	IN P.M.	OUT.	7 — 8.	— 9.	— 10.	— 11.	— 12.	1 P.M.	— 2.	— 3.	— 4.	— 5.	— 6.	RATE.	AMOUNT.	TIME. Reg.	TIME. Over.
	2201																		
Kinsley	02	7	..	5	0	..	....	...	....	...	....	....	...	..	..	$39.00	$6.50	9	
	03																		
	04																		
Hollen	05	7	..	5	Raf	..	....	Raz	....	...	Ref	....	Rec	..	..	40.00	6.67	9	
Howard	06	7	..	5	Fec	..	Fed	...	Fedw	...	....	Fewb	...	..	..	48.00	8.00	9	
	07																		
Murdick	08	7	..	5	0	..	....	...	....	...	....	.. .	...	..	..	21.00	3.50	9	
	09																		
	2210																		
Zavrello	11	7	..	5	Dad	..	....	Mux	....	...	Mef	....	Ded	..	..	39.00	6.50	9	
	12																		
	13																		
	14	7	..	5	Fec	..	Fewb	...	....	...	Fedw	....	...	..	..	.85	7.65	9	
	15	7	..	5	Fef	..	....	...	....	...	....	....	...	..	..	.85	7.65	9	
	16	7	..	5	Fec	..	Fewb	...	....	...	Fedw	....	...	..	..	.85	7.65	9	
	17	7	..	5	Fef	..	....	...	....	...	....	....	...	..	..	.85	7.65	9	
	18	7	..	5	Fec	..	....	...	....	...	Fed	....	...	..	..	.85	7.65	9	
	19	7	..	5	Fec	..	....	...	....	...	Fed	....	...	..	..	.85	7.65	9	
	2220																		
	21	7	..	5	Raz	..	....	...	Ref	...	....	....	...	..	..	.55	4.95	9	
	22	7	..	5	Raz	..	....	...	Ref	...	....	....	...	..	..	.55	4.95	9	
	23	7	..	5	Rec	..	Raf	...	....	...	Ref	....	...	..	..	.55	4.95	9	
	24	7	..	5	Rec	..	Ref	...	....	...	....	....	...	..	..	.55	4.95	9	
	25																		

26	7	..	5	Mef	..	....	Ref	....	...	....	Mh	...	..	..	·70	6.30	9
27	7	..	5	Pel	..	Pem	...	....	...	Mh	....	...	..	..	·70	6.30	9
28	7	..	5	Mh	..	....	...	....	...	....	....	...	..	..	·70	6.30	9
29																	
2230																	
31																	
32	7	..	5	Mux	..	....	...	Muy	...	....	....	....	..	..	·50	4.50	9
33	7	..	5	Mux	..	....	Mef	....	...	....	....	...	..	..	·50	4.50	9
34	7	..	5	Mux	..	....	Mef	....	...	....	....	...	..	..	·50	4.50	9
35	7	..	5	Mux	..	....	...	Muy	...	....	....	...	..	..	·50	4.50	9
36	..	1	5	...	..	....	...	....	...	Mef	....	...	..	..	·50	2.00	4
37	7	..	5	Dad	..	....	Mef	....	...	....	....	...	..	..	·50	4.50	9
38	7	..	5	Dad	..	....	Ded	....	...	....	....	...	..	..	·50	4.50	9
39	7	..	5	Dad	..	....	Ded	....	...	....	....	...	..	..	·50	4.50	9
2240																	
41																	
42																	
43																	
44																	
45																	
46																	
47																	
48																	
49																	
2250																	
																$149.27	229

possible, ruled similarly. This fact I do not believe is usually given the emphasis that it deserves.

5. *Waste Sheet.*

The office cost man, with the timekeeper's field sheets before him, now uses a sheet which is called a "Waste Sheet." He combines all the "Fef," "Med," "Ref," etc., symbols of the Field Sheet and figures the total daily expenditure under each symbol. These amounts he enters each in a column headed with its proper symbol. The total should check with the total daily pay roll.

This sheet is ruled for seven days. It is kept up to date daily, so that at the end of the week the cost man has the total weekly expenditure for all the symbols under which work has been performed. The quantity man gives him the quantity of work accomplished, which he enters under the total weekly cost of the "Waste Sheet" and then figures the unit cost and writes that under the quantity. He then has under each symbol the total weekly expenditure, weekly quantity, and weekly unit.

6. *Labor Cost Record.*

The next step is to transfer these items to the Unit Cost Record Book. This is a loose-leaf, I. P. ring binder, carrying a sheet for each symbol. The first column of the sheet shows the date of the week ending; the second the weekly cost, the third the weekly quantity, and fourth the weekly unit. These items take up about one half the sheet. The other half shows the cost to date, quantity to date, and unit to date. As a partial check on these items there are included two columns, one for number of barrels of cement used, and one for cubic feet of concrete per barrel. At the top of the sheet, directly over the quantity, amount and unit to date column, is a space to write in the estimated quantity, amount and unit, so that these estimated figures can be compared with the actual figures at any time.

This is kept up to date each week, and is checked against the total pay roll of the job. This book is the permanent record of the labor costs and is sent to the home office at the completion of the job.

FORM V

Job No 1175 — WASTE SHEET — Week Ending 1-6-20

Date	Dad	Dadp	Dedp		Fec	Fic	Facw	Fecw	Fad	Fed	Fef	Fif	Ferb	Fewb	Fiwb		Gew			
12-31-19	10.25	77.90			30.00	12.00		8.40		17.95	74.95	32.00		12.48	8.25		8.50			
1-1-20		35.55	7.40		32.85	15.45		7.65			82.10	31.50	14.50	14.50	12.00		8.50			
1-2-20		59.20	9.00		27.50	17.20		9.20			78.80	31.99		12.00	10.30		10.20			
1-3-20	6.00	60.63			30.42	14.85	7.35	6.85			69.03	33.60		11.05	5.75		9.75			
1-4-20																				
1-5-20		75.85	5.40		27.58	19.00		5.00			80.15	29.00		9.00	8.25		9.75			
1-6-20		61.00			26.00	12.60		6.45	10.25		80.00	32.10		17.50	1.00		6.38			
Total	16.25	390.13	21.80		174.35	91.10	7.35	43.55	10.25	17.95	465.03	190.19	14.50	76.53	45.55		53.08			
Quantity	8 c.y.	240 c.y.	6 l c.y.		16.2 sq	25.6 sq	1.2 sq	11.2 sq	1.9 sq	1.9 sq	90.5 sq	70.7 sq	4.7 sq	7 sq	15.7 sq		220 s.y.			
Unit	2.03	1.63	.36		10.75	3.57	6.15	10.35	5.51	9.65	5.14	2.69	3.10	10.30	2.90		.24			

Date	Mecw	Med	Mef	Mh	Muy		O		Pe	Pel		Rac	Rec	Raf	Ref		Serp	Sev		Total
12-31-19		4.10	141.61	50 30			15.41		7 70	3.50		5 06	11.45	8.40	27.43			15 60		583.24
1-1-20	18 50	3.00	168.14	54 90			15.41			8 00		4 23	12.16	9 23	31.80		9.75			617.12
1-2-20	9.00	4.60	176.23	53.10	11.00		15.41			2.00		5.73	9 81	8 80	24 10					585.17
1-3-20	2.50	1.55	86.64	48.60			15.41			2 00		7.10	10.42	10 15	29.48			6.29		474.82
1-4-20																				
1-5-20		4 60	93.22	61 33			15.41			1.00		3.10	8 63	9.41	32.46		11.40			509.54
1-6-20			40.72	62.65			15.41					2 20	15 60	7 26	15.33					412.45
Total	30.00	17 85	705.96	330.88	11.00		92.46		7.70	16 50		27.42	68 07	53.25	160.60		21.15	21.89		3182.34
Quantity	14 c.y.	7 c.y.	218 c.y.		98 c.y.							8 T.	9 T.	11 T.	18 T			700 #		
Unit	2 14	2 55	3 24		.112							3.43	7.56	4.84	8.92			.031		

Payroll W/E 1-6-20 : $3182 34

FORM VI.

Form 57. 1-21-20

ABERTHAW CONSTRUCTION COMPANY

LABOR COST RECORD

JOB No. 1175

SYMBOL Med

ITEM Concrete Footings & Piers

ESTIMATED

COST	QUANTITY	UNIT
$444 00	306 c.y.	1.45

Week Ending	Weekly Cost		Weekly Quantity	Weekly Unit	Total Cost		Quantity To Date	Unit To Date	Bbls. Cement	Cu. Ft. Per Bbl.
11-25-19	117	90	117 c.y	1.01					194	16.3
12-2-19	251	96	120 "	2.10	369	86	237 c.y.	1.56	198	16.3
12-9-19	72	27	42 "	1.72	442	13	279 "	1.23	69	16.4
12-16-19	9	97	6 "	1.66	452	10	285 "	1.59	10	16.2
1-6-20	17	85	7 "	2.55	469	95	292 "	1.61	12	15.7
1-13-20	4	86	2 "	2.43	474	81	294 "	1.62	4	13.5
1-20-20	12	70	10 "	1.27	487	51	304 "	1.60	17	15.8

7. *Labor Cost Statement.*

We are now ready to make out the Weekly Labor Cost Statement. In this, first the symbol is shown, then the kind of work; next, the weekly cost and weekly unit. Succeeding columns offer a detailed comparison with the Analysis of Estimate, — the estimated quantity unit and cost being set against the actual quantity and unit and cost attained in operation. The last two columns give opposite each item, in one case, the overrun; in the other, the saving.

As an illustration:

Suppose we have listed in our analysis of estimate 1 000 cu. yds. of concrete under the symbol " Med," at a unit cost of $1.50 per cu. yd. By the fifth week of the job there has been completed 700 cu. yds. at a unit cost of $2.00 per cu. yd. Seven hundred cubic yards at $1.50 would be $1 050, which would have been the expenditure on that item, provided the work had been done at the estimated unit of $1.50. But actual cost is $2.00 per cu. yd., which means an expenditure of $1 400, or an overrun of $350 on this item. If it had been done for a unit of $1.00, there would have been a saving of 50 cents per cu. yd., or a total saving to date of $350. Each item is figured out similarly, and the difference between the saving and overrun is shown in the proper column.

For those items on which no quantity is reported, as plant, watchman, overhead, etc., a percentage is used. For example, if $1 000 is allowed for overhead and the job is to last ten weeks, this overhead will average $100 per week. If, after the job has gone six weeks and $700 has been expended, and it is figured that $450 more will be expended, the overrun will be $150; and this is shown.

The labor cost sheet gives the costs in detail for the job superintendent to study, and informs him just where he should concentrate and what he should study. If 75 per cent. of his total overrun is in two items, the place for him to remedy his high units is clear. Without some such data how can a superintendent intelligently talk to his foremen or know his job?

FORM VII.

ABERTHAW CONSTRUCTION COMPANY.

AT TORRINGTON, CONN.

Job No. 1175. Sheet No. 1.

LABOR STATEMENT TO DECEMBER 23, 1919. — 8TH WEEK.

	Item.		Quantity.		Unit.		Cost.		Saving.	Overrun.
			Estimate.	Actual.	Estimate.	Actual.	Estimate.	Actual.		
	Excavation.									
Das	Clear site	$	100	.....	.....	.....	83	83		
Dad	Dig footings	c. y.	800	702	1.70	1.35	1 193	948		
Ded	Backfill around footings and walls	c. y.	950	331	.83	.54	275	179	683	
Dadp	Dig for pipe and conduit trenches	c. y.	1 030	931	1.70	1.48	1 583	1 378		
Dedp	Backfill pipe and conduit trenches	c. y.	980	442	.83	.52	367	230		
							3 501	2 818		
	Plant.									
Pe	All plant	$	1 895	.....	.....	.....	1 137	1 379		242
	Forms.									
Fed	Footings and conduit supports	sq.	39	36	10.50	8.91	378	321		
Fadw	Piers below first floor and walls	sq.	52	52.7	2.65	3.84	140	202		
Fedw	Piers below first floor and walls	sq.	78	78.7	10.50	9.77	826	769		
Fidw	Piers below first floor and walls	sq.	78	30.2	3.15	2.79	95	84		19
Faf	Floor and roof slabs	sq.	110	74	2.75	3.46	204	209		
Fef	Floor and roof slabs	sq.	320	41	5.50	7.73	225	317		
Ful	Unload and handle form lumber	M	96	47	2.30	1.98	108	93		
							1 976	1 995		
	Reinforcement.									
Raz	Cut and bend miscellaneous steel	t.	26	16	4.10	11.22	66	180		136
Rez	Place miscellaneous steel	t.	26	14	14.10	15.64	197	219		
							263	399		

	CONCRETE.									
Med	Footings and piers	c. y.	306	285	1.45	1.59	413	453	9	
Mux	Unload and handle cement	bbl.	3 400	3 147	.16	.14	504	441		
Mux-T	Team cement	bbl.	3 400	3 147	.11	.10	346	315		
Muy	Unload and handle sand	c. y.	850	415	.085	.12	35	50		
Muz	Unload and handle stone	t.	2 020	1 208	.085	.09	103	109		
Muz-T	Team stone	t.	2 020	1 208	.02	.04	24	48		
							1 425	1 416		
	MISCELLANEOUS.									
Sez	Miscellaneous iron work	$	400	.....	.....	.....	147	147	.81	
Mh	Cold weather expense	$	2 500	.....	.....	.....	295	295		
O	Overhead	$	1 700	.....	.....	.....	592	511		
							1 034	953		
	Saving $376									
							9 336	8 960	773	397
	Pay roll to date $8 597									
	Teams to date 363									
	Total to date $8 960									

8. *Labor Comparison.*

In order to condense this report for the management, a comparison of savings and overruns is made, listed under the various symbols. All the overruns or savings on one class of work are totaled, and the total overrun or saving shown as concrete, forms, reinforcement, etc. The record of the previous week is also shown so it may be compared with that of the current week.

The Labor Cost Statement, together with this labor comparison sheet attached, is sent into the main office each week so as to reach there not later than the Monday morning following the closing of the pay roll. One copy goes to the general superintendent and one to the Cost Department.

9. *Pay-Roll Sheet.*

The pay-roll sheet is ruled for seven days, with two columns for each day, — one to show regular and the other overtime hours. The regular and overtime hours are extended and shown in separate total columns, as also is the regular and overtime rate, the total amount earned for the week being in the next column.

The man's name and number appear in the extreme right-hand column. This, I think, is rather unusual, but we find it much better when paying off, as the person paying need only look at the next column and not from one side of the sheet to the other to check the name and amount, which lessens the danger of errors considerably.

So much for the labor cost records. Their handling is so standardized that we can transfer our cost men, if necessary, to any job, and they can readily pick up another timekeeper's or cost man's duties.

FORM VIII.

ABERTHAW CONSTRUCTION COMPANY

Job 1185 At Biddeford Me. 20th Week

LABOR STATEMENT COMPARISON

	W/E 7-13-20		W/E 7-20-20	
	Saving	Overrun	Saving	Overrun
Concrete	5214		5982	
Plant		883		1078
Forms		2877		4426
Reinforcement		79	118	
Excavation		4095		5666
Masonry	1228		1474	
Carpentry		1597		1606
Ironwork		199		243
Sash				
Painting				
Overhead, etc.				
Miscellaneous				
	6442	9730	7574	13019

Labor Overrun to 7-20 1920 - $ 5445.

Labor " to 7-13 1920 - $ 3288.

Weekly Payroll $ 8,758.49
" Teams 606.00
" Trucks 150.00
" Total $ 9514.49

Payrolls to date $ 97,691.30
Teams " " 7,995.00
Trucks " " 199.38
Total " " $ 105,885.68

FORM IX.

ABERTHAW CONSTRUCTION COMPANY.

Job No. 1175.

PAY ROLL.

AT TORRINGTON, CONN.

	Wed. 24.	Thurs. 25.	Fri. 26.	Sat. 27.	Sun. 28.	Mon. 29.	Tues. 30.	HOURS. R.	HOURS. O. T.	HOURS. S.
1	9		9	9	....	9	9	1 wk.	....	....
2	9		9	9	....	9	9	1 wk.	....	....
3										
4										
5	9		9	9	....	9	9	1 wk.	....	....
6	9		9	9	....	9	9	1 wk.	....	....
7										
8	9		9	9	....	9	9	1 wk.	....	....
9										
10										
11	9		9	9	....	9	9	1 wk.	....	....
12										
13										
14	9		9	9	....	$6\frac{1}{2}$	9	$42\frac{1}{2}$	....	....
15	9		9	9	....	9	9	45	....	....
16	9		9	9	....	9	9	45	....	....
17	9		9	9	....	9	9	45	....	....
18	9		9	9	....	9	9	45	....	....
19	9		9	9	....	9	9	45	....	....
20										
21	9		9	9	....	9	9	45	....	....
22	9	Holiday.	9	9	....	9	9	45	....	....
23	9		....	9	....	9	9	36	....	....
24	9		9	9	....	9	9	45	....	....
25										
26	9		9	9	....	7	9	43	....	....
27	9		9	9	....	9	9	45	....	....
28	9		9	9	....	9	9	45	....	....
29										
30										
31										
32	9		9	9	....	9	9	45	....	....
33	9		9	9	....	6	9	42	....	....
34	9		9	9	....	9	2	38	....	....
35	9		9	9	....	9	9	45	....	....
36	9		9	4	....	9	9	40	....	....
37	9		9	9	....	9	9	45	....	....
38	9		9	9	....	8	9	44	....	....
39	9		9	9	....	9	9	45.	....	....
40										
41										
42										
43										
44										
45										
46										
47										
48										
49										
50										
	243		234	238	....	$234\frac{1}{2}$	236	1 $185\frac{1}{2}$	....	....

Sheet made out by H. W. Murdick.
Checked by H. S. Kinsley.

FORM IX. — CONTINUED.

ABERTHAW CONSTRUCTION COMPANY.

PAY ROLL. — CONTINUED.

From 12-24-19 to 12-30-20.

	Rate.			Amount.	Date Pd. Off.	Man's No.		
	R.	O. T.	S.					
1	....	....	....	Pd. by B. O.	....	Supt.	2201	Richardson
2	$39.00	....	....	$39.00	....	Clerk	02	Kinsley
3							03	
4							04	
5	40.00	....	....	40.00	....	Steel Fore.	05	Hollen
6	48.00	....	....	48.00	....	Carp. Fore.	06	Howard
7							07	
8	21.00	....	....	21.00	....	Timekeep.	08	Murdick
9							09	
10							2210	
11	39.00	....	....	39.00	....	Lab. Fore.	11	Zavrello
12							12	
13							13	
14	.85	....	....	36.13	....	Carp.	14	
15	.85	....	....	38.25	....	Carp.	15	
16	.85	....	....	38.25	....	Carp.	16	
17	.85	....	....	38.25	....	Carp.	17	
18	.85	....	....	38.25	....	Carp.	18	
19	.85	....	....	38.25	....	Carp.	19	
20							2220	
21	.55	....	....	24.75	....	Steel	21	
22	.55	....	....	24.75	....	Steel	22	
23	.55	....	....	19.80	....	Steel	23	
24	.55	....	....	24.75	....	Steel	24	
25							25	
26	.70	....	....	30.10	....	Mech.	26	
27	.70	....	....	31.50	....	Mech.	27	
28	.70	....	....	31.50	....	Mech.	28	
29							29	
30							2230	
31							31	
32	.50	....	....	22.50	....	Labor	32	
33	.50	....	....	21.00	....	Labor	33	
34	.50	....	....	19.00	....	Labor	34	
35	.50	....	....	22.50	....	Labor	35	
36	.50	....	....	20.00	....	Labor	36	
37	.50	....	....	22.50	....	Labor	37	
38	.50	....	....	22.00	....	Labor	38	
39	.50	....	....	22.50	....	Labor	39	
40							2240	
41							41	
42							42	
43							43	
44							44	
45							45	
46							46	
47							47	
48							48	
49							49	
50							2250	

Approved, W. E. Richardson, Supt.

Approved, Inspect.

Page total, $773.53

SECTION II.

MATERIAL COSTS.

1. *Purchase Order.*

The first form necessary, of course, for material records is the Purchase Order. This form is made to give all the necessary information and to show what the material is to be used for which gives the cost man his distribution.

2. *Material Received Form.*

On receipt of the material, it is checked and entered on the Daily Material Received Form, showing the order number, vendor and material. On receipt of an invoice it is checked against this material received sheet for receipt of the goods.

3. *Invoice Record.*

When the invoice has been approved and passed for payment it is entered in the Invoice Record. There is a page here for each vendor, and all payments made are entered, showing the invoice number, commodity and amount. In the right-hand columns are shown the check number with which the invoice was paid, date and voucher number. The last column shows the statement number on which the invoices appear when the month's expenditures are reported to the owner.

A page is also used for the weekly pay rolls, and this register should check with the total of the Labor and Material Cost Books.

4. *Analysis of Estimate — Material.*

As stated previously, the Summary of the Estimate is divided into the Labor and Material Analyses. The Material Analysis shown here includes all the material to be used on the job, with the quantities, unit prices and total money; also the subcontracts, insurance and field office equipment.

This analysis is used for all material cost comparisons and by the Purchasing Department in checking up their purchases and prices submitted.

Form 53E. 9-24-19

Job No. _____ } To be Marked on Invoice

Order No. E4753 } To be Marked on Invoice

ABERTHAW CONSTRUCTION COMPANY, AGENT
BOSTON, MASS.

VENDOR'S COPY

PURCHASE ORDER

Date _____ 191__

TO _____

Ship to ABERTHAW CONSTRUCTION COMPANY, Agent

Address _____

Via _____

Invoice to _____ Owner
ABERTHAW CONSTRUCTION COMPANY, Agent

Mail Invoice to ABERTHAW CONSTRUCTION COMPANY, Agent

You agree to make shipment _____

From your STOCK—MILL—FACTORY _____

Address _____

At _____

SEND INVOICE IN TRIPLICATE and address all correspondence as above

Please furnish the following:

PRICE _____	USED FOR _____	Bldg. _____
F. O. B. _____	RECEIVED _____	Req'n No. _____ Auth'n No. _____
TERMS _____	BILL REC'D _____	Bill O.K.'d _____

We reserve the right to cancel in case of delay

Although the principal is solely responsible for the payment of materials and services furnished hereunder, the seller may with respect to materials and services so furnished deal with Aberthaw Construction Company as agent for said principal.

Owner's Name _____

By ABERTHAW CONSTRUCTION COMPANY
Agent

This confirms our mutual _____ agreement

By _____

DETACH, SIGN AND RETURN ACCEPTANCE BELOW BY NEXT MAIL

ACCEPTANCE

Owner's Name _____

Date _____ 191__

ABERTHAW CONSTRUCTION CO., Agent

We accept your Order No. E4753 dated _____ on your Form _____

_____

CONSTRUCTION COSTS.

FORM 179

ABERTHAW CONSTRUCTION COMPANY

MATERIAL RECEIVED

JOB NO. 1175

AT Torrington Conn

DATE December 27 1919

ORDER NUMBER	DESCRIPTION	QUANTITY	FROM WHOM RECEIVED	DATE INVOICED	HOW DELIVERED	CHARGES	REMARKS IF CHARGEABLE TO MERCHANT NOTE IN THIS COLUMN
D 11944	Gravel	20 yds	Torrington Bldg. Co.	1/3	Truck		
E 6950	"	15 "	F.W. Fuller	1/6	"		
"	Sand	12 "	" "	1/6	"		
D 11977	12" Hacksaw Blades	12	W. H. Morrison		Messenger		
D 11978	Sledge Hammer Handles	6	Lyford Hdwe Co.		"		
"	8" Flat Files	6	" " "		"		
E 3619	Dragon Cement	231 bbls	Portland Stone Ware		Freight C B & Q 132208		

SIGNED ABERTHAW CONSTRUCTION CO.

PER H. S. Kinsley

Form 242. 3-29-20

PAGE 52

INVOICE RECORD

Job No. 1177 VENDOR Portland Stoneware Co

INVOICE NO.	DATE	MATERIAL	GROSS AMOUNT	DEDUCTIONS	DISCOUNT	NET AMOUNT	CREDITS	CHECK NO.	DATE OF CHECK	VOUCHER No.	STATE. NO.
36	11-20-19	Cement	652 12		11 90	640 22		44	11-28-19	10	2
46	11-24-19	"	474 02		8 65	465 37		63	12-5-19	10	3
142	12-8-19	"	474 02		8 65	465 37		113	12-16-19	10	4
163	12-10-19	"	827 00		15 00	807 00		123	12-19-19	10	5
188	12-24-19	"	643 90		11 75	632 15		143	12-24-19	10	6
189	12-24-19	"	474 02		8 65	465 37		143	12-24-19	10	6
201	12-26-19	"	685 00		12 50	472 50		185	1-5-20	10	7
222	12-26-19	"	657 60		12 00	645 60		192	1-7-20	10	7
242	12-28-19	"	641 16		11 70	629 46		203	1-8-20	10	7
246	12-28-19	"	632 94		11 55	621 39		203	1-8-20	10	7
260	12-31-19	"	474 02		8 65	465 37		216	1-13-20	10	8
261	12-31-19	"	800 08		14 60	785 48		216	1-13-20	10	8
277	1-2-20	"	474 02		8 65	465 37		216	1-13-20	10	8
278	1-2-20	"	679 14	267 35	11 55	400 24		222	1-14-20	10	8
279	1-6-20	"	643 90		11 75	632 15		222	1-14-20	10	8
287	1-6-20	"	394 56		7 20	387 36		240	1-20-20	10	9
C.V. 1	2-26-20	" Job 1178					2 16 32			1	
C.V. 10	4-10-20	" bags					5 33 60	Check rcd to cover			26
C.V. 15	6-7-20	" "					31 13	"	" "	"	29

SECTION II. — FORM IV.

ABERTHAW CONSTRUCTION COMPANY.

Job No. 1175. January 8, 1920.

ANALYSIS OF ESTIMATE.

MATERIALS AND SUBCONTRACTS.

Cement	3 400 bbls.	$2.29	$7 790
Freight and loss on empties	3 400 bbls.	.05	170
Tests	3 400	.02½	85
Sand	3 850 c. y.	2.00	1 700
Gravel	1 500 c. y.	2.50	3 750
Peastone	50 tons	2.50	125
Cinders	220 c. y.	1.50	330
Plant: Small tools and supplies; Rental for mixer, motor, joists, towers; Power and fuel; Temporary buildings; Stagings, ladders and runs; Sawmill			2 300
Form lumber, 95M (less salvage)			5 000
Nails, oil and sundries			375
Metal forms erected	# 48	18.30	875
Lumber, 2-in. spruce planks	17M	65.00	1 105
3-in. planks	1⅓M	65.00	87
⅞-in. furring; 2 x 4 studding; ⅞-in. tongue and groove			50
1-in. maple flooring	10M	92.00	920
1-in. cork flooring	68 s. f.	.44	30
1-in. cell board	135 s. f.	.38	50
Building paper	76 rolls	3.50	266
Stair rail	80 ft.	1.00	80
Steel reinforcement	111 tons	80.00	8 880
Steel spirals	4 tons	100.00	400
Steel sash	6 800 s. f.	.353	2 400
Glass	6 100 s. f.	.13	800
Putty for glazing	3 200 lbs.	.06	192
Lime	4 tons	22.00	88
Terra-cotta blocks, 4 in.	5 400 s. f.	.12	648
Terra-cotta blocks, 6 in.	1 080 s. f.	.15	162
Nonpareil insulating brick, 4 in.	200 s. f.	.40	80
Nonpareil insulating brick, 2½ in.	160 s. f.	.30	48
Akron Tile Pipe, 8 in.	290 fl.	.30	87
Akron Tile Pipe, 6 in.	60 fl.	.20	12
Akron Tile Pipe, 5 in.	50 fl.	.20	10

SECTION II. — FORM IV. CONTINUED

Metal lath	8 s. y.	$1.30	$10
Sundry plaster materials			25
Freight elevator			3 475
Electrical contract			2 300
Heating and sprinkler contract			12 962
Plumbing			3 500
Cold weather materials			1 000
Liability insurance			1 500
Superintendent's salary, travel, board, stationery, office, etc.			1 600

5. *Material Cost Record.*

The Material Cost Record consists of a loose-leaf I. P. binder book. In it each item in the Material Estimate has a page, and the estimated quantity, amount and unit is entered at the top of the sheet. After the invoices for material have been checked and paid they are entered in the Material Cost Record. The date of the invoice, vendor's name, kind and amount of material, and cost, are entered.

There is also a column headed "Outstanding Orders," and the amount of an order, as soon as it is placed, is shown in this column in pencil. As payments on these orders are made they are entered in ink in the amount column, and the outstanding order figure reduced correspondingly. The next column is for credits and the last shows the total cost.

This book, then, contains all amounts paid for material on the job, and the total of this book and the labor cost record at the completion of the work must check with the total cost as shown in the bookkeeper's ledger. This book is the permanent record of the material costs, and is sent to the home office at the completion of the job.

6. *Material Cost Statement.*

In order to know how our purchases for material compare with the analysis of estimate, we make each month a Material Cost Statement similar to our Weekly Labor Cost Statement and show the overruns or savings on each item.

This form shows the item first, then the estimated and actual quantity, estimated and actual unit and estimated and actual cost. In the next column is entered the outstanding

SECTION II. — FORM V.

MATERIAL COST RECORD.

Job No. 1175.

Item, Form Lumber.

Estimated.	Unit.	Estimated
91M.	$55.00	5,000

Date.	Bought from	Amount and Description.	Cost.	Out-standing Orders.	Credits.	Cost to Date.
		2 000′ 4 x 4 chestnut, 125/12′	.....	.....	.....	.....
		720′ 3 x 4 chestnut, 60/12′	.....	.....	.....	.....
		2 038′ 4 x 4 chest., 36/10, 81/12 and 14/14	$199.82	.....	.....	.....
11-18-19	J. C. Iffland Lumber Co.	4 010′ 2 x 6 N. C. pine	.....	.....	.....	.....
		2 502′ 1 x 8 N. C. roofers	.....	.....	.....	.....
		1 070′ 3 x 4 chestnut	.....	.....	.....	.....
		910′ 4 x 4 chestnut, oak and hemlock	424.82	.....	.....	$624.64
11-22-19	J. C. Iffland Lumber Co.	20 707′ 1 x 6 N. C. roofers	978.87	.....	.....	1 603.51
11-29-19	J. C. Iffland Lumber Co.	1 086′ 1¼ x 6 spruce, D4S	75.26	.....	.....	1 678.77
		756′ 2 x 4 x 18 rough spruce	.....	.....	.....	.....
		1 122′ 3 x 6 rough spruce	.....	.....	.....	.....
		476′ 4 x 6 rough spruce	.....	.....	.....	.....
		1 206′ 2 x 6 x 18 S2E spruce	.....	.....	.....	.....
		2 016′ 2 x 6 x 18 S2E spruce	386.42	.....	.....	2 065.19
12-1-19	J. C. Iffland Lumber Co.	13 603′ 3 x 4, 2 x 6, 3 x 6 rough and S2E spruce	942.69	.....	.....	3 007.88
12-2-19	J. C. Iffland Lumber Co.	4 779′ 3 x 4, 2 x 6, 3 x 6 D2E spruce	331.18	.....	.....	3 339.06
12-3-19	J. C. Iffland Lumber Co.	3 217′ 1 x 6 N. C. roofers	175.17	.....	.....	3 514.23
		7 074′ 6 x 6, 3 x 6, 1 x 6, 2 x 3, 2 x 6 and 1¼ x 4 rough spruce	490.23	.....	.....	4 004.46
12-4-19	J. C. Iffland Lumber Co.	3 130′ 3 x 6, 3 x 8, 1¼ x 4 rough spruce	216.91	.....	.....	4 221.37
12-5-19	J. C. Iffland Lumber Co.	5 375′ 1¼ x 4, 1¼ x 8, 1 x 6, 3 x 4 and 3 x 6 rough spruce	372.49	.....	.....	4 593.86
12-8-19		1 626′ 1¼ x 6 D4S spruce	.....	.....	.....	.....

12-8-19	J. C. Iffland Lumber Co.	1 216′ 3 x 4 and 1¼ x 4 spruce	$196.95	.....	.....	$4 790.81
12-9-19	J. C. Iffland Lumber Co.	2 193′ 1¼ x 6 D4S spruce	151.97	.....	.....	4 942.78
		340′ 1¼ x 8 D4S spruce	.....	.....	.....	.....
12-12-19	J. C. Iffland Lumber Co.	639′ 1¼ x 6 D4S spruce	67.84	.....	.....	5 010.62
		1 190′ 1¼ x 8 D4S spruce	.....	.....	.....	.....
		571 1¼ x 6 D4S spruce	122.04	.....	.....	5 132.66
12-13-19	J. C. Iffland Lumber Co.	508′ 2 x 6 N. C. pine	29.67	.....	.....	5 162.33
12-15-19	J. C. Iffland Lumber Co.	115′ 1¼ x 4 D4S spruce	7.97	.....	.....	5 170.30
		366′ 2 x 3 D4S spruce	.....	.....	.....	.....
		476′ 3 x 4 x 14′ D2E spruce	.....	.....	.....	.....
		468′ 3 x 6 D2E spruce	90.78	.....	.....	5 261.08
12-24-19	J. C. Iffland Lumber Co.	2 010′ 1 x 6 rough boards	69.65	.....	.....	5 330.73
12-11-19	J. C. Iffland Lumber Co.	1 228′ 1¼ x 6 D4S spruce	85.10	.....	.....	5 415.83
3-31-20	Torrington Mfg. Co.	55 000 salvage, lumber at $35 per M	.....	.....	$1 925.00	3 490.83
3-30-20	A. C. Co.	P. C. salvage on lumber	.....	.....	17.00	3 473.83

SECTION II. — FORM VI.

ABERTHAW CONSTRUCTION COMPANY.

AT TORRINGTON, CONN.

Job No. 1175. MATERIAL STATEMENT TO FEBRUARY 2, 1920. Sheet No. 1.

ITEM.		QUANTITY.		UNIT.		COST.		OUTSTANDING ORDERS.	SAVING.	OVERRUN.
		Estimate.	Actual.	Estimate.	Actual.	Estimate.	Actual.			
CONCRETE.										
Cement	bbl.	3 400	3 378	2.29	2.29	7 740	7 740	.....		
Freight and loss on empties	bbl.	3 400	3 378	.05	.037	170	125	.....		
Tests	bbl.	3 400	3 378	.025	.025	85	85	.....		
Sand	c. y.	850	829	2.00	2.05	1 658	1 236	470		218
Gravel	c. y.	1 500	1 405	2.50	2.66	3 513	3 404	332		
Peastone	t.	50	45.5	2.50	2.33	114	42	64		
						13 280	12 632	866		
Plant	$	2 300	.....	.....	.....	2 100	4 249	100		249
Estimated credit	$	.....	.....	.....	.....	2 000	.....	.....		
FORMS.										
Form lumber	M	91	91	55.00	59.50	5 000	5 416	.....		
Nails, oil and sundries	$	375	.....	.....	.....	375	933	45		218
Metal forms erected, No. 48	$	875	.....	.....	.....	875	573	301		
Estimated salvage on form lumber	$	.....	.....	.....	.....	800	.....	.....		
						7 050	6 922	346		
LUMBER.										
2″ spruce plank	M	17	20.5	65.00	55.75	1 105	.....	1 142		
3″ plank	M	1 1/3	1.5	65.00	70.00	87	.....	109		
7/8″ furring 2 x 4 studding, 7/8″ tongue and groove	$	50	.....	.....	.....	50	.....	89	170	
1″ maple flooring	M	10	10	92.00	93.00	920	.....	930		
1″ cork flooring	s. f.	68	68	.44	.155	30	11	.....		
1″ cell board, 135 s. f.	$	50	.....	.....	.....	50	32	.....		
Building paper	roll	76	7	3.50	3.50	266	.....	25		
						2 508	43	2 295		

REINFORCEMENT, ETC.										
Steel bars	t.	111	125.7	80.00	77.40	8 880	9 721	.....		
Steel spirals	t.	4	2	100.00	100.00	400	199	.....		
Steel sundries		.....	.....	.....	.....	.....	45	.....		
Estimated credit on steel		.....	.....	.....	.....	1 800	.....	.....	1 247	
Steel sash	s. f.	6 800	6 800	.353	.332	2 400	2 276	.....		
Putty for glazing	lbs.	3 200	3 400	.06	.058	192	187	10		
Glass	s. f.	6 100	6 100	.131	.129	800	787	.....		
						14 472	13 215	10		
MASONRY.										
Lime	t.	4	1.75	22.00	53.00	39	92	.....		
Terra cotta blocks, 4″	s. f.	5 400	6 600	.12	.117	648	420	123		
Terra cotta blocks, 6″	s. f.	1 080	200	.15	.....	162	.....	32		
Nonpareil insulating brick, 4″ and 2½″	$	128	.....	.....	.....	128	160	.....	149	
Akron tile pipe, 8″, 6″, 5″	$	109	.....	.....	.....	109	131	.....		
Metal lathe	$	10	.....	.....	.....	10	6	.....		
Sundry plaster material	$	25	.....	.....	.....	20	.....	3		
						1 116	809	158		
Saving $881						42 526	37 870	3 775	1 566	685

orders. In the estimated quantity column is entered the total quantity as shown in the Analysis of Estimate and in the actual quantity column the quantity actually paid for. This statement is made to show as nearly as possible not only what the overrun is at the time the statement is made, but the final overrun or saving.

Of course, on the first three or four statements on a job that will take ten months to complete this is not possible, as all purchases will not be made or all contracts let, but in a very short time this comparison will indicate quite clearly the saving or overrun on the material costs that will show at the completion of the work. In addition to the outstanding orders being shown, we also estimate salvages and credits on plant, form lumber, etc., and include these figures in our statement.

Three copies of this monthly Material Statement are made. Two copies are sent the home office, — one for the general superintendent and one for the Cost Department. The third copy is for the job files.

We have, therefore, in the home office each week a Labor Cost Statement and each month a Material Cost Statement.

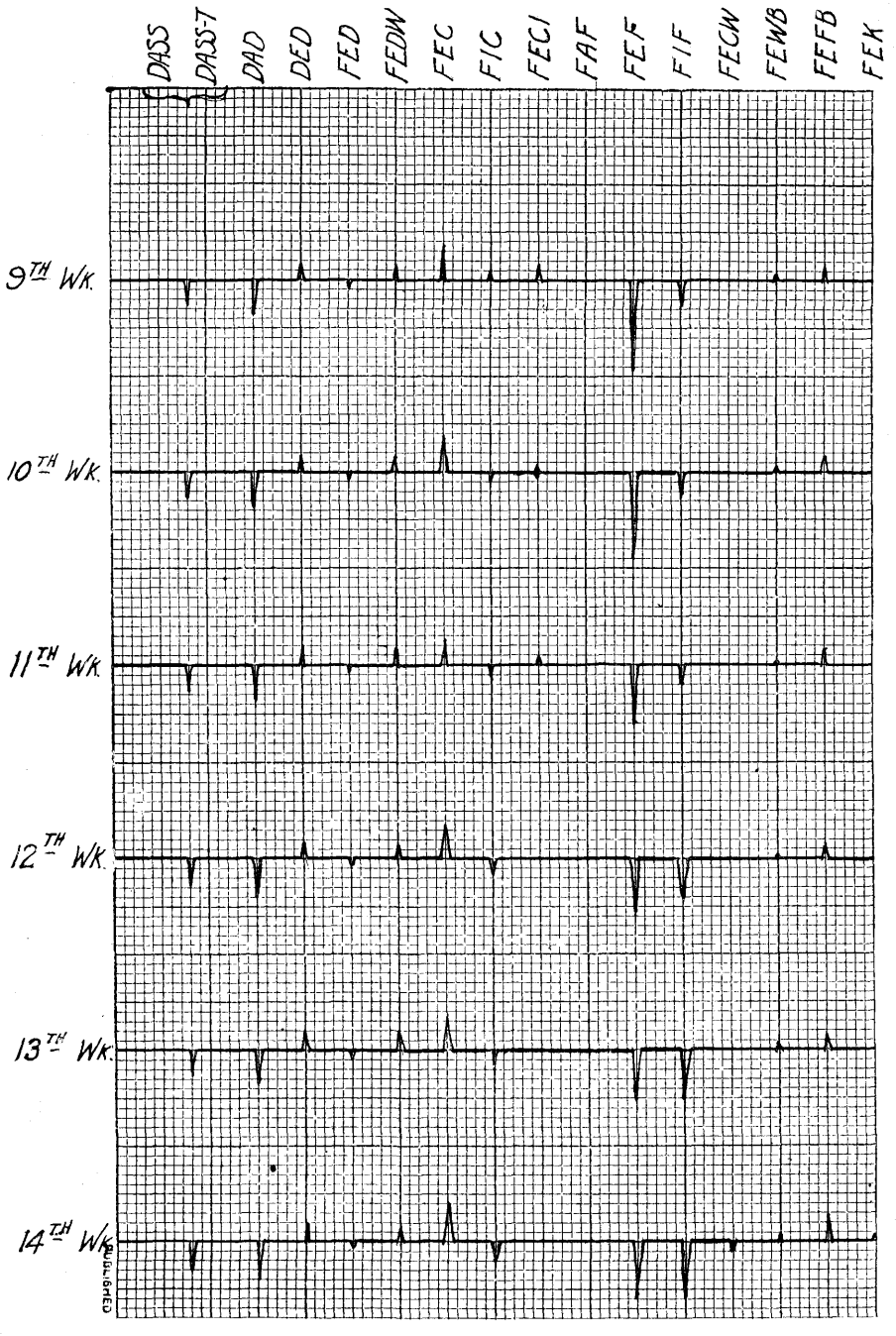
7. *Tabulating Job Cost by the Graphic Method.*

The purpose of this graphic chart is to place before the general superintendent and construction manager the status of the job and enable them to quickly pick out those items which are above the estimate and need special attention.

This chart shows what the final overrun or saving will be on the various items if the unit obtained to date is maintained for the remainder of the work.

A valuable feature of this chart is that the quantity of work influences the tabulation, thereby showing that a small overrun on a very large quantity would result in a much larger money overrun at the end of the job than a large overrun on a small quantity of work. This would indicate that the large quantities of work to be performed should have the first attention in getting low unit costs.

On our Labor Cost Statement you will remember we show the saving or overrun to date on the various items of work.



SECTION II. — FORM VII.

SECTION II. — FORM VIII.

Job No. 1145. ABERTHAW CONSTRUCTION COMPANY.

COST SUMMARY.

MANUFACTURING BUILDING FOR E. A. MALLORY & SONS, INC., DANBURY, CONN.

Date started, 4-17-19. Date completed, 10-24-19.

	Item.		Quantity.	Labor. Mix. Place.	Unl. Cem.	Unl. Agg.	Total Unit.
	CONCRETE.						
1	Footings, columns, floors, roof, etc.	c. y.	2 077	1.20	.338	.935	2.47
2	Window sills, coping, etc.	f. l.	1 548	.15	.0029	.021	.173
3	Carbo. rub, inside and outside.	s. f.	14 210	.143	....	....	.143
4	Granolithic finish, laid after	s. f.	28 000	6.20	.29	.38	6.87
5	Unload and handle cinders	$	.....	....	....	....	18.00
			Quantity.	Mix, Tend, Lay.	Unl. Cem.	Unl. Sand.	Total Unit.
	MASONRY.						
6	Unload, mix mortar, tend and lay 4″ x 6″ T. C., part incl. stagings	s. f.	5 861	13.30	.12	.187	13.61
7	Plaster partitions and metal sash	s. y.	1 291	.582	.018	.0077	.607
8	Picking second-floor ceiling for plaster	s. y.	970	.098	....	....	.098
9	Plaster second-floor ceiling	s. y.	970	.457	....	....	.457
10	Metal lath partitions	$	.....	.....	....	....	64.00
			Quantity.	Make Erect Strip.	Unl. Lumb.		Total Unit.
	FORMS.						
11	Footings, foundations, brook wall, etc.	s. f.	16 808	7.98	.17	....	8.15
12	Floors, beams, curtain walls, etc.	s. f.	46 422	11.30	.17	....	11.47
13	Columns and mullions	s. f.	7 852	17.90	.17	....	18.07
14	Sidewalk	$	.....	.....	....	....	47.00
15	Windows, coping, etc.	f. l.	1 590	.27	.0009	....	.2709
16	Brook wall under first floor	$	.....	.....	....	....	144.00
17	Tunnel walls	$	.....	.....	....	....	383.00
			Quantity.	Bend and Place.	Unl. and Team.		Total Unit.
	REINFORCEMENT.						
18	Cut, bend and place, including spirals	t.	84.74	14.99	2.29	....	1 728
			Quantity.				
	EXCAVATION.						
19	Clear site	$	.....	.....	....	....	307.00
20	Dig footings, foundations, etc.	s. y.	1 742	1.06	....	....	1.06
21	Backfill	$	.....	.....	....	....	438.00
22	Sheeting	$	.....	.....	....	....	353.00
23	Coffer dam	$	.....	.....	....	....	652.00
			Quantity.	Labor Unit.			Total Unit.
	CARPENTRY.						
24	Framing, temp. roof, etc.	M	31	16.95	....	....	16.95
25	Erect wood partitions, sash, doors, etc.	s. f.	3 330	.75	....	....	.75
26	Setting wood doors	$	.....	.....	....	....	742.00
27	Setting wood sash	s. f.	3 784	.241	....	....	.241
28	Carpentry work — bulkhead	$	....	.....	....	....	65.00

ABERTHAW CONSTRUCTION COMPANY.

COST SUMMARY. — CONTINUED.

MANUFACTURING BUILDING FOR E. A. MALLORY & SONS, INC., DANBURY, CONN.

Supt. John L. Noel

	MATERIAL.				PLANT.				Total Unit.	Total Cost.
	Cost, Cem.	Cost, Agg.		Total Unit.	Labor.	Supplies.	Frt. Rental.	Total Unit.		
1	3.40	1.825	....	5.225	.627	.795	1.04	2.46	10.15	20 831
2	.029	.0401	....	.0692	.0154	.019	.0254	.059	.30	469
3	.....	.....	....	.....	....	....	....	....	.143	2 044
4	2.97	.86	....	3.83	....	....	....	....	10.70	2 997
5	.....	.....	....	.....	....	....	....	....	.....	18
										26 359
	Cost, Cem.	Cost, Brick and Tile.	Misc. Mat.	Total Unit.					Total Unit.	Total Cost.
6	1.34	17.00	1.62	19.96	....	....	....	....	33.57	2 000
7	.182	.....	.021	.203	....	....	....	....	.81	1 048
8	.....	.....	....	.....	Air hammers & points .085				.183	178
9	.....	.....	.109	.109	....	....	....	....	.566	562
10	.....	.....	....	56	....	....	....	....	.....	120
										3 908
	Cost, Lumb.	Misc. Mat.		Total Unit.					Total Unit.	Total Cost.
11	6.64	1.10	....	7.74	....	....	....	....	15.89	2 664
12	6.64	1.10	....	7.74	....	....	....	....	19.21	8 944
13	6.64	1.10	....	7.74	....	....	....	....	25.81	2 028
14	.....	.....	....	.....	....	....	....	....	.....	47
15	.0299	.0055	....	.0354	....	....	....	....	.306	494
16	.....	.....	....	.....	....	....	....	....	.....	144
17	.....	.....	....	.....	....	....	....	....	.....	383
										14 704
	Cost, Steel incl. Spirals.	Misc. Mat.		Total Unit.					Total Unit.	Total Cost.
18	75.80	.518	....	76.318	....	....	....	....	93.598	7 964
									Total Unit.	Total Cost.
19	.....	.....	....	.....	....	....	....	....	.....	307
20	.....	.....	....	.....	....	....	....	....	1.06	1 851
21	.....	.....	....	.....	....	....	....	....	.....	438
22	.....	.....	....	276	....	....	....	....	.....	629
23	.....	.....	....	.....	....	....	....	....	.....	652
										3 871
				Total Unit.					Total Unit.	Total Cost.
24	.....	.....	....	.....	....	....	....	....	16.95	524
25	.....	.....	....	2.27	....	....	....	....	3.02	10 037
26	.....	.....	....	.....	....	....	....	....	.....	742
27	.....	.....	....	.018	....	....	....	....	.259	982
28	.....	.....	....	.....	....	....	....	....	.....	65
										12 350

Any seemingly small unit overrun on this labor statement would not always cause serious comment on the part of the job superintendent or management, but on these charts this small unit overrun, if it applied to a large quantity of work, would result in a very large money loss at the end of the job.

Plotting these costs each week, directly under the previous weeks, shows any variations and can be easily studied, compared and acted upon immediately before it is ancient history and too late to do any good.

8. *Final Cost Summary.*

At the completion of the job and after all bills have been paid, the final cost summary is worked up. The labor, material and plant units are shown separately and each divided into two or more items, and the total unit and total cost obtained.

These summaries are blue-printed and a copy furnished the Estimating Department.

Attached to this summary is a Job History, giving information regarding —

Personnel;
Prices paid for cement, sand, brick, etc.;
Nature of the soil;
List of subcontractors;
Wages paid labor;
How concrete was distributed, whether by buggy or chutes;
Number of towers and height, etc.

9. *Cost Comparisons.*

In order to stimulate interest among our foremen we have been making up at the home office weekly comparative cost statements showing the units obtained on various jobs for similar classes of work. On this comparison we show the bogey unit allowed each job on the items compared, the quantity done, and the unit obtained on the job. Under each job we show the superintendent and foremen's names, and the units below the estimate have a square around them, and the foreman showing the best performance as compared with his own estimated unit has a star opposite his name. We find that these comparisons arouse considerable interest and some rivalry.

COMPARISON OF UNIT COSTS TO DATE FOR JOBS WITH SIMILAR ITEMS OF WORK

DATE 1/6/20	JOB NO. 1185 LOCATION Biddeford, Me. SUPT. H.S. Wright FOREMAN (D&M) D. Grosse* FOREMAN (F) McCarron FOREMAN (R) Lynch				JOB NO. 1188 LOCATION Somersworth, N.H. SUPT. H.V. Sheahan FOREMAN J. Sully Buchinni FOREMAN Reeks FOREMAN Davis *				JOB NO. 1191 LOCATION Worcester, Mass. SUPT. J.J. Keane FOREMAN T. Grosse * FOREMAN Cairns * FOREMAN Nichols				JOB NO. 52 LOCATION Danville, Va. SUPT. J.D. Henderson FOREMAN (D) Bussey FOREMAN (F) McCarthy FOREMAN (R) Greenwood FOREMAN (M) Masselli *				JOB NO. 54 LOCATION Durham, N.C. SUPT. Clasby & Marshall FOREMAN White FOREMAN Robinson FOREMAN Newsome FOREMAN Murphy			
SYMBOL	QUANTITY		UNIT EST.	UNIT ACT.	QUANTITY		UNIT EST.	UNIT ACT.	QUANTITY		UNIT EST.	UNIT ACT.	QUANTITY		UNIT EST.	UNIT ACT	QUANTITY		UNIT EST.	UNIT ACT.
Dad	2186	cy	5.82	5.49	3361.6	cy	5.90	8 55	270	cy	3.25	*2.10	1338	cy	4 20	3.88	2019	cy	1.92	1.99
Fef	1380	Sqs.	6.08	7.50	35322	Sqs	7.10	10.40	485	Sqs	7.10	*6.20	5286	Sqs.	7.50	11.61	1213	Sqs	705	12.00
Ref	323.88	T	8.63	7.88	834.86	T	10.60	*6.76	85	T	8.00	10.49	1374	T	9.30	11.32	229	T	8.26	7.35
Med	632	cy	2.60	*1.27	1090.1	cy	2.90	2.41	230	cy	2 40	1.53	1070	cy	2.78	2.54	703	cy	1.87	2.80
Mef	6323	cy	2.08	*1.65	16610.9	cy	2.15	2.19	1843	cy	2.25	2.54	27985	cy	2 40	2 72	5655	cy	2.30	3.14
Mecw													844	cy	5.04	*6.42	60	cy	5.40	10.02

▭ Shows units below bogey

* Shows best performance

The quantity man, of course, has to keep in very close touch with the timekeeping and cost departments. He reports the quantities under the symbols as shown on the Analysis of Estimate, and must keep these right up to date in order to insure the cost statement being completed promptly.

On small jobs the reporting of quantities will be done by the engineer, but on large operations one man will be assigned to this work alone. Without good accurate quantities up to date at all times the cost data are, of course, practically useless.

Does it pay?

You may say, "Well, this seems to be a good system, but does it pay?" I think it does.

On one job, recently, the brick costs were high compared with the estimated unit. It was found that masons were laying 1 100 to 1 200 brick a day, a good average for that particular class of work, so attention was given to the tending. It resulted in a rearrangement of the delivery of the brick to the elevator, and a very substantial saving on the unit per thousand. The costs showed this high unit at once, and afforded the means of rectifying it before it was too late.

On a large job in the South, last summer, the labor overrun was steadily increasing, and a detailed study of the costs was made. It was found that 60 per cent. of the overrun was in the form work, and further, that 80 per cent. of this 60 per cent. was in two items. You can readily see that this gave to the management a big advantage in showing them what to concentrate on. This they did, with the result that many thousands of dollars were saved and the curve showing the overrun flattened out, and remained practically so during the remainder of the work.

On one job the cost of laying maple flooring was running high. A man was set to watch the operation. The building had square interior as well as exterior columns, the corners of which had been chamfered by fitting a fillet in the column form. When the edge strip was fitted around these columns a small triangular piece was fitted into the chamfered space. Time

taken on this one operation showed that it added 20 cents per square over the whole floor, as there were four pieces fitted to each interior and two to each exterior column, or twelve to each bay. It was too late to make the maximum saving of 20 cents per square on this job, but by filling these holes with neat cement mortar the cost per square was reduced about 13 cents, and on the next similar building, by cutting off the fillet strip on a bevel just above the level of the edge strip, the full 20 cents per square was saved.

On another job the cost of laying floor plank was high. A time study was made and several reasons discovered for the high cost, one being the high cost of lumping, largely due to lack of proper planning. The cost prior to the time study was $10 per thousand board feet. The time study showed that it could be done for $5.25 if done at 100 per cent. efficiency. The final average for this job was $8.65.

The above are some examples where the savings can actually be traced to our cost system. We feel that there are many other instances where savings are made and economies obtained and that if all contractors could establish some such system it would be of great advantage to all.

DISCUSSION.

LEONARD C. WASON.* — I think that Mr. Connor has proved most conclusively that it does pay. The company developed a cost accounting system at a very early date. The present system is the outgrowth of experience. Its first object is to give promptly information to the job superintendent wherein work is costing too much, so that it can be quickly corrected. Its secondary object is to obtain accurate data for assisting in making future estimates of the cost of similar work.

I will cite one of our early contracts, twenty or more years ago, when dollars counted a great deal in the results accomplished.

* President, Aberthaw Construction Company, 27 School Street, Boston, Mass.

Before building the concrete fence around Harvard's Athletic Field, we made an estimate of cost of labor per lineal foot of posts above the horizontal beam at the ground level, of $1.00 per lineal foot. The first week these were started the cost was $2.40 per lineal foot. I had the report on Saturday morning, and when I went to pay off I called the attention of the foreman to this item. He said he was doing the best he could. I couldn't stop to look into it then, but on Monday morning I went over, spent the forenoon there, and gave him my ideas as to how he could straighten it out. The result was that the cost dropped to between fifty and sixty cents per lineal foot, and did not exceed the estimate again during the life of the job, which ran several months. Prompt action changed a loss into a profit without any loss in quality of work. The great thing is to check the work when you can act on what you find instead of when it has become ancient history.

I know one large local construction firm which has a most elaborate cost system, but they do not obtain their records until about three weeks after the work has progressed. It is then ancient history, — too late to act in order to correct expensive items.

Eight to twelve items, out of the fifty to seventy total into which our records are subdivided, include nearly 80 per cent. of the total cost of all operations. These are analyzed and on the superintendent's desk at ten o'clock on the morning following the execution, and he has all the rest of the day to act upon them, if necessary. So our costs enable him to keep the work under absolute control, and, thereby, savings are made.

I assure you most positively that it does pay. It paid several years ago when we were doing strictly lump-sum contract work, and it pays much more now on percentage work. It keeps the work under absolutely close control. It also keeps us on very friendly terms with the owner. I wish that more contractors did it. If they did there would be fewer failures and there would be more profits made in the contracting business.

To illustrate by one comparison before closing, as to the difference in cost between lump-sum bidding and percentage work. We have had two cases — one a very small contract and

one fairly sizable — where the owners received lump-sum bids and thought them rather high. They were strictly competitive bids from several contractors. They were rejected and we were awarded the contract on a cost-plus basis. We completed the small job about 4 per cent. under the lowest bid, and on the large job we saved over 10 per cent., showing that work on a percentage basis and with the cost under close control can be done cheaper than on the lump-sum contract basis.