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By

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ABERTHAW CONSTRUCTION COMPANY
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THIS paper is, we believe, the first which has been presented on the principles and methods of cost accounting on construction work. It was prepared with the idea of showing how cost accounting can be made to serve the interests of both contractor and owner, particularly under the rapidly increasing use of the cost-plus-profit form of contract. It is at once flexible and extremely accurate, and should make toward the best interests of all concerned. — ABERTHAW CONSTRUCTION COMPANY.

COST ACCOUNTING ON CONSTRUCTION WORK.*

With a Description of the System used by the Aberthaw Construction Company.

By LESLIE H. ALLEN,
of the Aberthaw Construction Company.

INTRODUCTION.

THE problem of cost accounting on construction work is one that has not received the amount of attention and study that its importance warrants. When we consider the vital importance to the contractor on construction work of a knowledge of the cost of his work, it is surprising to find that only a few contractors have succeeded in finding out in detail what the unit costs of their work are. Many of our big commercial enterprises make a point of figuring very carefully their cost of production, but building and engineering contractors seem content to go on in their old ways, with only a vague idea how their work is coming out, and no definite knowledge as to the amount of profit or loss made until the job is completely finished and paid for. Mr. Sanford Thompson, in his book on "Concrete Costs," asserts that "as generally practiced, cost keeping is so approximate and inaccurate as to be of comparatively little value for estimating or for immediate use," and later on he states that estimates of labor costs are frequently mere guesses, because "the contractor does not know with any degree of accuracy the time and cost of doing each kind of work." I venture to assert that not more than ten per cent. of the con-

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tractors in Boston doing work on a lump sum basis can tell within one thousand dollars what their profits or losses are on their unfinished contracts now in hand.

It is not hard to find a reason for this state of affairs. The old-time superintendent of construction was usually a mechanic who by reason of special ability had risen to the command of men and become a superintendent. These men, of whom many are still with us (and doing good work), are men to whom figures and costs meant very little. They relied for success on their innate common-sense and their ability to drive the men under them, and although they made mistakes, some of which would have been self-evident if they had studied costs carefully, yet they did excellent work and achieved results not to be despised even in these days of scientific management, cost accounting and complex organizations of one sort or another. Such men, however, took no interest in cost accounting, and if directed to furnish cost figures took very little care to see if they were made up rightly or not.

Another reason is that there is often a lack of definite instruction given from the office as to how costs are to be kept. Cost accounting is not an automatic process, and one essential of a successful system is to have a man who has studied the problem and knows definitely just what is wanted, in charge of the work and personally responsible for it. The timekeeper on a construction job is a very busy man. Often he has materials to order and check, and many other duties to perform, and has no time to think out the details of a cost-accounting system for himself, and he contents himself with as little work in subdivision of payrolls as his experience tells him will " get by." Then when his reports come in they are handled by clerks who do not understand them and who do not make any effort to correct them as they go through. As often as not the bookkeeper works them up in his spare time, and for these reasons the cost-accounting system becomes unreliable and one is told that " it is impossible to keep accurate costs on construction work."

It is probably true that every contractor and builder has made some attempt to find out the unit costs of the work he does. Some contractors have already a system that really

gives them the information they need. Many firms have a cost-keeping system which tells them approximately what their unit labor costs from week to week are, but takes no account of materials and gives them no idea as to how the whole job stands financially. Such men have no real idea as to whether their jobs are profitable or not until the bookkeeper's statement at the close of each job shows the actual profit or loss made. Many have tried to keep a cost-keeping system but have thrown it up owing to its difficulties and inaccuracies, and rely simply on their bookkeepers to tell them how much expense has been incurred on the job, while their eye tells them how much of the job is done. The writer remembers in his earlier days being directed to visit half-completed jobs for which he had made estimates and make a survey of same for comparison with the bookkeeper's statements, and this was the only way known by his firm at that time of comparing estimated costs with actual costs to see what profit or loss had been made, although a system of reporting weekly costs was being used similar to that outlined above.

With the change of the times and the change in contractors' methods, the attitude of the contractor to cost-accounting systems is changing, too. The old-time superintendent is giving place to the technical graduate who is a man with engineering training accustomed to view the situation from all sides and relying on actual cost figures rather than on his own judgment to tell whether his work is efficient. Modern competition is becoming so keen and work is taken on such a small margin of profit that it is of vital importance that every item of the work be kept down to its estimated cost, and cost keeping is fast becoming a necessity to all who wish to make a profit out of contracting on construction work.

The purpose of any cost-accounting system is threefold, — first, to watch the job from week to week to see if the work is being carried out economically; second, to see whether the cost is above or below that of the original estimate; and third, to furnish information for future use in estimating and for use in supervising work in progress. In other words, first, to determine the items of prime cost and the unit prices of these items,

with their fluctuations from week to week; second, to discover what relation these bear to a predetermined selling price; third, to establish new selling prices for future work. The relative importance of these three items is in the order given.

The problem before the contractor's accountant is an entirely different one from that of the bookkeeper or the factory cost keeper. A good deal of the dissatisfaction and incompleteness of many existing systems is because the problem has been approached from the financial point of view rather than the engineer's. The bookkeeper's viewpoint is the financial one, and deals with totals and balances of cash. The cost accountant's viewpoint is an engineer's, and deals with unit costs and quantities of materials. The two cannot be satisfactorily held by one man unless he has had a thorough training both in bookkeeping and engineering lines. Such a training is rare. The primary object of the cost keeper in a large factory or mill is to determine the selling cost of the articles, and therefore every item of expense burden incurred in carrying on the factory is prorated or apportioned to the cost of the articles produced for sale. The contractor's selling cost is determined beforehand and he is faced with the problem of so splitting up his selling cost that he has a proper appropriation for each item of expense, the very reverse of the factory accountant's problem. In a factory the article is first made and its cost determined, and then it is sold. The engineering contractor first sells his work, then makes it, and then determines the cost. It is for this reason that I have placed prime cost first as being the most important, and selling cost last as of least importance, in contracting work.

The contractor's cost accounts, if they are to be of any use, must show not only the amount of money spent in the work, but the way in which it has been spent; and this cannot be shown if items of general expense, such as plant, watchmen, etc., are all distributed among the items of excavation or concrete. The result may be financially accurate but uninforming to the contractor. For instance, on the cost accounts on the Panama Canal, shown in the *Canal Record*, the cost of plant, track, forms and general expense, etc., all are worked out in terms of per

cubic yard of concrete. This is correct from the financial viewpoint, and the result shows the cost of the concrete to the government. But it does not tell an engineer whether the work is being done efficiently or not. He wants to know the cost of setting up and repairing the plant, the cost of handling the material, the detailed cost of form work, while general expense is meaningless to him unless he knows the details. When the cost of moving tracks, repairing plant, etc., is reported at so much per cubic yard as a subdivision of excavating cost, the cost of the operation cannot be criticised. It is very necessary that this distinction be kept in mind and that costs should be worked out from an engineer's standpoint rather than from a bookkeeper's or an accountant's standpoint. The information turned out by the cost-accounting department should not only show results but should give information showing their meaning.

In the writer's judgment, the cost accounting on construction work should be handled in connection with the estimating department rather than in connection with the bookkeeping department. The estimator should know best what information he requires from a job to check up the work he has estimated, and into what units the costs should be divided. He is then enabled to keep closely in touch with actual work in progress and compare with his estimate from time to time.

The method usually employed by contractors in their cost accounting is to divide up the time spent on the job under certain headings, such as excavation, brick work, mason work, concrete work, carpentry, and so on, and to make a report of the quantity of each kind of work executed, and to work out from this data, either daily or weekly, the unit labor costs; at the close of the job to work these up into totals and also to work up at this time the cost of all materials into units of work done and combine them with the labor costs, giving the total cost of labor and material on each item of the work. This works well in some offices as far as it goes, and shows whether each week's work was efficient and economical. But if no account is kept of material until the job is closed, and no check is taken on quantities reported by the men on the job, and no comparison is made with the estimate, its value is not very great. In the system used by

the Aberthaw Construction Company, we have added from time to time the following features which do not appear in most accounting systems. First, in addition to the weekly labor costs, the average labor cost on each item to date is figured. Second, a periodical check on the quantity report is made. Third, we use a standard mnemonic code revised to suit the requirements of each job. Fourth, an accounting of material is kept up from month to month. Fifth, an analysis of the estimate is made for comparison with the weekly costs. Sixth, a monthly balance is struck, showing profit or loss to date. Seventh, a "field sheet" is furnished to the timekeeper, which enables him to keep track more regularly and systematically of the men at work.

It is the purpose of this paper to describe the Aberthaw Company's system in detail, taking up in logical order the above points and matters incidental thereto. The present system has been a gradual development. The cost-keeping system was installed early in the history of the company by Mr. Wason, the president of the company, who laid work out upon the usual lines indicated above. The additional features have been added since the beginning of 1910 in the order indicated above, and the complete system may be said to have been in working order for over two years, long enough for us properly to try it out and to know that it really gives us the information we need. The system I am about to describe is really practicable, is not expensive in operation and can be used by any contractor who has but the patience to study his problem and insist on getting just the results he wants.

Although the writer's firm specializes in one branch of construction work, the system is equally applicable to any other work of similar nature, whether in the line of heavy engineering or the building of modern office buildings or frame dwelling-houses.

SECTION I.

THE ANALYSIS.

At the start of a job, an estimate is made of its cost in the usual way. This estimate is then analyzed to show its component costs. Fig. 1 shows an estimate on a small job executed by the Aberthaw Company last year. Figs. 2 and 3 show the analysis of the same. This analysis is almost self-explanatory but it will be well to call attention to one or two points in it. It will be noted that the seven items of concrete and finish in the estimate have been resolved into nineteen items in the analysis, and the seven items of forms in the estimate have been resolved into eleven items in the analysis, and so on, each item being resolved into its component parts, and where these parts are alike in two items adding them together. For instance, concrete labor in footings appears by itself, but the cement, sand and stone are added to those in the columns and floors. By adding together, it will be found that the seven items of concrete in the estimate have the same total cost as the nineteen items in the analysis.

This analysis is used as a basis of comparison during the life of the job, and the original estimate is not referred to at all. This is different from the general practice, as it is usual to build up the units of labor costs on a job in a synthetical manner to compare with the estimate, rather than to analyze the estimate to compare with the units on the job. This is a very important feature of the system and is a solution of one great difficulty. The usual method is to try and build up the price of each item from the information on unit costs given, so as to compare it with this item in the estimate. Take, for instance, the item of concrete. The price of concrete is compiled by reckoning up the labor of unloading cement, sand and stone and the cost of these materials, and also the labor of mixing and placing and finishing the concrete and the cost of the tools and plant. (I do not mention forms, which I regard as an entirely distinct and different item.) If at the end of a month 500 cu. yd. of concrete have been placed and material

Estimate No. 1210 **ABERTHAW CONSTRUCTION CO., BOSTON** Sheet No.
Job No. 1990

Summary of Estimate

May 17th 1913

Concrete footings 1:2½:5	246 cu. yds	6.00	1476
" columns 1:1½:3	169 "	7.50	1268
" floors & wall beams 1:2:4	690 "	6.60	4554
" window sills	629 ft lin	.25	157
Cinder concrete crickets on roof			25
2" Cinder concrete fill between screeds	20940 sq ft	.03	628
Rubbed external finish on concrete			300
Forms to footings	4573 sq ft	.10	457
" " internal columns	3037 "	.15	456
" " external columns	7300 "	.15	1095
" " internal column heads	70	4.50	315
" " external columns brackets	55	1.00	55
" " mushroom floor slabs	28618 sq ft	.10	2862
" " wall beams	3918 sq ft	.12	478
" " window sills	629 ft lin	.20	94
Steel reinforcement, plain round bars. base sizes	20 Tons	43.00	860
¼" slab bars	21 "	48.00	1008
sundry steel	5 "	46.00	230
¼" spirals	2½ "	80.00	200
Inserts	1000	.15	150
Rivetted bearing plates in footings	17	3.00	51
Brickwork 8" curtain walls in Flemish bond	1200 ft.	.55	660
Cutting, toothing & patching old walls adjoining			50
2" Wire lathed & plastered both sides partition	18 sq. yd	3.00	54
Hard pine posts framed in to support old building	2 M	80.00	160
Repair old floors where old building adjoins new			250
Pine Stairs & enclosure 1st Floor to Basement			35
Pine railing			50
Miscellaneous cast iron work			436
" wrot iron & steel work			341
Tinned doors & hardware & erection	2	30.00	60
Steel sash including glass and glazing	5260 "	.43	2270
erection of same		.05	263
Excavation over site	100 c.y.	.50	50
" for trenches for footings etc	553 c.y.	.80	442
Spruce sheet piling to trench	10 M	50.00	500
Grading			100
Clean up the job and clean glass			100
Travel, board & superintendence			300
Liability Insurance			400
Contingencies & sundries			400
Total Estimated net cost, excluding profit.		$	23640

Fig 1.

enough to mix another 600 cu. yd. is on the ground and all the plant is set up, it will be a very difficult matter to determine exactly how much labor and material should be charged to work that is done and how much is chargeable to future work. If all the masons' staging is erected and only one third the brick work done, the cost of brick work will be

Job No. 1990 ABERTHAW CONSTRUCTION CO. Sheet No. 1

Analysis of Estimate

			Labour		Materials & Sub Contracts
Concrete					
Labour in footings	246 c.y.	1.00	246		
" " columns	169 "	1.50	254		
" " floors & beams	690 "	1.00	690		
" " window sills	629 f.l.	15	95		
" " cinder concrete crickets			20		
" " cinder concrete fill between screeds including laying screeds finished by owner	125 c.y.	2.00	250		
" Rub with carborundum			300		
Plant erect & repair			250		
" dismantle			50		
" freight					150
" rental					300
" small tools & supplies					450
Cement	2000 bbls			1.75–.40 · 1.35	2700
tests				03	60
Unloading, teaming & loss on M.T.S.				05	100
Sand	520 c.y.			80	416
Crushed stone	1400 tons			1.40	1960
Cinders	130 c.y.			50	65
Concrete sundries					52
Forms.					
Labour in footings	4580 sq.ft.	7.00	321		
" " floor slabs	28618 "	7.00	2005		
" " wall beams	3981 "	9.00	359		
" " external columns	7300	11.00	803		
" " column brackets	#55	70	39		
" " internal columns & heads				Sublet	771
" " window sills	629 f.l.	15	94		
Lumber, nails, & oil etc.					1070
Unloading & handling lumber			50		
Sawmill			100		100
*Detailing forms in Boston office					100
Steel Reinforcement.	46 Tons			37.00	1702
Spirals	2½ "			60.00	150
Tests					10
Unloading	48½ "	50	24		
Wires & sundries				50	24
Bend & place	48½ "	8.00	388		
Rivetted bearing plates in footings	#17			3.00	51
Inserts	#1000	05	50	10	100
			6388		10331

Fig 2

unbalanced in the same way. To solve this difficulty, we use an analysis of the estimate and keep the costs on each item of the analysis separately. The estimate is put away and never referred to again, and all comparisons are made with the analysis. You will see when I describe the monthly statement how easily this takes care of difficulties like those referred to or to unfinished

work. It is not until the job is completed and the books are closed that I make a synthetical summary showing what

Job No. 1990 ABERTHAW CONSTRUCTION CO. Sheet No. 2.

Analysis of Estimate Const'n

		Labour		Materials & Sub Contracts
Brot forward		6388		10331
Brickwork	1200 fo	20 240	35	420
Cutting and patching old brickwork		35		15
Metal lathed & plastered partition		24		30
Hard pine posts		50		110
Repair old floors		200		50
Pine Stairs & enclosures		20		15
Pipe railings		10		40
Miscellaneous cast iron work		36		400
" wrot		70		271
Turned doors & including erection	" 2		30"	60
Steel sash including glazing & erection	5262sft	05 263		2270
Excavation over site	100 c.y	50		
Excavation for footings	553 c.y	80 443		
Spruce sheet piling	10 M	15" 150	35"	350
Grading		100		
Clean up the job & clean glass		100		
Travel, board & Superintendence				300
Liability Insurance				400
Contingencies & Sundries				400
		8178		15462
Net Total			$ 23640	

Fig 3

a cubic yard of concrete or a cubic foot of brick work has cost.

I lay stress on this because the difference between analysis

and synthesis in accounting is vital, and it is my belief that it is not possible to get a clear and accurate idea of the fluctuations of cost on construction work by a synthetical method, because labor and material and overhead expense are so distributed that they cannot be properly identified or criticised. It will be noticed that labor and material are kept in separate columns in the analysis and are kept entirely distinct all through the job. For accounting purposes, material includes subcontracts, insurance, traveling expenses, electric power, and other indirect expense; in fact, everything except labor and teams. Teams when hired by the day are reckoned as labor, but teams working under contract, at an agreed price per load, per yard, etc., are reckoned as subcontracts and kept in the material account.

On the work of most contractors it will be found that the amount and cost of the materials will not vary very much, and, except for checking consumption of cement, coal and lumber, the profit or loss made on materials at the start of a job will remain steady all through. But the labor does fluctuate exceedingly from week to week. It is on the labor side that most of the losses or profits may be expected. In this paper and in the writer's firm a good deal more attention is given to the labor side than to the materials. At the same time the material must not be overlooked, as wasteful use of cement, lumber, etc., may run the cost of a job up unexpectedly, to say nothing of the need of a periodical check, if there is any suspicion of graft among subordinates.

We furnish a copy of the analysis in note-book form to the superintendent on the job as well as to our general superintendent and to the heads of the firm. This is particularly useful to the job superintendent as he knows what the office expects him to accomplish in the way of costs. If his judgment on costs is not sound, it tells him what the items of his work ought to be done for.

SECTION II.

THE CODE.

Having analyzed the estimate, instructions are made out for the timekeeper in the form of a code, Figs. 4, 5 and 6. This code is made up from the standard mnemonic code used by the author. The code differs from that used by other contractors only in the fact that the mnemonic principle is used instead of numbers, and that the divisions of time have been carried a good deal further than is usual. Although this does not seem to be an important item in itself, it is so because it simplifies the work of the timekeepers on the job to a very large extent, and insures more accurate and intelligent reports being made from the job.

All contractors who have attempted any cost keeping will agree on the necessity for some sort of a code to report work done, not on the ground of secrecy but to obtain concise, quick descriptions. It has been found that if timekeepers are simply told to report the work done and describe it, their descriptions will be misleading and verbose, and in going their rounds they will probably make up a code for themselves which afterwards they have to turn into a written description.

It may be worth while to spend a little time in explaining the principles of the mnemonic code used. The initial letter is always a capital and indicates the kind of work to be done. For instance, M stands for concrete Masonry, F for Forms, R for Reinforcing Steel, S for Structural Steel and miscellaneous iron work, B for Brickwork, and so on. As far as possible the initial letters chosen are mnemonical, that is, they are the first letters of the items they represent. The second letter is always a vowel and indicates what is being done in the division of work which it is describing; "a" stands for making items before setting, and "e" stands for erecting or setting or fixing in place; "i" stands for stripping or removing or pulling down; "o" stands for repairing or patching; "u" is a general utility item standing for unloading and other similar items. It will be seen that these are mnemonic in that each vowel is the vowel sound of the word that it represents. The third letter, which is always a consonant, indicates mnemonically the place or part of the

STANDARD TIMEKEEPING CODE.

MAIN DIVISION — Kinds of Work.

Initial Letter:

P Plant.
D Digging, earthwork and rockwork and items in connection.
M Concrete.
F Forms.
R Reinforcement.
K Finish of concrete surfaces.
C Finish carpentry (windows, flooring, etc.) and any carpentry not belonging to P, D or F.
S Miscellaneous steel and iron work and other metal work.
B Brick masonry, stonework, tile, Akron pipe, etc.
Z Miscellaneous.
X Extra work (prefix to any of above).

SUBDIVISION — Kinds of Labor.

Second Letter (for all main divisions except D and K):

a Making or preparing, viz., making up forms, mixing concrete, bending or fabricating steel, etc.
e Erecting, placing or building, viz., erecting forms, placing concrete, laying brick, fixing sash, etc.
i Removing, stripping or cutting away, viz., stripping forms, cutting away concrete or brick, etc.
o Repairing, viz., patching voids in concrete, repairing mixer, etc.
u Receiving, unloading, piling, loading, etc., viz., receiving cement, sand, lumber, etc., unloading and storing same, unloading plant and reloading at close of job, etc.

Second Letter with D:

a Excavate.
e Backfill.
i Pumping.
o Grading.
u Drilling and blasting.

Second Letter with K:

a Picking.
e Plastering.
i Rubbing with Carborundum.
o Repairing, filling voids, cleaning floors, etc.
u Granolithic finish laid integral with the slab.
ua Granolithic finish laid after concrete has set.
y Cement wash.

FIG. 4.

building in which the work is done, that is, " f " indicates floors, " c " columns, " b " beams, " k " cornice, " l " lumber, " d " doors, and so on. As far as possible these are mnemonic, but it is not possible to make every item so, and some consonants have to be arbitrarily chosen to make out. As the standard code is

STANDARD TIMEKEEPING CODE.

SUBDIVISIONS — Location of Work in the Building.

Third Letter (for all main divisions except P, S and C):

b	
bc	Belt course.
c	Columns.
ch	Column heads (mushroom).
cc	Cinder concrete.
d	Footings.
dp	Drain pipe (tile).
f	Floors.
fs	Floor slabs.
fb	Floor beams (beam construction).
fm	Corrugated metal to slabs.
g	
h	Cellar or basement.
j	
k	Cornice.
l	Lumber.
m	Monitor or pent house.
n	Lintels.
p	Paving or sidewalk.
q	
r	Rubbish.
s	Stairs.
t	
v	Vault lights.
w	Walls.
rw	Retaining walls.
ws	Window sill.
cw	Curtain walls.
x	Cement.
y	Sand.
z	Stone or gravel.

Third Letter with C:

c	Column.
d	Door.
df	Door frame.
dt	Door trim.
f	Floor.
fb	Floor beam.
fs	Floor screed.
fp	Sub-floor plank.
ft	Top floor maple.
g	Gates.
h	Hardware.
ho	Operating gear.
j	
k	Cornice.
l	Lumber.
m	Monitor or pent house.
ms	Monitor sash.
n	Lintels.
p	Partition.
pl	Platform.
r	Roof.
rb	Roof beam.
rp	Roof plank.
rt	Roof truss.
s	Stairs.
t	
v	
w	
x	
y	
z	Miscellaneous.

FIG. 5.

the same on every job and is used simply with adaptations to meet the requirements of the work in hand, these arbitrary symbols are quickly learned. It will be noticed that the third letter has to be a different one in the case of items relating to plant.

It should be an easy matter to revise this code to apply to any other sort of construction work, or to industrial work of any kind, bearing in mind the general principles on which it is framed.

STANDARD TIMEKEEPING CODE.

SUBDIVISIONS — Location of Work in the Building.

Third Letter with S:		*Third Letter with P:*	
b	I-beams, channels, etc.	b	Boiler.
c	Columns.	c	Crusher and elevator.
cb	Column bases.	ch	Chute.
d	Doors.	d	Derrick.
dg	Door guards.	f	
df	Door frames.	g	Locomotive, portable engine and boiler.
ds	Door sills.	h	Hoisting engine.
fl	Flashing.	j	
g		k	
h		l	Elevator tower, bucket and hoist.
j	Bolts.	m	Mixer and engine.
k	Cornice.	n	Temporary buildings.
l		p	Pump.
m		q	
n	Lintels.	r	Runways, staging, ladders and guard rails, etc.
p	Pipe.	s	Wood-working shop, saw bench, planes, etc.
q		t	Track.
r	Railings, gratings, etc.	v	
s	Stairs.	w	Water supply.
sr	Stair rails.	x	
sl	Sleeves.	y	
t	Trusses.	z	Miscellaneous.
v	Inserts for sprinklers, etc.		
w	Windows.		
ws	Window shutters.		
wg	Window guards.		
x			
y			
z	Miscellaneous.		

FIG. 6.

Although at first sight it looks complicated, yet it has been found to be very simple in practice, and new timekeepers and superintendents very quickly pick up its essentials.

It has the advantage that if any work is done on the job which was not known of or contemplated when the original code was made out, it is a simple matter to adapt the letters and make up a fresh code word for the new work. As a matter of precaution, we always require our timekeepers to give the explanation of a new code word whenever he makes one up, although very often we can read them without such explanation, owing to our familiarity with the principles on which the code is based.

From the standard code as given above, a special code is written out in the head office for the job before the work is started, and from time to time additions are made from the office or by the job, to meet special items of work met with on the job; but all the main items of work, such as concrete in columns and floors, forms, and reinforcement, have the same code word at all times, for example.

M — CONCRETE.

	Mix.	Place.	Fill Voids, Smooth Up, Etc.
Footings,	Mad	Med	Mod
Floors and Roof,	Maf	Mef	Mof
Columns,	Mac	Mec	Moc
Walls,	Maw	Mew	Mow

F — FORMS.

	Make.	Erect.	Strip.
Footings,	Fad	Fed	Fid
Floors and Roof,	Faf	Fef	Fif
Columns,	Fac	Fec	Fic
Walls,	Faw	Few	Fiw

SECTION III.

THE TIMEKEEPING.

A. The Field Sheet.

On the job the timekeeper is supplied with what we call a "field sheet," an example of which is shown in Figs. 7 and 8. This field sheet is, we believe, an innovation in timekeeping. A

fresh sheet or sheets is used every day and is carried around by the timekeeper on the job. In the left-hand column he enters the numbers of all the men who are at work, and it will be noticed that the tenth line is a heavy line and that numbers ten, twenty, thirty, and so on appear on these heavy lines always, and if necessary, blanks are left in between to insure this being done.

Job No. 1990 1 — ABERTHAW CONSTRUCTION COMPANY, BOSTON — Date 7/2/13

At Northwood, Mass — TIMEKEEPER'S FIELD SHEET — Timekeeper's Name Dunham — Sheet No. 1

Men's Number	In a. m.	In p. m.	Out	7 a.m. to 8	8 – 9	9 – 10	10 – 11	11 – 12	12 – 1 p.m.	1 – 2	2 – 3	3 – 4	4 – 5	5 – 6	Overtime	Total Hours
Lyell	✓	✓	✓	—	—	—	—	—		—	—	—	—			9
Parker	✓	✓	✓	—	—	—	—	—		—	—	—	—			9
Dunham	✓	✓	✓	—	—	—	—	—		—	—	—	—			9
Rutledge	✓	✓	✓	Ref	Refb	—	—	—		Mef	—	Fecm	Sev			9
Stevens	✓	✓	✓	Rec	—	—	—	—		Ref	—	—	—			9
611	✓	✓	✓	Ref	—	—	—	Refm		—	—	—	—			9
614	✓	✓	✓	Ref	Refb	—	—	—		—	—	—	—			9
616	✓	✓	✓	Refb	—	—	—	—		—	—	—	—			9
617	✓	✓	✓	Fecm	—	—	—	—		—	—	—	—			9
618	✓	✓	✓	Refb	—	—	—	—		—	—	Mef	Refb			9
619	✓	✓	✓	Ref	—	—	Fec	—		—	—	—	—			9
620	✓	✓	✓	Ref	—	—	Fec	—		—	—	—	—			9
621	✓	✓	✓	Ref	Refb	—	—	—		—	—	—	—			9
622	✓	✓	✓	Refb	—	—	—	—		—	—	Mef	Refb			9
623	✓	✓	✓	Refb	—	—	—	Fecm		—	—	—	—			9
639	✓	✓	✓	Refb	—	Ref	—	Sev		—	—	—	—			9
640	✓	✓	✓	Refb	Mef	Ref	—	—		Rec	—	Bew	—			9
								Fig 7								

Job No. 1990 — ABERTHAW CONSTRUCTION COMPANY, BOSTON — Date 7/24/13

At Northwood, MASS — TIMEKEEPER'S FIELD SHEET — Timekeeper's Name Dunham — Sheet No. 2

Man's Number	In a.m.	In p.m.	Out	7 a.m. to 8	8 – 9	9 – 10	10 – 11	11 – 12	12 – 1 p.m.	1 – 2	2 – 3	3 – 4	4 – 5	Overtime	Total Hours
651	/	/	/	Mef	—	—	Fin	—		—	Mef	—	—		9
652	/	/	/	Mef	—	Fin	—	—		—	—	—	—		9
653	/	/	/	Mu	—	—	—	—		—	—	—	—		9
654	/	/	/	Mef	—	Fin	—	—		—	—	—	—		9
655	/	/	/	Rec	—	—	Ref	—		Rec	—	Ref	—		9
656	/	/	/	Mef	—	Fef	Ref	—		Fef	—	Ref	—		9
657	/	/	/	Fec	—	—	—	—		—	—	—	Fin		9
658	/	/	/	Mef	—	—	Fin	—		Mef	—	—	—		9
659	/	/	/	Mef	—	—	Fin	—		—	Mef	—	—		9
660	/	/	/	Mef	Rec	—	Ref	—		—	Ben	—	—		9
662	/	/	/	Mu	—	—	—	—		—	Fin	—	—		9
663	/	/	/	Rec	—	—	Ref	—		Rec	—	Ref	—		9
664	/	/	/	Fef	—	—	—	—		—	—	—	—		9
665	/	/	/	Mef	—	—	—	—		—	—	—	—		9
667	/	/	/	Mo	—	—	—	—		—	—	—	—		9
668	/	/	/	Bew	—	—	—	—		—	—	—	—		9
670	/	/	/	Rec	—	—	Ref	—		Rec	—	Ref	—		9
671	/	/	/	Fec	—	—	—	—		—	—	—	—		9
672	/	/	/	Rec	—	—	Ref	—		Rec	—	Ref	—		9
673	Kw	/	/	X	Bew	—	—	—		—	—	—	—		8
674	Kw	/	/	X	Bew	—	—	—		—	—	—	—		8
676	Kw	/	/	X	Bew	—	—	—		—	—	—	—		8
677	/	/	/	Fef	—	—	Ref	—		—	—	Fin	—		9
679	/	/	/	Rec	—	—	Ref	—		Rec	—	Ref	—		9
681	/	/	/	Mu	—	—	—	—		—	—	—	—		9
682	/	X	X	Fef	—	—	Fec	—							5
683	/	/	/	Mef	—	Fef	—	Fecm		—		—	—		9
684	/	/	/	Fef	—	—	—	—		—	—	—	—		9
685	/	/	/	Mu	—	—	—	—		—	—	—	—		9
690	/	/	/	Fef	—	—	—	—		—	Fecm	Fin	—		9
691	/	/	/	Fecm	—	—	—	—		—	—	—	—		9
692	/	/	/	Fef	—	—	Fefp	—		—	—	—	—		9
693	/	/	/	Fecm	—	—	—	—		—	—	—	—		9
697	/	/	/	Fef	Fec	Ref	Peno	—		—	—	—	—		9
1 Team Murphy				Mu	—	—	—	—		—	—	—	—		9
1 Team Sanders				Mu	—	—	—	—		—	—	—	—		9
							Fig	8							

(The object of this will be explained later.) After having checked the men in, in the second column from the left, the timekeeper starts on his rounds and in the column headed 7 to 8 he places against each man's number the code word for the work he is doing. On making his second round, which is usually about ten o'clock, if the man is still on the same work he simply

places a check in the intervening columns to show that the same work is going on. The timekeeper has to make at least four rounds every day and has to find each man on every round. If a man is not found, his pay is docked unless he can satisfactorily explain where he was.

It will be noted that the field sheet provides columns for checking the men in after the noon hour and for checking the men out at night and for overtime. The last column is the total number of hours worked during the day, which is used in making up the payroll, as will be shown later.

In going his rounds, the timekeeper carries the field sheet in a stiff binder similar to that used by the express companies. On a large job, sometimes as many as six or eight sheets are used every day. They are of course all numbered up with the numbers of the men before he starts on his rounds. The advantages of this field sheet are as follows:

1. The timekeeper keeps a permanent record of what the men are doing every hour in the day. This is an improvement on the old method, when timekeepers used to take the time on old pieces of scrap paper, backs of envelopes, or pieces of old board, and kept no permanent record of the work in any form. In that way men were frequently missed and their time afterwards guessed at, and there was no check on the men that showed they were all at work.

2. The superintendent can easily check the work of a timekeeper. Most of our superintendents, each time that they go out on to the work, make a note of the numbers of three or four of the men and note what they are doing at that time, and on coming in refer to the timekeeper's field sheet to see what work he has entered them as being on, and by picking out at random a few men every day in this way it is easy to find out whether the timekeeper is doing his work correctly.

3. It is easy to disprove men's claims for more time than they are allowed, as in addition to the record on the payroll we have this actual check on what the men were doing hour by hour, and a man who claims his time is short is confronted with the field sheet, which shows exactly what he has been doing.

4. On a large job, two men can work together on the time-

keeping, for on a job where the payroll is as much as four thousand dollars a week it is all one man can do to go round the work and note the men's time. He turns in his field sheet to an assistant timekeeper, who makes out the payroll and time sheets from it. Under the old methods, when rough notes were made on scrap paper, this would be a very difficult if not an impossible thing to get done correctly, and the result would be that the timekeeper's field work would suffer and the cost accounts would be inaccurate.

There are necessary limits to the number of subdivisions made in the work. Some timekeepers with more zeal than discretion will multiply subdivisions without end if not watched. It is a standing instruction to our men that the laborer who shakes out and bundles cement bags is to be charged to the largest concrete item of the day, and that the saw filer is to be reported on the largest piece of form work. All time on temporary dams for construction joints in concrete floors are reported with floors. The superintendent, timekeeper and water boy are not so charged but are prorated on every item, as will be seen in section IV–*A*.

B. The Time Sheet.

Figs. 9 and 10 show the daily time sheet. In this it will be noted that the ruling is the same as on the field sheet, with every tenth line reserved for numbers 10, 20, 30, and so on, so that the men's numbers appear always on exactly the same line on each sheet. In the left-hand column are the numbers of the men and on the top of the succeeding column are written the code words of the work in progress. Under these is entered against every man the number of hours he has spent on the section of the work denoted, and on the right-hand side is a column for the man's rate. The next two columns are headed "For Office Use," and when the sheets come into the office the total amount spent on each subdivision of the work is worked up and entered there, as is shown in the example. The extreme right-hand column is reserved for the report of the quantities of the work done, which are entered by the timekeeper every day, or, in

some cases where the work is unfinished at the end of the day, every second or third day.

These sheets are entered up by the timekeeper on the job, sometimes in the evening after the day's work is done, but usually in the morning following the day in which the work was done. They are mailed to the office daily.

Job No. 1990 ABERTHAW CONSTRUCTION COMPANY, Boston Date 7/2/1913
At Northwood. MASS DAILY TIME SHEET Sheet No. 1

Man's Number	Fefb	Fef	Mef	Sev	Fecm	Rec	Ref	Fec	Bew	O	Rate	For Office Use		Amount of work done and materials used
Lyell										9	37.50	O	11 16	
Parker										9	18.00	Fefb	26.27	Weather Fair
Dunham										9	13.00	Fef	15.60	Temperature, 7 a.m. 82°
Rutledge	4	1	2	1	1						36.00	Fec	10.15	1 p.m. 90°
Stevens							5	4			25.00	Fic	8.40	6 p.m. 90°
														Bew 46 Bags Cement
611	5	4									30	Mef	15.23	1 bbl lime
												Mo	10.95	
614	8	1									50			Fif 5394.00
												Sev	2.16	Fef 5381.00
616	9										45			Fefb 537.00
617					9						50			Fefb 11.94.00
618	7	2		1	2						.	Fecm	12.86	Fec 1218.00
619			3						6		45			Fic 1015.00
620			3						6		.			Sev .288
														Rec 5358.00
621	8	1									.			Ref 9239.00
622	7		1	1							.			Bew .9143.45 Fb
623	4				5						25	Rec	9.95	Bu .16300 bbl
												Ref	12.24	
												Bew	17.10	
												Peno	1.20	
													153.29	
												Temps		
												Mo	10.00	
639	2			5				2						
640	1		1			2	3		12					
												Sheet made out by		C. N. Dunham
												Checked by		W. L. Parker
												Approved by		J. R. Lyell Superintendent
												Approved by		Inspector

Fig 9

Job No. 1990 — ABERTHAW CONSTRUCTION COMPANY, BOSTON — Date 7/2/13

At Northwood, Mass. — DAILY TIME SHEET — Sheet No. 2

Man's Number	Mef	Fir	Mu	Rec	Ref	Fef	Fec	Bow	Feum	Fefb	Perc	Rate	For Office Use
651	6'	3'										50	
652	2'	7'										25	
653			9'									"	
654	2'	7'										"	
655				5'	4'							"	
656	2'				4'	3'						35	
657		1'					8'					25	
658	7'	2'										"	
659	6'	3'										27½	
660	1'			2'	3'			3'				45	
662		3'	6'									25	
663				5'	4'							30	
664						9'						25	
665	9'											35	
667			9'									25	
668								9'				"	
670				5'	4'							"	
671							9'					"	
672				5'	4'								
673								8'				62½	
674								8'				37½	
675								8'				62½	
677		2'			4'	3'						27½	
679				5'	4'							25	
681			9'									30	
682						3'	2'					25	
683	2'					7'						"	
684						4'			5'			"	
685			9'									"	
690		2'				6'			1'			25	
691									9'			"	
692						3'				6'		"	
693									9'			30	
697					1'	1'	1'				6'	20	
1 Teams			9'									5.00 day	
1 Teams			9'									5.00 day	

Amount of work done and materials used:

Weather

Temperature, 7 a.m.

1 p.m.

5 p.m.

Mef - Concrete stops, hoisting runways, barrows etc to roof.

Sheet made out by C. H. Dunham

Checked by W. L. Barker

Approved by J. R. Lyell Superintendent

Approved by Inspector

Fig. 10.

C. The Payroll.

Figs. 11 and 12 show the payroll, which is also ruled up in sets of ten lines, like the field sheet and the time sheet. This is similar to all contractors' payrolls and needs no comment, except to point out the immense saving of time that has been made by the use of time sheets, field sheets and payrolls, all

ruled uniformly, and insisting on leaving blank spaces rather than using every line on the time sheets and payroll. The payroll is filled in simply by placing the field sheet over the payroll, and transferring the number of hours' work without even referring to the men's number. The payroll is then checked by the time sheet, so that there is a circular check on the whole of the operation.

Job No. 1990 — ABERTHAW CONSTRUCTION COMPANY, Boston — Page 1

at Northwood, Mass. — PAY ROLL — From 6/26/1913 to 7/2/1913

Men's No	26	27	28	29	30	1	2	Total Hours	Rate	Amount
Izell	9	9	9		9	9	9	54	37.00	37.00
Parker	11	9	9		10	9½	9	57	18.00	18.00
Dunham	11	9	9		10	10	9	58	13.00	13.00
Rutledge	9	9	9		10	10	9	56	36.00	36.00
Stevens	9	9	9		9	10	9	55	25.00	25.00
611	9	9	9		10	10	9	56	30	16.80
614	9"	9	9		10	10	9	56"	50	28.25
615	5							5	30	1.50
616	9	9	9		6	10	9	54	45	24.30
617	9	9	9		10	10	9	56	50	28.00
618	9	9	9		10	10	9	56	"	28.00
619	9"	9	9		10	11"	9	68	45	26.10
620	9	9	9		9"	11"	9	57	"	25.65
621	9	9	9		10	10	9	56	"	25.20
622	9	9	9		10	10	9	56	"	25.20
623	10	9	9		10	10	9	57	25	14.25
639	11	9	5		10	9	9	53	30	15.90
640	11"	9	9"		10	10	9	60	25	15.00

Sheet made out by C. W. Dunham Approved T. R. Izell Supt.

Checked by W. L. Parker Approved Inspector

Total $

Fig. 11.

Job No. 1990 — ABERTHAW CONSTRUCTION COMPANY, BOSTON — Page 2

at Northwood Mass — PAY ROLL — From 6/26/13 to 7/2/13

Man's No.	26	27	28	29	30	1	2	Total Hours	Rate	Amount
651	12½	9	9		10	9	9	64½	50	32.25
652	11½	1	9		9½	5½	9	45½	25	11 38
653	11	9	9		9	9	9	56		14.00
654	11	9	5		9½	9	9	52½	"	13.13
655	11	9	9		10	10	9	58		14 50
656	12	9	9	6	9½	9	9	63½	35	22.23
657	12½	9	9		9½	9	9	58	25	14.50
658	12½	9	9	6	9½	10	9	65		16.25
659	12	9	9		9½	9	9	57½	27½	15 81
660	12½	9	9		10	10	9	59½	45	26 78
662	12	9	9		4	6½	9	49½	25	12.38
663	11	9	9		10	10	9	58	30	17.40
664	11½	9	9		10	9	9	57½	25	14.38
665	12	9	9	6	9½	9	9	63½	35	22 23
666	6½							6½	25	1.63
667	11	9	9		9	9	9	56	.	14.00
668	11½	9	9		9	9	9	56½	.	14 13
670	11½	9	9		9½	10	9	58	25	14 50
671	11	9	9		10	10	9	58	.	14.50
672	11	9	9		9	10	9	57	"	14.25
673	8	8	8		8	8	8	48	62½	30.00
674	8	8	8		8	8	8	48	37½	18 00
675		8	8		8	8	8	40	62½	25.00
677	11½	9	9	6	9½	9	9	63	27½	17.33
679	11½	9	5		9½	10	9	54	25	13.50
681	11½	9	9		9	9	9	56½	30	16 95
682	11	9	9		9½	9	5	52½	25	13 13
683	11	9	9		10	10	9	58	.	14.50
684	2	9	9		5	2	9	36	.	9.00
685	11½	1	9		9	9	9	48½	.	12.13
686		9	9		10	5½		33½	.	8.38
690	11	9	9	6	9½	9½	9	63	25	15 75
691	12	9	9		10	10	9	59	.	14 75
692	11½	9	9		10	10	9	58½	25	14.63
693	11	9	9		10	10	9	58	30	17.40
697	11½	9½	8		10	10	9	58	20	11 60
										572.28
								Total first sheet		402.15
								Grand	Total	$974.43

Sheet made out by C. W. Dunham Approved Y. A. Lyell Supt.

Checked by N. L. Parker Approved .... Inspector

Fig. 12

D. *The Quantity Report.*

This has already been referred to when considering the time sheet. It is of course of vital importance that the quantities should be accurately reported. We make it the duty of the engineer in charge of the level and transit to compute the quantity of work done each day and turn it in to the timekeeper to

enter in the column provided. It is often a difficult matter to insure correct reports being received on the quantities of work done, and at the time the system was installed the writer made a practice of visiting jobs monthly and making a rough survey of them whereby he could calculate from his original estimate the quantity of work done, and use this as a check. The practice on our work has improved a good deal since then and it is very seldom necessary now to make this check, but it is one that should not be neglected by any one starting on a cost-accounting system, as without this check the cost accounts may be rendered worthless by quantities either in excess or less than the actual amounts being reported. On one job, some years back, we found that a superintendent had reported 20 000 sq. ft. more forms than he had put up, with a view to making his costs look low and getting credit for economical work. Our estimates show what the total quantities should be, and an occasional survey and a final comparison will prevent any such errors being made now.

In concrete work the only item of labor that can be checked from the bills is the steel reinforcement, and every other quantity has to be obtained by scaling and computation. This is also true in most other branches of construction work, with the exception of structural steel.

E. The Inquiry Form.

We also use a brief standard form in case of any apparent mistakes on any of the reports received from the field. Often a man's rate is entered wrongly, or a different number of hours appears on the payroll to that on the time sheet, or time is reported with no quantities or quantities with no time. It is only by picking up all these mistakes at once and having them corrected that a system is kept going properly, and the men in the field, knowing that their work is carefully watched, are more keen in getting work done accurately. This may seem to be a trivial detail but the writer's experience is that it is not possible to get accurate and careful work from men in the field unless careful attention is paid to the smallest items, and any

inaccuracies or omissions are promptly followed up. If the men on the job are made to realize that their work is important and really counts for something they will be a good deal more careful and eager to coöperate with the office in matters like this.

Job No. 1990 **ABERTHAW CONSTRUCTION CO.** Sheet No.

WASTE SHEET 6/26/1913 to 7/2/1913

	Fef	Fif	Fefb	Fifb	Fac	Fec	Fic	Fecm	Fesc	Fir
6/26	95	9.00	5.80			6.40			8.62	
6/27	60.24	17.70					4.17	1.90	1.50	
6/28	16.21	8.85		1.50		25.77	15.48			
6/29										
6/30	30.32	10.15	15.53	3.17	2.50	32.11		1.10		9.44
7/1	22.95		15.48		9.10	18.00	75	4.95		6.84
7/2	15.60		26.27			10.15		12.86		8.40
	146.27	45.70	63.08	4.67	11.60	92.43	20.40	20.81	10.12	23.68
O 7 6/10 %	11.11	3.47	4.78	35	88	7.02	1.55	1.58	77	1.80
	157.38	49.17	67.86	5.02	12.48	99.45	21.95	22.39	10.89	25.48
Quantities	5381'	5394'	1194'	537'		1218'	1015'			
Unit Cost	2.92	.91	5.68	.93		8.15	2.16			
Total to date	278.72	160.25	3835	1901		5184	3751	$112.56	$11.10	$31.02
Average unit cost	2.02	.92	7.62	.82		8.12	2.03			

	Mef	Mof	Mu	Rec	Ref	Kiw	Ded	Bew	Biw	Pel
6/26	84.47		5.92		13.70			12.75		
6/27	5.22	3.78	5.80	3.84		1.80		19.51		4.32
6/28		3.15	7.45	8.10		13.25		16.67	1.20	1.25
6/29						11.55		16.80		
6/30	3.99	.27	4.20	4.39	5.85	19.39	2.32	16.25		
7/1	.37		7.85	12.90	2.11	11.58	1.62		1.50	
7/2	15.23		10.95	9.95	12.26			17.10		
	109.28	7.20	42.17	39.18	33.92	57.57	3.94	99.06	2.70	5.57
O 7 6/10 %	8.29	.55	3.20	2.98	2.58	4.36	30	7.51	20	.42
	117.57	7.75	45.37	42.16	36.50	61.93	4.24	106.57	2.90	5.99
Quantities	181 c.y.			5258'	9240'			9143		
Unit Cost	65¢			15.72 Ton	7.90 Ton			11.65 M		
Bbls Cement	295		Teams 33.33					457 f.c.		
C.f. per Bbl.	163							23¾ f.c.		
Total to date	665.14		934.4	352438'	51340'	$115.17	$4.53	9143		$235.67
Average unit cost	86		82	11.32 T	6.87 T			11.65 M		

	Per	Pen	Sev	Se	Sew	Cef	Ceo	Ces	O	Bu
6/26	4.05		30	1.35				10.35	12.90	40
6/27					6.75		9.17	3.00	11.16	1.45
6/28						10.80	.95		11.16	2.90
6/29										
6/30			.60		4.30				11.16	
7/1		2.08	3.20	.90	.52				11.16	
7/2		1.20	2.16						11.16	
	4.05	3.20	6.26	2.25	11.57	10.80	10.12	13.35	68.70	4.75
"O" 7 6/10 %	.30	.24	.47	.17	.88	.82	.76	1.00	.7 6/10 %	.36
	4.35	3.44	6.73	2.42	12.45	11.62	10.88	14.35		5.11
Quantities			288							
Unit Cost			.02¾							
Total to date	$11.55	$65.98	1313	$37.98	542'					
			.03½		.04⅓					

Total PR		974.40
Teams		33.35
		$1007.75

FIG. 13

SECTION IV.

THE WORK IN THE OFFICE — LABOR RECORDS.

A. Working up the Time Sheet.

As soon as the time sheets come into the office, the total cost of each operation is worked out and entered in the column headed " For Office Use " on the time sheets, as shown in Fig. 9. At the end of the week the totals are drawn off on to an abstract sheet, shown in Fig. 13, and the items are totaled. The overhead labor expense (superintendent, timekeeper, waterboy, etc.) is then distributed by adding a percentage to each item, and the complete cost of each operation for the week is arrived at. The quantities are then written underneath each one and the unit costs worked out. They are then entered on the office record sheets, which will be described in the next section, and under them is entered the total quantity of work done to date (which is obtained from the office sheet) and the average cost of the work to date.

B. The Weekly Summary.

Fig. 14 shows a copy of the weekly summary of labor costs. The top line shows the total amount spent during the week on the items. The second line shows the quantity done, and the third line the unit cost. There are then left two or three lines for notes; in the case of concrete the number of barrels of cement used and the number of cubic feet of concrete obtained with a barrel of cement is noted. The two lower lines show the total quantity of that kind of work done to date and the average cost. Four copies of this sheet are made every week, and are furnished to the heads of the firm and the general superintendent, and one copy goes to the superintendent in the field. He also has a copy of the analysis. With these two he is able for himself to see how the costs of his work are running and how they compare with the estimate. Most of our superintendents also work out daily unit costs in the field on the larger items of the work, to keep more closely in touch with their costs. We believe in letting our men know just what we expect of them in the way

of costs and letting them know just how they are coming up to or bettering our expectations. Since we adopted the plan of letting them know what the weekly costs were, there has been a marked improvement in the unit costs and a real enthusiasm for getting low costs.

I may be asked why we do not "go one better" and work out daily costs in the office instead of weekly. The reason this

ABERTHAW CONSTRUCTION CO. BOSTON

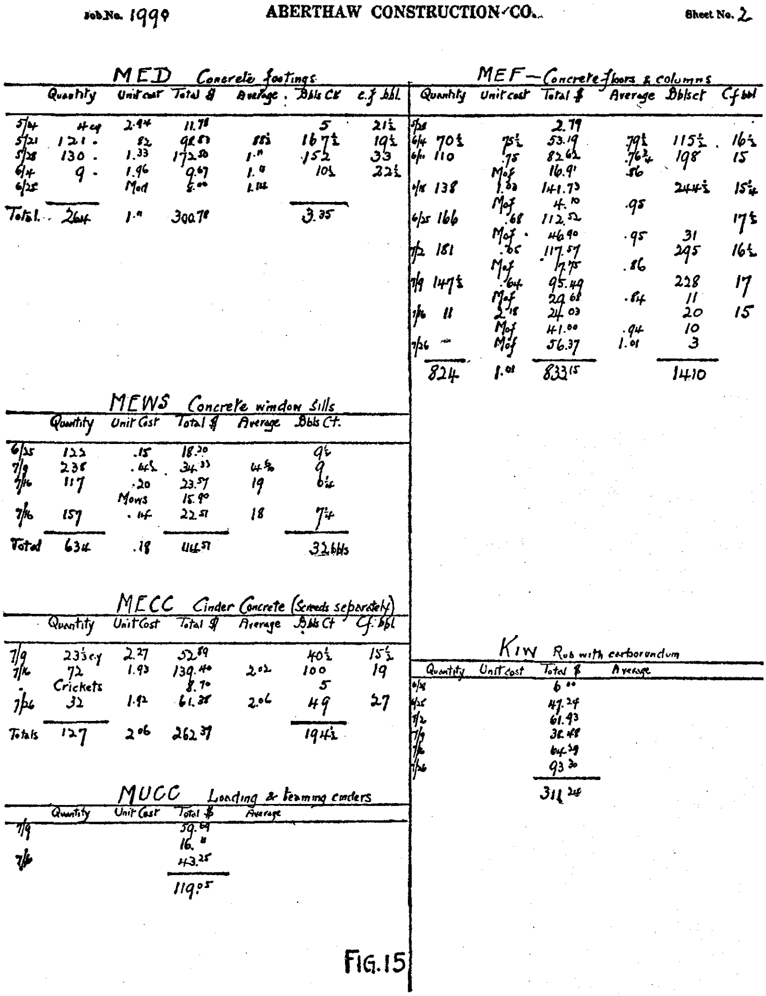
WEEKLY SUMMARY

Job No. 1990 **At** Northwood. Mass. **Week ending** July 2nd 1913

Item	Fef	Fiy	Fefb	Fifb	Fac	Fec	Fic	Fecm	Fesc	Fir		Mef	Maf	Mu		Rec	Ref		Krw		Ded		Bew	Brw	Bu
Total cost	157.38	44.17	67.56	5.03	12.46	99.85	21.95	22.39	10.89	25.48		117.57	7.75	45.37		42.16	36.50		61.93		4.24		106.57	2.90	5.11
Amount done	5381	5394	1194	537		1218	1015					181 c.y.				5255	9240						9143		
Unit cost	2.92 sq.	91	5.68	93		8.15	2.16					65		Teams		15.72 Ton	7.90 Ton						11.65 M		
											CF Bbls	295		33.33									457[illegible]		
												16½											.23⅓ f		
Total Done	27872	16025	3835	1901		518.14	3751	$112.56	$11.10	$31.02		665 c.y.		934 c.y.		35438	51340		$115.17		$14.53		9143		
Average Cost	2.02 sq.	.92 sq.	7.62 sq.	.83 sq.		8.12 sq.	2.03 sq.					86		.82 c.y.		11.37 Ton	6.87 Ton						11.65 M		
Item	Pel	Per	Pen		Sev	Se	Sew		Cef	Cee	Ces		O												
Total cost	5.99	4.35	3.44		6.73	2.42	12.45		11.63	11.88	14.35		68.70												
Amount done					388								7 6/10 %												
Unit cost					.023¼																				
													Included in preceding amounts			Payroll		$	974	.40					
																Teams			33.	35					
Total Done	$235.67	$11.55	$65.96		1313	$37.96	542																		
Average Cost					.03½		.04½																		

FIG. 14

is not done is not on the ground of expense — although it would be a very expensive proceeding — but because if we worked out the cost of every item every day we should have such an overwhelming mass of figures to study that we should never have any clear idea as to how the jobs stood, — and then again the costs would show such astonishing variations from day to day that they would be in many cases useless. For example, suppose a line of sheet piling set up and braced one night but not driven right down till next day, following our rule (to report quantity when work is done) one day would show a large expense in money and no quantity, the next a large quantity with small expense and exceedingly low unit cost.



Job No. 1999 ABERTHAW CONSTRUCTION CO. Sheet No. 2

MED Concrete footings

	Quantity	Unit cost	Total $	Average	Bbls Ct	c.f. bbl.
5/14	4 c.y.	2.94	11.78		5	21½
5/21	121.	.82	92.83	.85½	167½	19½
5/28	130.	1.33	172.80	1.11	152	33
6/4	9.	1.96	9.67	1.0	10½	22½
6/25		Med	8.00	1.12		
Total	264	1.1	300.78		3.35	

MEF—Concrete floors & columns

	Quantity	Unit cost	Total $	Average	Bbls ct	Cf bbl
5/28			2.79			
6/4	70½	.75½	53.19	.79½	115½	16½
6/11	110	.75	82.62	.76¾	198	15
		Mof	16.91	.86		
6/18	138	1.02	141.73		244½	15¼
		Mof	4.10	.95		
6/25	166	.68	112.52			17½
		Mof	46.90	.95	31	
7/2	181	.65	117.57		295	16½
		Mof	17.75	.86		
7/9	147½	.64	95.49		228	17
		Mof	29.68	.84	11	
7/16	11	2.18	24.03		20	15
		Mof	41.00	.94	10	
7/26	—	Mof	56.37	1.01	3	
	824	1.01	833.15		1410	

MEWS Concrete window Sills

	Quantity	Unit Cost	Total $	Average	Bbls Ct.
6/25	122	.15	18.20		9½
7/9	238	.14½	34.33	14%	9
7/16	117	.20	23.57	19	6¼
		Mows	15.90		
7/16	157	.14	22.51	18	7¼
Total	634	.18	114.51		32 bbls

MECC Cinder Concrete (Screeds separately)

	Quantity	Unit Cost	Total $	Average	Bbls Ct	Cf. bbl
7/9	23⅓ c.y.	2.27	52.89		40½	15½
7/16	72	1.93	139.40	2.02	100	19
	Crickets		8.70		5	
7/26	32	1.92	61.38	2.06	49	27
Totals	127	2.06	262.37		194½	

MUCC Loading & teaming cinders

	Quantity	Unit Cost	Total $	Average
7/9			59.64	
			16.11	
7/16			43.25	
			119.05	

KIW Rub with carborundum

	Quantity	Unit cost	Total $	Average
6/18			6.00	
6/25			47.24	
7/2			61.93	
7/9			38.48	
7/16			64.39	
7/26			93.30	
			311.24	

FIG. 15

C. The Office Labor Sheets.

Fig. 15 shows the regular record kept in the office of the labor. This sheet shows only a few items and there would be some ten or twelve sheets for every job. It will be seen that the first column contains the date, next the quantity of work done in the week, the next the unit cost of that work, and the next column

the total cost of that work. The next column contains the average cost of the work to date, combining the week's work with all the previous weeks. In the case of concrete, two additional columns are used, giving cement used and the proportion of the mix. These are entered up from week to week from the abstract mentioned previously. The totals are kept in pencil at the foot of the columns and altered from week to week, so that it is a simple matter to add one week's work to the total of the preceding week and work out the average unit cost.

On some items, such as forms, the cost of making, erecting and stripping of forms is carried in separate columns, and another column is kept for the total unit cost of the work to date. This is obtained by adding the totals of the three money columns and dividing by the number of square feet erected. This inclusive unit cost does not give quite such an accurate idea of the cost as the three subdivisions do, as all the making is done at the beginning of the job and some of the stripping may not come until a good while after, but is in many cases a very useful figure to have, and it is, of course, the figure which compares with the analysis which is made out at the beginning of the job. As already mentioned, when the cost of the item for the week has been entered, the average is worked out and then the resulting average and the total quantity to date is transferred back to the waste sheet from which the weekly summary is made out.

SECTION V.

IN THE OFFICE. THE MATERIAL RECORDS.

Figs. 16 and 17 show a part of the material records kept in the head office. These are entirely distinct from the bookkeepers' records and are not a ledger account. No merchants' names appear as a rule, but chiefly quantities of materials and costs.

The records are kept on loose sheets and at the start of the job, columns are headed for each item that appears in the analysis. In some cases these items are subdivided. Then every item of expense is entered under its proper heading regularly as the work goes on. Freight in every case is entered with the item to which it relates. Demurrage also is entered in the columns

of "Cement," "Brick," "Lumber," etc., as the case may be. The column headed "Cement" will also contain items of freight, freight on empty bags, credit on empty bags, tests, demurrage, etc., so that the final price per barrel of cement that appears in the final summary may be several cents higher than the price entered on the original order, especially if many empty

Job No. 1990 ABERTHAW CONSTRUCTION CO. Sheet No. 1

MATERIAL RECORDS

PLANT

SMALL TOOLS SUPPLIES

f.22	Lights Shovels pick hdle	12.02
·	Bolts & Washers Clips all for Rl	21.50
·	Misc. small tools & supplies	35.33
··	Oil clothing 54.88 Lights 3.85	58.73
·	Sharp tools	3.40
·30	3 pieces tree 2.45 Yard labor & Team	23.00
·68	Credit Switches etc to yard	12.60 x
·45	Switches fuses etc	14.50
·	Repair gears	25.23
	Small tools	14.10
	Wire ropes	8.58
	Power	21.60
	Sharp tools 2.40 Pails rope etc	23.25
	Power	62.20
		314.90

RENTAL

f.68	for entire job	513.40

OFFICE TRAVEL BOARD Etc

f.15	Fares telegrams, misc exps	69.60
f.23	Tel 11.83 Stationary 5.54	17.37
	Teleg	98
f.30	Express on money	8.05
f.66	Tel. fares etc	8.55
	Travel from Office	14.383
f.45	Tel	28.00
f.62	Express 4.60 Chair & desk	25.18
··	Tolls 10.39 Telegram 78	11.17
·	Tel	2.11
f.68	Credit Desk	15.00 x
		295.37

FREIGHT TEAMING

f.15	Yard labor 6.96 T. 19.50	26.46
·	Misc expressage plant	24.52
f.62	Frt a.O.	60.70
		111.70

TEMP BUILDINGS

f.26	Lumber for misc plant	331.68
·	Roofing paper	12.25
·68	Credit sold shanty	58.75 x
		285.18

FORM Details from Boston Office

f.15	Blue prints & tels	12.16
	Draftsman's time	68.54
		80.70

RENT of LAND for working space

f.62	Moostruck Silk Co	35.00

WATER SUPPLY

f.52	North Water Works	10.60
·	Misc. fittings	17.39
·68	Water	8.33
		36.52

FIG. 16

Job No. 1990 ABERTHAW CONSTRUCTION CO. Sheet No. 1

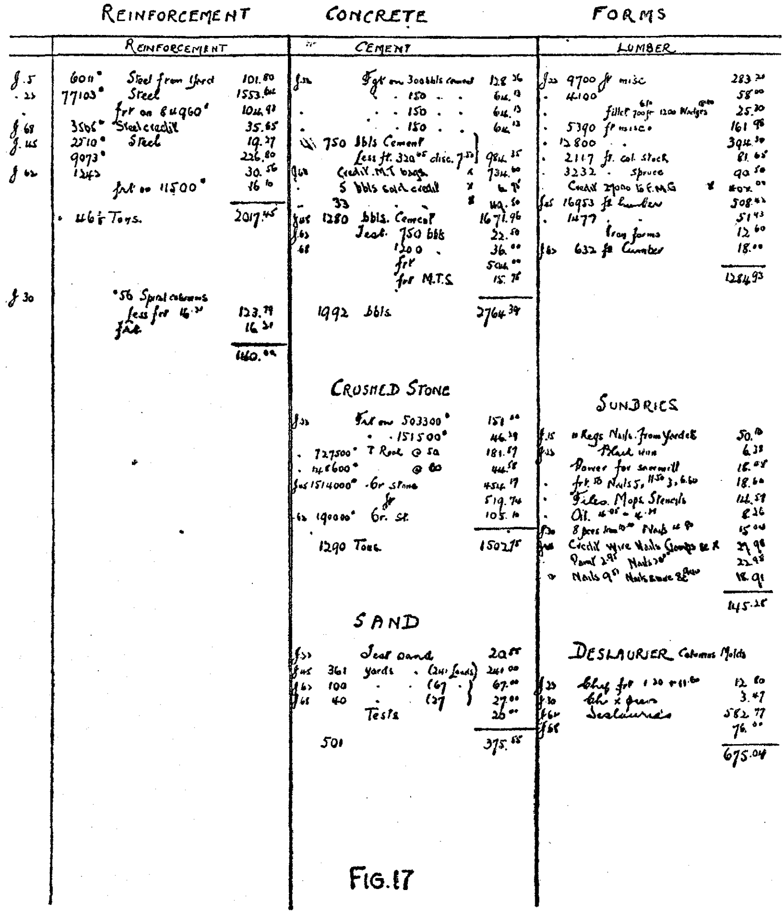


Fig. 17

bags have been lost. There is no column for all lumber. Lumber is entered under " Plant," " Forms," " Roof Plank," " Cofferdams," " Temporary Buildings," etc., according to the use it is to be put to. If lumber is bought for sheeting trenches and afterwards used for forms, it is first entered to the excavation item and then its second-hand value is credited and charged to

forms. Credits are entered in red in the same columns as debits, as there are very few of them and it would be cumbersome to have to keep double columns for each item to provide for possible credits.

To get hold of the information entered in these sheets the procedure is as follows: All bills are sent to the job to be checked and returned to the head office, from whence they are paid. As soon as the receipted bills come in they are sent to the Cost Accounting Department. They are then entered up in a waste book and at once returned to the bookkeepers. One waste book only is kept, and the bills are entered as they come in, a page at a time being kept for each job number, and another page taken when one is filled. When the bills are checked at the job, the material clerk notes on same what the material was used for (as in the case of lumber just referred to). This information is usually put in by using the timekeeper's code and then there is no question in the Cost Accounting Department as to where to charge any unusual item. The use of the waste book is simply to save time. The weekly labor summaries take precedence in the Cost Accounting Room, and on the last three days of the week we are much too busy getting these out to give any time to the material sheets. These can be entered up later in spare moments. Once a month, at least, each job is brought up to date and the total compared with the bookkeeper's ledger.

All orders are also examined by the Cost Accounting Department, and a note sheet kept on each job of all large orders and subcontracts, so that when a monthly statement is made of the financial standing of the job these can be included. The saving or loss on the estimate when a contract such as painting is sublet is not made when the final payment has been made but when the order is given, and should be taken into account then. We do not, however, keep a record of any but the big orders, as the thousand and one small items of nails, bolts, tools, etc., are billed and paid for very soon after receipt and quickly find their place in our records from the bills.

SECTION VI.

THE MONTHLY STATEMENT.

Fig. 18 shows the statement which is prepared monthly to ascertain the amount of money saved or dropped on the job. These are not made for every job on the same day, but by taking two or three jobs in turn each week we make it part of our regular routine without undue pressure at any time.

The weekly summaries showed labor costs only. If any item (excavating, for instance) was costing 20 cents per yard more than the estimate, it did not show how many dollars the total loss amounted to. Every job fluctuates from week to week. Some items are over the estimate and some show a saving. This statement brings these items all into view in such a way as to show how serious an over-run may be, and the final footings show within a very small amount just how the job stands.

The way the sheet is made up is, — first to copy from the analysis the description of all the items and place the unit prices in the column provided on the left. Then from the labor and material records to enter in the "Actual Cost" columns quantities of work done and materials purchased, with their unit costs and total costs to date. Then to work out in the "Estimated Cost" column the cost of the quantities done at the estimated prices. Then to enter all subcontracts made in the "Actual Cost" column and the corresponding "Estimated Cost," and finally to work out the totals saved or lost on each group of items.

A glance at the sheet before us will show some considerable variations from the original estimate. It is not within the scope of this paper to discuss the actual costs on this work, but it will be well to point out what is shown on the sheet and to give a few explanations as to local conditions to make things clear.

It will be seen, first, that concrete labor is running very close to the estimate, although the quantity placed in the footings was eighteen yards in excess of that estimated. Plant shows a loss of $268, chiefly on the labor items. An old construction elevator was sent to the job, which was rather out of repair and several parts had to be refitted or remade before it could be

erected. There is also a loss on the sand and stone. It was found that the crusher that had been counted on to supply us could not be depended on and so we had to purchase from a quarry further off, having a railroad delivery, and to unload and team from the railroad, about a mile to the site. As we were thus using teams regularly, we decided to buy sand F.O.B.

Job No. 1990 ABERTHAW CONSTRUCTION CO. Sheet No.

Monthly Statement of Costs to & including June 23rd 1913

		Estimated Cost		Actual Cost		Saving	Loss
Concrete footings labour	246 c.y.	1.00	246	264 c.y.	293		
floors	248 c.y.	1.00	248			4	
Columns	70	1.50	105	95	302		
Plant erect & repair			250		440		
freight		half	75		100		268
rental & depreciation			300		300		
Small tools & supplies etc.			450		503		
Cement	1825 bbls	1.35	2464	1.35	2464		
" tests		03	55	.03	55		
" teaming etc.			91		91		
Sand for whole job	520 c.y.	80	416	66⅔	347		
Crushed stone	1400 tons	1.40	1960	1.28	1792		269
Teaming sand and crushed stone to date					506		
Forms to footings labour	4580 □'	7.00	321	2375 sq.ft. 10.8	257		
floor slabs	16000 □'	7.00	1120	3.48	557		
wall beams	1950 □'	9.00	176	8.90	174		
external columns	2733 □'	11.00	301	11.51	314	642	
" wall brackets			30	incl.			
internal columns sublet			771		675		
Slab labour in connection					100		
Form lumber, nail, oil etc.			1070		1747		
Sawmill, labour & equipment			200	not used			
unloading & handling lumber			50		41		168
probable credit on lumber at close			300				
Steel Reinforcement	46 Tons	37.00	1702		2064		
Spirals	2½	60.00	150				212
Labour unloading & teaming			24		82		
" bending & placing slabs	15	8.00	120	6.79	102		
" " beams	3½	8.00	27	4.16	14		153
" " Columns	10	8.00	80	4.90	119		
Wire & sundries			24		6		
Excavation	100 c.y.	50	50	438 c.y.			
	553	80	443	1.90	945		
Sheet Piling labour			150		138		98
lumber			350		208		
Miscellaneous C.I. work			400				
W.I.			271		428	294	
Revetted bearing plates in footings			51				
Inserts	400	6	90	"	99		
" labour	509	05	26	05	26		9
Steel Sash & glazing			2270	sublet	2270		
Travel & board etc. to date	half		150		92	58	
Insurance	only		350		401		51
				Totals		998	1228
		Net overrun on Estimate to date				$230	

FIG. 18

teams at the pit, instead of F.O.B. the job, so as to keep teams steadily employed, so the statement shows a saving on sand and stone offset by an overrun on teaming. It is not necessary at this time to discuss the other variations but simply to note that the difference between the savings and the losses shows a net loss of $230 on the estimated total.

The amount of contractor's profit does not appear on these sheets or in any of the Cost Accounting records, and the amounts of saving or loss in the monthly statement have to be added to or deducted from the estimated profit.

Section VII.

MONTHLY COMPARISON OF BEST PERFORMANCES.

Fig. 19 shows a statement we prepare monthly showing the unit labor costs of the three or four principal items of construction on all jobs during the preceding month. A copy of this sheet is sent to every one of our foremen and superintendents. This is not an essential part of our system but it is awaited with great interest by our field superintendents and has proved a very useful factor in stimulating a general interest in the timekeeping and cost accounting work, and is an additional incentive to our men to try for low costs.

The costs shown on this statement are nearly always lower than our average costs, as they show the best work done month by month and do not bear any preliminary expense or other incidental items. They will give some idea of what *can* be done under favorable circumstances but would not be a safe guide for estimating future work.

Section VIII.

THE FINAL COMPARISON.

Figs. 20 and 21 show the final comparison of estimated with actual costs. This is similar to the monthly statement (Section VI) and needs no further explanation as to the method adopted, but a brief notice of some of its chief features will be of interest.

ABERTHAW CONSTRUCTION COMPANY.

Principal Unit Costs for Month of October, 1911.

Concrete — Unload, mix and place.

N.B. 2 mixers on Job 941.

	Job No.	Cu. Yds.	Unit Cost.
Largest 6 days' run of concrete,	917	313	$0.71
	941	2 205	.38½
	944	602	.62½
	946	558	.57
Largest 1 day run of concrete,	917	107½	.80½
	941	451	.38
	944	150	.54½
	946	233	.51½
Lowest day's unit cost — floors,	917	96	.68½
	941	408	.31½
	944	16½	.31½
	946	132	.38
Month's average unit cost,	917	700	1.17
	941	5 030	.59½
	944	1 418	1.02
	946	393	.84
		Sq. Ft.	Per 100 Sq. Ft.
Forms — Erecting only.			
Floor forms,	917	45 628	$3.53
	941	291 016	3.92
	944	82 107	6.24
	946	24 568	7.10
Wall forms,	917	None	None
	941	31 556	5.80
	944	3 855	9.59
	946	15 247	7.47
Column forms,	917	3 725	3.17
	941	41 260	7.15
	944	11 494	9.08
	946	7 095	10.05
		Tons.	Per Ton
Placing Floor Steel (beam and slab),	917	82.18	$5.36
	941	886.5	4.17
	944	63.82	6.47
	946	37.00	6.85
Bend and Place Column Steel,	917	6.56	5.30
	941	14.33	2.84
	944	15.92	8.62
	946	7.33	14.71

FIG. 19.

The cost of laying wood screeds to receive top flooring was unexpectedly high. The bulk of it was done in one week at the close of the job when the best of the men had been transferred elsewhere, and is a good illustration of the necessity of unceasing vigilance in superintendence to avoid sudden drops like this. The rest of the carpenter work was very well done, showing a saving of $944 on the forms. Plant continued to run high;

Job No. 1990 — ABERTHAW CONSTRUCTION CO. — Sheet No. 1

Final Statement of Costs.

	Quantities Estimated	Quantities Reported	Estimated Cost		Actual Cost		Saving	Loss
Concrete Labour on footings	246 cy	264 cy	1.00	246	1.14	301		
" " columns	169 "	169 "	1.50	254	1.01	171		
" " floors	690 "	655	1.00	690	1.01	662	37	
" " window sills	629 f.l.	634 f.l.	15	95	18	114		
" cinder concrete crickets				20				
" cinder concrete fill					3.06	262		
& laying screeds	125 cy	127	2.00	250	Screeds	326		338
Rub with carborundum				300		311		11
Plant Labour erect & dismantle				300		801		
" freight etc				150		112		
" rental				300		514		864
" Small tools & supplies				450		637		
Cement	2000 bbls	1972 bbls	1.35	2700	1.36	2682		
" tests			.03	60	03	59		
" unloading, teaming &c				100.		92		
Sand	520 cy	501	.80	416	.75½	376		106
Crushed Stone	1400 tons	1290 tons	1.40	1960	1.16	1502		
Teaming sand & stone						546		
Cinders	130 cy		50	65	Labour 119 Mtl. 3	202		
Concrete sundries				52				
Forms to footings labour	Sq. ft 4580	2375	7.00	321	10.87	257		
" " floor slabs	28618	27872	7.00	2005	3.58	997		
" " wall beams	3918	4025	9.00	359	9.34	376		
" " external columns	7300	6808	11.00	803	9.03	615		
" " wall brackets	1 = 55		70	39	Incl.	675		
" " internal col. heads	Sub contract.			771	Sublet ACC	115	944	
" " window sills	629 f.l.	631	15	94.	16	101		
Form lumber, nails, oil etc				1070		1430		
Unloading, handling lbr., cleaning "				50		221		
Sawmill				200	Not used			
Detailing forms in Boston	Office			100		81		
Steel Reinforcement	46 T	46⅓ T	37.00	1702	av. 43.66	2017		
" " spirals	2½ T	2⅓ T	60.00	150	56.00	140		
" " tests				10				
" " unloading	48½ T		50	[illegible]				311
" " wire & sundries				24				
" " bend & place in floors		26⅓ T	8.00		8.14	216		
" " " " columns	48½ T	17 T	8.00	388	11.32	193		
" " " " sundries		5⅓ T	8.00		7.00	36		
Inserts	1000	1313	.10	100	.09¾	128		
" labour	1000	1313	.05	50	.03½	46	23	
" billed as extra	313		15	47				
					Carried forward		1004	1630

FIG. 20

Job No. 1990 **ABERTHAW CONSTRUCTION CO.** Sheet No. 2

	Quantities	Estimated Cost		Actual Cost.		Saving	Loss
	Brot. forward.					1004	1630
Brickwork labour	1200 c.f.	.20	240	27½	332		
material	285 M		420	Qd	256		
				Lime	42	8	
				Cement 9½B	23		
Cutting & patching old work			50		49		
Metal lathed & plastered partition			52		37	17	
Repair old floors			250		173		
Pine Posts			160		145	128	
Hard Stairs			35		30		
Pipe Rail			50				
Miscellaneous cast iron work	wall		400				
	wrot		271		428	376	
Rivetted bearing plates			51				
	Labour on Misc ironwork		106		74		
Tinned doors			60	inc. frames	91		31
Steel Sash & glazing			2270		2270		
erection	5262 sq ft	.05	263	.056	268		5
Excavation	100 c.y.	Est'd	50		50		
	553 c.y.	.80	442				
	Reported 438 c.y.			1.70	745		
			100		10		86
Grading Sheet Piling	lumber		350		218		
	labour		150		205		
Clean up the lot, clean glass etc			100		124		24
Travel, board, superintendence etc			300		295	5	
Liability Insurance			400		450		50
Contingencies & sundries.			400		55	345	
						1883	1826
		Net gain on Estimate.				$57	

FIG. 21

110 tons less stone was used than estimated, owing to its being extremely well graded and therefore economical in use. Cinders cost three times the estimated amount, owing to there being none available at the owner's plant and no other factories near that could supply us. Some of our cinders had to be teamed four miles.

SECTION IX.

THE FINAL SUMMARY.

When the job is completed and all accounts are paid, the figures are worked up into a final summary which shows the costs in the same manner as the original estimate. The cost of plant, cement, etc., is added to labor cost of forms, and in general figures are compiled which correspond with the prevailing methods of figuring construction work.

The final summary on the job from which my other exhibits have been taken is not yet made up, so I have taken one from another job, a storage building completed last year. (See Figs. 22 and 23.) It shows the method of setting out the figures so that, at a glance, any of the important details of the cost can be referred to. The final summaries of all the jobs are bound together in a loose-leaf book and are not filed with the job records. They are thus always at hand for ready reference when estimating future work.

CONCLUSIONS.

The system has been used by the Aberthaw Construction Company for over two years, and it is interesting to look back and see what results can be traced to an accurate system of Cost Accounting. In comparing my estimates of five years ago with those made to-day, I find that I estimate concrete labor at least 40 per cent. lower than then. On the other hand, I have found that not half enough money used to be figured for plant and tools. Our labor costs on forms have come down over 25 per cent., but I think that most of the saving on this item is due to improved designs and methods of erection than to a study of the unit costs. Steel reinforcement is handled for probably 10 per cent. less than before. Our superintendents have all got a good knowledge of costs, and are really interested in following them from week to week. If a special and unusual piece of construction work is to be built, our men are keen to find out just what it costs.

Some time ago a large job began to show high unit costs; six weeks after the footings were complete the monthly state-

ment showed that labor had overrun the estimate by $10 000. From any point of view but the Cost Accounting, the job looked all right, — well organized, a large force of men all working busily. Each week's report showed unit costs as high as its predecessor. At the expiration of the six weeks the organization of the job was entirely changed; a new carpenter foreman

Job No. 1970 **ABERTHAW CONSTRUCTION CO.** Sheet No. 1

Storehouse in Cambridge Mass.

Final Summary of Cost Accounts

		Labour					Material			Plant					
Concrete	Cu yards	Mix & Place	Fill voids	Unload Mtl	Clean up	TOTAL LABOUR	Cement	Aggregate	TOTAL MATERIAL	Labour	Supplies	Rentals	TOTAL PLANT		Total Cost per cu yd
Footings	184	44		.03½	03½	81	1.75	1 91	3 66	30	25	33	88		5.35
Walls	102	1.35	34	.13½	03½	1.86	2.06 .27	1.91	4.26	30	25	33	.88		7.00
Floors & columns	935	.73	.11	.13½	03½	1 01	2.02	1.91	3 93	30	25	.33	.88		5.82
Pent House	9	1.69		13½	03½	1.86	2.29	1 91	4.20	30	.25	.33	88		6.94
Cinder Concrete	89	55			03½	58	.65	44	1 29	30	25	33	88		2.79
Stairs	206 lin	23	finish 03½	00½		27	11	.07½	.18½	01	01	01	03		48¢ lin ft
Float Floors	24652 sq	41				41									41¢ square
Grout over cinder concrete	4940 sq	50				.50	1.24	.20	1.44						1.94 "
Rub walls	3080 sq	3.47				3.47	10		10						3 57 "
Grout Elevator Beams	1 c.y	4.74				4.74	1.00		1.00						5.74 c.y
Windows						$ 12									$ 12
Heating Concrete	-					$361	Coke	salt etc	$ 125	Salamanders			$ 104		$590
Forms	Square feet	Make erect & Strip	Unload Mtl	Clean Lumber	Clean up	Total Labour	Lumber & Carrying	Nails oil etc	TOTAL MATERIAL	Labour	Mtl		TOTAL PLANT	Detail Forms	Total Cost per square
	(a per	100	Square feet												
Footings	1257	2 32	.05	16	06	2.59	2.37	.75	3.12	39	.15		.54	.28	6.53
Walls	7486	6.83	05	16	06	7.10	2.37	.75	3.12	39	.15		54	.28	11 04
Columns	5346	9.30	05	16	06	9.57	2.37	.75	3.12	39	15		.54	28	13.51
Column Heads	*24	5.96				5.96									5.96 ea
Wall Brackets	*34	1.68				1.68									1 68
Corbels	*21	.83				.83									83
Floor slab	17800	3.85	05	16	06	4.12	2.37	75	3.12	39	15		.54	28	8.06
Wall Beams	6064	7.57	.05	.16	.06	7.84	2.37	.75	3.12	39	15		.54	28	11.78
Pent House	593	14.42	05	.16	.06	14.69	2.37	75	3.12	39	15		.54	28	18.63
Stairs	206 lin	38½				38½	.04½	.01½	.06	01			01		46¢ lin ft
Steel Reinforcement	lbs	Bend & Place		Unload Material		Total Labor	Steel	Wire	Total Material						Total Cost per Ton
		per ton		per ton		per ton									
Footings	8012		3.42		40	3.82	40.52	.66	41.18						45 00
Walls	3151		19.77		40	20.17	40.52	66	41 18						61 35
Columns	16566		8 10		40	8.50	40.52	66	41.18						49.68
Floor Slab	67328		5.91		40	6.31	40.52	66	41.18						47.49
Beams	15857		5.17		40	5.57	40.52	66	41.18						46.75
Pent House	944		17.27		.40	17.67	40.52	66	41.18						58.85
Stairs	835		14.04		40	14.44	40.52	66	41.18						55.62
	206 lin		.03			.03			01						11¢ lin ft
Pitch on Basement Walls					$ 20				$ 11						$ 31
Hydrolithic in Elevator pit									$ 60						$ 60

FIG. 22

was put on and several other alterations in the force were made, and at once costs began to go down. At the end of the whole job the whole of the $10 000 over-run had been picked up and a saving of about seven hundred dollars made on the estimated labor costs. It is not often that such extensive changes are needed, but often on a job some item runs too high for two or three

Job No. 1970 **ABERTHAW CONSTRUCTION CO.** Sheet No. 2

		Labour			Material				
Drains Excavation	46 c.y			52					.52¢ c.y
" Backfill	31 c.y			.30					.30¢ c.y
" 5" Pipe	30' lin			.03			20		23¢ l.f.
Excavation & Piles			Sublet	.			$2664		$2664
Miscellaneous excavation & fill by A Co.				$192					192
Grading " "				$201					201
8" Tile Walls	10000 sq ft	labour & material		sublet complete	for		.27½	per sq ft	.27½
Brick Piers	750			34185	Brick 16.00	Cement 5.32	21.33		56.18 per M
Platform & Canopy	64 M. bd ft			13.77			34.51		48.28 per M
Window frames, sash & trim	1500 sq ft	Stock 09½	Hardware 01½	.11	Frames 28	Hardware 05	.30		.41¢
Roadway	15307			8.88			17.21		26.09 per M
Misc Carpentry				$162			$13		$175
Inserts	#288		.24				.08		.32¢ ea
Door Sills	#14		4.07				3.36		7.43
" Frames	#6		6.59						
Door frames & guards, stair railing includ'g erection ladders etc							$262		$262
Miscellaneous Ironwork			$17				$33		$50
Fire Doors tinned	#7						12.44		12.44 ea
Kinnear Doors	#7						56.44		56.44 ea
Plumbing					Sublet		$96		$96
Painting							$144		$144
Roofing							$260		$260
Sheet Metal work							$714		$714
Office, telephone, travel etc							$136		$138
Insurance							$340		$340
Surveyor							$11		$11

FIG. 23

weeks. Special attention is given to that item until it is reduced to its normal level. I believe that our system is a reliable barometer, showing from week to week what our jobs are doing. The contractor does not want a post mortem which, however interesting, does not bring back lost profits. He wants to know as the job goes along whether he is making money or not, where his profits or losses are, and whether his losses can be stopped.

Our system is elastic enough to take care of any special situations or furnish any information required. A little time back, I wished to analyze closely the cost of our form work with a view to furnishing our chief engineer with data which would guide him in making the most economical form designs possible. It was a simple matter for me in laying out the code for three jobs to subdivide the form work symbols by adding fourth letters, and get the cost and quantities of posts, joists, mud sills, panels and beam sides, etc., all reported separately and their unit costs worked out, so that we were able to compile data showing how much each post, joist, etc., cost to erect.

Although the system may at first sight seem to be complicated and costly, it is not so in fact. The work in our office is all done by my two assistants, and I give not more than one fifth of my own time to supervising and directing it. Our total payrolls in the summer time sometimes amount to as much as $18 000 a week, and this is all handled by these two men without difficulty, and leaves my chief assistant time to visit the jobs occasionally. In the field we spend little more than other contractors do on timekeeping. On a job having a payroll of $1 500 to $2 000 a week, one timekeeper at $15 would give his whole time to timekeeping. All the materials would be looked after by a material clerk at about the same wage. Larger and smaller jobs would have different organizations as their needs required.

I think the difficulties which are hardest to overcome and which need the most careful attention are; *first*, getting the timekeepers interested enough to study their work and divide the time rightly; *second*, seeing that quantities are reported for every item and reported correctly; and *third*, having the

figures handled in the office by men that understand them. My assistants have been picked not from the ranks of bookkeepers but from our own timekeepers. I am sure all the time that they know the meaning of the figures they are handling and can detect errors as they occur.

For the establishment and conduct of a proper Cost Accounting System on construction work, the chief requisites do not seem to be so much a high degree of technical skill and expert knowledge as much as a common-sense view of the problem to be tackled and patient persistence in working out the details, refusing to be halted by any obstacles. It is easy to pay large fees to experts to install a system. It is not so easy to toil week after week working out the system, patiently instructing men, detecting errors, correcting them, overcoming opposition, and GETTING RESULTS.

This paper has not been easy to write, and certainly has been very difficult to make interesting. As far as I know, it is the first time that a paper on the principles and methods of Cost Accounting on construction work has been presented, although many have been read on the subject of costs. If this effort accomplishes anything towards the establishment of accurate and uniform methods of figuring costs in contracting work, I feel sure that my company will not be the loser, and that I shall be more than recompensed for the time put in in compiling these remarks.