TABLE III.—MATERIALS AND COST DATA OF EXPERIMENTS WITH OIL-CEMENT CONCRETE AT WASHINGTON, D. C.

Experiment No.	Section No.	Description. Oil	Quantity of material. Length of section (ft.)	Area of section (sq. yds.)	Stone (cu. yds. per sq. yd.)	Screenings (cu. yds. per sq. yd.)	Sand (cu. yds. per sq. yd.)	Cement (cu. yds. per sq. yd.)	Oil (gal. per sq. yd.)	Cost data (cts. per sq. yd.) Stone at mixer.	Screenings at mixer.	Sand at mixer.	Cement at mixer.	Oil at mixer.	Mixing and laying concrete.	Foundation and miscellaneous.	Total Cost. Cents (per sq. yd.)	Entire section.
1	7	Fluid residual petroleum.....	65.8	142.6	0.063	....	0.027	0.015	0.534	15.75	....	6.75	14.18	4.01	24.20	52.52	117.41	$167.43
2	6	" " "	24.3	52.6	.047	....	.024	.018	.640	11.75	....	6.00	17.01	4.80	23.05	52.52	115.13	60.56
3	5	" " "	45.0	97.5	.047	0.036	....	.018	.640	11.75	9.00	....	17.01	4.80	23.05	52.52	118.13	115.18
4	4	" " "	37.0	80.2	.047	.024	.012	.018	.960	11.75	6.00	3.00	17.01	7.20	23.05	52.52	120.53	96.67
5	3	Cut-back petroleum residue....	68.0	147.3	.047	.024	.012	.018	.937	11.75	6.00	3.00	17.01	12.18	23.05	52.52	125.51	184.88
6	2	" " "	72.4	156.9	.047	.024	.012	.018	.625	11.75	6.00	3.00	17.01	8.13	23.05	52.52	121.46	190.57
7	1	None	39.4	85.4	.047	.024	.012	.018	....	11.75	6.00	3.00	17.01	....	23.05	52.52	113.33	96.78

SCIENTIFIC COST RECORDS IN CONSTRUCTION WORK.

Ignorance of real costs is a danger whose seriousness every contractor will appreciate. What is less clearly appreciated is the extent to which real costs are not known, and the degree to which construction estimates are based on gravely unreliable data. Discussing this matter, Sanford E. Thompson, Consulting Engineer, who has been associated for years with Frederick W. Taylor, the pioneer in Scientific Management says:—

Besides being of use as a preliminary step toward the introduction of scientific management, cost keeping, that is, cost determination of work in progress, is of value to the engineer for making up estimates and checking the work of the builder, and to the builder in bidding on subsequent contracts and keeping track of the cost of the work as it progresses from day to day. In construction work based on the principle of cost-plus-a-fixed sum, and other similar systems, the accurate recording of detail costs on different parts of the work is absolutely essential for submitting the accounts to the owners.

To accomplish any of these aims, the cost records must be accurate enough to serve:—

(1) As records for estimating costs of subsequent jobs.

(2) For immediate use.

(a) To determine whether the builder is making or losing money.

(b) To fix any point of loss or of too small profit.

(c) As an incentive to the foreman and workmen.

As generally practised, cost keeping is so approximate and inaccurate as to be of comparatively little value for any of these purposes.

The point just made may be illustrated simply by a comparison of the methods now usually employed in estimating materials and labor. In estimating materials the engineer or contractor notes every item, usually taking the schedule from the plans, and by adding a percentage for contingencies reaches a total which will check fairly well with the actual subsequent cost. Before he starts to do any work he must order the required amount of each material separately, and the cost of each item is carefully looked into to see that the lowest figures are obtained consistent with the quality of the work required.

With labor, on the other hand, the plan heretofore adopted has been largely a system of guess work. Frequently one hundred or more carefully tabulated material items are set down while the estimate for labor is given in one lump sum, and yet the labor may amount to one-fourth or one-third the sum total of the materials. The variation in the actual cost of the labor from that given in the estimate almost always makes the difference between a profit and a loss to the contractor. These "guesses" at labor costs are commonly excused because it is claimed that the work done by different workmen varies to a great extent, or that it is impossible to provide for unforeseen contingencies. This, however, is merely dodging the whole responsibility. The real reason for such approximations is that in many cases the contractor does not know the time and cost of doing each kind of work with any certain degree of accuracy; and the fact is only just coming to be recognized that it is possible to determine in advance how fast each element of the work should be done nearly as accurately as the cost of supplies and materials are now determined, and that once having the fundamental data, it is possible to estimate labor nearly as accurately as material.

STEEL PIPES FOR WATER MAINS.

At a meeting of the Birmingham (England) Association of Mechanical Engineers, held recently, a paper was read on welded steel pipes for water mains. The following is a synopsis of this paper: "The most important requirement of a pipe is reliability, by which is meant not merely that the pipe must be strong, but that the engineer should have a reasonably good idea of just how strong it is. Mild steel pipes are at once the strongest and most reliable, and are gradually but surely taking the place of cast iron, not only for water but for sewage and gas mains. Another advantage which the lapwelded steel pipe claimed over cast iron was its increased carrying capacity, the smoothness of the bore, reducing the friction, known as 'skin friction,' between the fluid and the surface of the pipe. This is an important point frequently overlooked or often underrated, but seeing that the capacity of a pipe of a given bore may be more than doubled by substituting a smooth for a rough interior surface, it would be understood that it is a matter worth careful consideration. The smoother rolled surface of the lapwelded pipe took an excellent coating or protective solution having a hard glossy surface. Added to this the pipe was a smooth cylinder from end to end, as there was a complete absence of anything in the nature of rivets, butt straps or lapped plates. In consequence, the frictional resistance was less, and the velocity and carrying capacity greater with lapwelded than with any other form of pipe. The question of the life of steel pipes had long been the subject of much conjecture, owing to the fact that there was no data on which to base a rule. All that could be said was that the oldest and best known steel pipe lines were as far as could be ascertained, in as good condition and as free from corrosion now as when they were laid."