A High Record in Bricklaying Attained by Novel Methods.

By L. W. PECK.*

High records in bricklaying were attained a short time ago in the construction of six brick buildings for Atwood & McManus, box manufacturers, at Chelsea, Mass. By the use of interesting special methods, a remarkably large output per man and a low cost per thousand were reached. At times individual records at the rate of 3,000 brick per day were made, and on the last two days of the contract the entire bricklaying gang averaged 2,600 bricks per day per man; this last was on 12-in. walls, jointed both sides.

A short description of the methods follows. The graphical records of performance mentioned in this article were under the personal supervision of the writer, who was in charge of the cost analysis for the general contractor, Frank B. Gilbreth.

In order that the reader may note the process that more than doubled the output, it will be well to start with the arrival of brick on the job. Carload lots of face and common brick, about equally proportioned, were set in on the spur track on one side of the job. Different methods were used in unloading the brick. From one to six men were tried on a car and their work carefully recorded. It was found that one man could unload a car much cheaper than two or more men, provided his individual record or output was recorded, but it was necessary to have six or eight men in each car because the siding was not long enough to accommodate more than three cars, and the brick were being laid as fast as unloaded in some cases. This also saved demurrage.

Charts posted on the field office wall showed the men holding high scores in unloading. Every man wore a button showing his number in large figures. A spirit of rivalry was created, and men on this work needed no other watching than recording their outputs, knowing their record would be marked up as soon as the car was empty.

"PACKETS" IN PLACE OF HODS.—Special carriers called "packets," holding 18 brick, were used exclusively on this work. These are simply rectangular frames of 1 × 2-in. strips, 8½ ins. wide and about 30 ins. long, accommodating 18 bricks in two tiers, on edge. They stack readily, whether full or empty, and are convenient to handle. The view Fig. 1 shows a number of empty packets, while in Fig. 2 they are seen as piled on the special barrow mentioned farther on, and in Fig. 3 on the staging.

The men unloading cars sorted the brick and piled them on packets. Packets of exterior and filling brick went onto the wall in different wheelbarrows, and picking over or culling a pile of brick by the masons on the wall was in this way eliminated.

Gravity conveyors were used between cars and storage sheds. These are something like unloading skids in form, and consist of ball-bearing steel rollers set in a frame of bar iron. In the case of two of the buildings, the conveyor carried packets from the car door direct to the elevator. This was as nearly an ideal condition as could be wished. One man taking packets from the conveyor and loading wheelbarrows kept the elevator supplied, which in turn supplied the masons. The highest records on brickwork were made where this arrangement was used.

The fact that the brick were handled in units of 18 only, up to the time the mason laid them, was but one of the advantages in the use of the packet. Its other important advantages will be realized on considering the time necessary to load loose brick into a hod, carry onto staging and dump, not to mention the time lost by the mason when looking for a certain kind of brick in a disorderly and badly mixed pile, of which many bricks are chipped. Reports of production on packet-handled brickwork demonstrated the economy as compared with ordinary brick hods.

Tests which proved that units of 90 lbs. were the most economical to handle decided the question of how many brick should constitute a packet. The precise position of the packets on the staging for best performance was determined by actual trials, and careful comparison of the times required to lay brick. At first the packets were set parallel to the wall, on the theory that the shortest distance from packet to wall should be the determining factor. It was soon found that other factors played a more prominent part, so all packets were placed at right angles with the wall. As there were two piles of brick, face and common, this arrangement made it easy for the mason to reach all the brick all the time, with his wrist normal to the brick—the most natural position. The packet plan of unloading and handling gave the mason the kind of brick he wanted when he wanted them.

All packets were painted black on one end. When brick were put on packets, on edge, the

Fig. 1. A Truckload of "Packets" on Way to be Reloaded.

natural top of each brick was placed toward this end. This arrangement of packets on scaffold or floor saved the mason turning brick over, or tossing aside on account of being chipped, etc.

Mortar boxes were spaced exactly 3 ft. apart on the staging. Packets were set flush against the left-hand side of the box as the mason faced it, leaving space for the tender to step in when placing new packets. Accurate recording proved that this accomplished the best results, although it was hard to convince the masons until the actual figures stopped all argument.

In the arrangement of mortar boxes and packets, care was taken that bricklayers did not have to pick brick or mortar cross-handed. Even changing the order of box and packet for left-handed masons was found to pay.

Trials were made with the mortar boxes at different heights, first close to the floor and afterward raised above the staging. The output was increased materially by elevating the mortar, so horses 12 ins. high were built, and planks laid on these to form a bench. The cost of these benches was so slight, and the output so much increased, that it was proven of value to build them even on a pole scaffold. Study of performances also proved that mortar tubs and packets were to the best advantage 19 ins. from the wall.

MEASURING OUTPUT OF BRICKLAYERS.—The usual custom for gaging the individual output on a wall is by measurement. Thus, each man works between two marks, and there is a tendency among the bricklayers to let each man take care of his allotted portion. To do away with this condition was necessary in following the plan laid out on this contract.

The question of measuring the output of each bricklayer was solved in the simplest way. Each bricklayer was told to pile his empty packets in his individual pile and these were counted each hour by wheeling them past the recorder.

There is a labor rule which forbids the line being slacked out and raised a course until each man has completed his portion. This is consistent with good workmanship. Its result is that the masons finishing first, under ordinary conditions, slow up their work until the delayed men have completed their sections. Counting the packets of the individual workmen changed this. It was found that the bricklayer who finished his section was glad enough to empty his packets by laying brick on the section of the man next who was waiting for stock or was behind for any reason. Instead of slowing his pace and killing time until the other man was caught up, he stepped over a few feet and kept busy.

WHEELBARROWS.—The time and cost studies on this job proved in repeated instances the previously discovered truth* that the losses due to workmen using traditional tools instead of tools best adapted to their work are much greater than the losses from their actual tendency to soldier or loaf. This was found particularly so in the case of the wheelbarrow.

Recording the number of brick each tender handled caused so much rivalry between different foremen, and in fact between the tenders themselves, that the wheelbarrow came in for its share of change and improvement. The average wheelbarrow holds from 50 to 60 brick, loose. The flat wooden wheelbarrow holds four packets, or 72 bricks. The "trucket," Fig. 2, a cross between a wheelbarrow and a baggage truck, was finally adopted. This trucket held 12 packets, or 216 brick. Owing to the fact that the two wheels were well back under the body, the trucket was handled easier than the old-fashioned wheelbarrow. The limit, however, is reached in 216 brick in most cases, as over 1,000 lbs. is concentrated on two wheels.

SECURING COMPETITION FOR HIGH RECORDS.—To engage the interest of the workmen in the endeavor to increase the output, charts showing the daily performance graphically were posted on the wall in the field office, where they could be seen by everyone on the job. In addition the bricklayer foreman on the building having the highest score one day was permitted to fly the largest flag the next day. Different size flags were provided, from 5 ft. by 8 ft. to 5 ins. by 8 ins. There were from four to six buildings under construction simultaneously, and a great deal of rivalry developed among the foremen in the attempt to get the largest flag. Miniature flags corresponding to those on the buildings were put on the charts posted in the field office to mark the race.

The enthusiasm which this system aroused is expressed in the fact that the most pessimistic foremen, who openly opposed the system at the start, were the strongest adherents and firmest believers at the finish.

OFFICE RECORDS OF PERFORMANCE AND COST.—Reports of the day's work were mailed to the main office daily. Here charts were made up showing the fluctuations of production and labor cost of the several gangs. Specimens of these charts are reproduced herewith in Fig. 4 (A, B, C and D).

Chart "A" shows the average hourly output per man from day to day on four different buildings. This is interesting, inasmuch as it shows how each gang stood in relation with the others, though it is not sufficient to tell the average effi-

*With Frank B. Gilbreth, Inc., 60 Broadway, New York City.

*See the paper "Shop Management," by Mr. F. W. Taylor, Trans. American Society of Mechanical Engineers, Vol. 24 (1903), p. 1337.

ciency of the foremen. Another chart made from the same data averaged the curves of "A" progressively, giving the gross average hourly output from the beginning of the job to any date, as is done for costs in chart "B."

In order to judge these records a knowledge of the conditions that existed upon the several

ferent foremen is found in charts such as C and D. These endeavor to show the ratio of cost of each class of labor to the total labor cost, 100% representing the sum of foreman's, bricklayers' and tenders' payroll for the day.

Naturally, all that the bricklayers' line can be moved up or the tenders' line down is [illegible]

work bring out the fact that the best work, as well as the cheapest, can be done when the tenders are from one-third to one-half the number of the masons.

On two of the other buildings of this group, for instance, the bricklayers' average was 72% and 6[illegible] respectively, and the tenders' average

FIG. 2. LOADED PACKETS ON TWO-WHEEL BARROW; LOAD ABOUT 1,000 LBS.

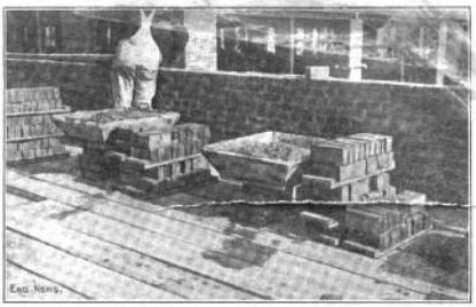


FIG. 3. VIEW ON STAGING, SHOWING PACKETS OF BRICK AND MORTAR-TUBS IN PLACE FOR BRICKLAYERS.

buildings is necessary. For instance, the Office building (Parsons, foreman) had the thinnest walls, with fancy cutting for arch work, in view of which an average of nearly a hundred brick per man per hour is very satisfactory. The Stable (also Parsons), had a great many openings, plumb corners, and arches, and therefore could not be expected to compete with the Mill or Receiving buildings in number of brick laid. Knowing this, the fact that Parsons is low man in production is not exciting, for in looking at chart "C" it is found that his cost per thousand brick laid is low, for that class of work.

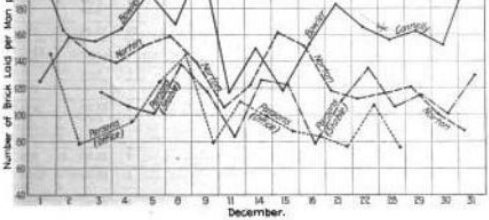
The true expression of the abilities of the dif-

Look at chart C. Here is shown the reason why highest production does not get lowest cost in all cases. Note that the average percentage for bricklayers shown on the margin, left side, is 58%, while the average for tenders is 35%. In chart D, on the other hand, the bricklayers' average is 67%, the tenders' average showing 27%.

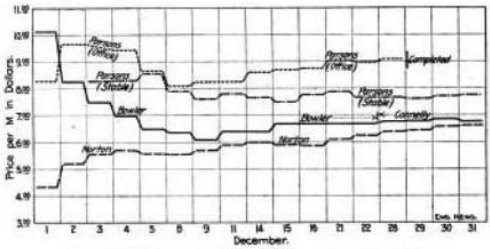
As tenders are not producers of scores by themselves, merely being the necessary evil enabling the bricklayers to run up the records, their percentage should be as low as possible. The saying on the wall for years has been, "a tender to every bricklayer," but performances on this

was 21% and 33%. These results were accomplished by the foreman shifting his men to suit conditions on the wall. Had there been no charts showing output, number of men, percentage of one group of men to the whole, etc., these results would not have been made. They show the ability of the foreman to place his men to advantage. Thus, chart D shows that Norton watched his tenders pretty closely, keeping their percentage down as much as possible. Under the conditions, Norton's record is good, for his building, the Mill, was straightwalled. There was never a minute when the tenders on this building did not have all they could attend to.

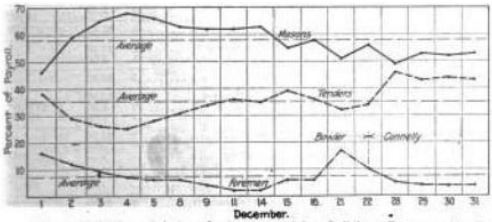
Field charts were made to cover this point especially, to show the various foremen why their records were what they were and point out the



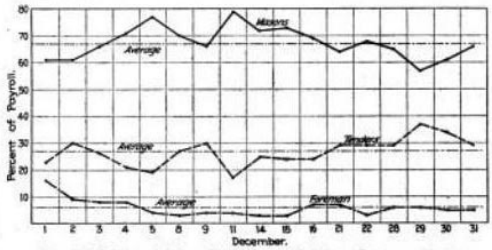
(A.) Average Hourly Output per Bricklayer During December, 1908.



(B.) Totalled Average Costs of Brickwork on Four Buildings.
(Ordinates show average cost per M. up to date of abscissa. Rates of pay: Foreman, $5 per day; Masons, 60 cts. per hr.; Tenders, 30 cts. per hr.; for 8-hr. day.)



(C.) Subdivision of Labor Cost on Receiving Building; Foremen, Bowler and Connelly.



(D.) Subdivision of Labor Cost on Mill Building; Foreman, Norton.

FIG. 4. SPECIMENS OF PERFORMANCE AND COST CHARTS FOR BRICKWORK OF ATWOOD & McMANUS BUILDINGS.

particular features which it was desirable to repeat or to eliminate.

In considering what was achieved on this contract, allowance should be made for the fact that the brickwork was started in midwinter and was rushed to completion in the fewest possible days regardless of weather conditions. While the output varied a great deal from day to day, it was far above ordinary results, especially under the difficult conditions of working, the interruptions and delays due to storms and low temperature of a New England winter, slow deliveries of lumber from Georgia to Boston, and the fact that the brickwork was strictly high-grade with walls jointed both sides.

The records on these six buildings erected under these conditions in four months, justify the expense of recording individual productions and maintaining a cost analysis department to chart the records and analyze the figures. Creating a spirit of emulation among the workmen down to the lowest grades, and posting the scores of performances, is apt to be little appreciated by one who has not studied the influence of these factors upon production.