

Some Recent Applications of Motion Study

How a Study of the Processes of Production and Shipping of Roofing Materials
Led to Standardization of Methods and Equipment With Resultant Economies

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THE effective exertion of human effort goes hand in hand with economy in production. The mental phase of this question is of great importance to psychologists and educators while the physical is of interest to the engineer.

Physical effort may be considered from many angles, but that which concerns us most is labor effort. Permit me then to consider this subject from the point of view of operations; of motions or their smallest units, therbligs.

Since motion study is not new to most of you, I will not attempt to discuss its fundamentals or its development as a science, but will confine myself to some of the recent practical applications in the production and shipping of roofing materials at one of the Maurer plants of the Barber Asphalt Company and to the methods we have provided to maintain the results accomplished.

Stapling and Packing Shingles

In one of our Middle Western plants a machine was developed for the stapling and folding of latite shingles. This machine requires the services of four men, while the one which we were using at Maurer at that time on the same work employed an organization of seven. It was not until machines of this new type had been in successful operation for one and one-half years at the other plant that they were installed at Maurer. The men operating the old machine were given places on the new; with very few exceptions the same methods were adopted; in this way we sought to transfer the skill and experience from one type of machine to the other. In spite of the fact that these men were already trained they were unable to make a fair day's output. Thus one of our first problems at Maurer was to find a more economical method of performing this work.

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We began our studies by considering the complete process of folding the 16-in. x 16-in. latite shingles and by analyzing each sub-operation with the aim of eliminating unnecessary motions and unnecessary fatigue. It was found that each man had been allowed to develop his own method and in the various sub-operations such as feeding the shingles into the machine and packing them after they had been discharged from it, the touch of individuality was quite prominent. Each of the men performing the operation felt that his method was the best. The correct one could only be determined by a careful analysis of the number of motions involved, their character and their sequence. Since the output of the machine was controlled by the feeding operation, this marked the starting point of our studies.

The complete cycle of motions was made by the feeder in approximately one and one-half seconds, comprising in all 10 elements of motion or therbligs. Of these 10, 8 were performed by the right hand; hence during eight-tenths of the cycle the left hand remained idle, and the time for the complete cycle was wholly dependent upon the work of the right hand. Further analysis showed that the right hand grasped the shingles once more than was necessary because it did not properly do so at the beginning of the cycle. The left hand merely held it while the other was in the act of changing grasp. The unnecessary "grasp" and "release" were eliminated and the work was so arranged that the two hands performed an equal number of elements of motion simultaneously, thus giving an equal burden of four therbligs to each hand. This study resulted in the reduction of time to one half of the original and increased the output of the feeder 100 per cent. We have chosen this example because of its simplicity; it is our opinion that it fittingly illustrates the fundamental principles of motion study.

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As a result of this analysis we were able to feed the machine at a much faster rate than the men at the discharge end could pack the shingles. It was quite natural for us then to exert our efforts towards devising a better method of performing that operation. Study of the sub-operations in the old packing process resulted in a radical change in the equipment. The old method of packing involved first, inserting a knock-down carton in a fixture mounted on a tying bench equipped with casters; second, stacking a definite number of shingles in the fixture; and third, tying the carton of shingles with four wires.

Analysis of these sub-operations showed that the stacking could be made simpler and easier to learn by reducing the number of positions in which the shingles were stacked. Some variation is necessary to provide for an even distribution of the added thickness caused by a fold on the corner of the shingles. However, the questions in our minds were: How many of these variations can we eliminate? What arrangement of the shingles will make possible a method involving fewer and simpler motions and yet maintain the quality of the package?

Our answers to these questions is a method which requires that the shingles be stacked in two positions instead of four. This reduced the stacking cycle from four to two sets of motions, thus enabling the new employee to learn the method involved in his work more quickly. Meanwhile the motions necessary to do that work were simplified and made less fatiguing by changing the relative heights of the discharge plate of the machine and the stacking table: the shingles are now practically dropped into place, while by the old method they were raised into the fixture.

The study of the next operation, tying the carton of shingles, pointed to many possibilities of savings. By the old method the packer, after stacking the shingles, would push the fixture, which was mounted on casters, to a point about fifteen feet away where the wires for tying the carton were located. In order to tie the carton, which was the next step, it was necessary for this man to position the four wires under the carton of shingles, two in one direction and the others at right angles to them. The manner in which this was done and the amount of time required to do it in proportion to the time required for the complete tying cycle immediately attracted our attention.

To make sure that every phase of the tying operation was analyzed properly, a "process chart" was made covering the cycle of motions in such detail that there was no doubt as to the actual moves the man made while performing his work. But what did the chart do for us? It merely provided a means of making a careful study of the method with absolute disregard of the time element and enabled us to point out possibilities of savings.

Why should the packer be required to move the tying bench containing the stack of shingles a distance of ten to fifteen feet? Why not pre-position the wires instead of positioning them after the shingles had been stacked? Why expect the man to pick up the knock-down carton from the floor, raising it about three feet to assemble it into the fixture for the next stacking operation, when it may be stored in a more convenient place? These practices were only a few of the most prominent symptoms indicating unnecessary exertion of effort. Consideration of all items indicating possible improvements led to the construction of a stacking and tying table composed of two sections of roller conveyors joined to form a unit on which the stacking fixtures are mounted. This unit is divided into two sections to give each of the two packers a separate set of equipment and a definite work place. The use of this new piece of equipment permits the men to do the stacking and the tying work in the same place, thus avoiding the transportation necessary by the old method, and the wires are now pre-positioned in approximately one-tenth of the time formerly required. A table made to hold the supply of knock-down cartons at a level above the height of the new stacking device permits inserting them into the fixture with the minimum of effort.

Thus the equipment and machines were changed and rearranged to permit the men to carry on their work in comfort; unnecessary fatigue was eliminated where possible; and to insure continuity of operation, elasticity stations were created between the feeder and the person supplying him—all of which served to make the "One Best Way" effective.

The foregoing discussion has special reference to the folding and packing of 16-in. latite shingles but applies also to the folding and packing process for the 12-in. latite shingles, because many of the sub-operations are common to both. The stacking cycle for the 12-in. shingles, however, consists of four sets of motions and the box of shingles owing