The efforts of a good foreman must tend towards obtaining the maximum amount of work with the least possible labor. He should see that the crusher bin is always well filled. On a water-bound or bituminous macadam job, carried out with local stone, the capacity of the crusher will be the key note of the whole organization. This capacity will rule the number of men and the number of wagons. It is, however, obviously necessary to keep the crushers to maximum capacity at all times. If a crusher has a capacity of 80 tons of stone a day, every effort must be made to obtain these 80 tons each and every day. The foreman must not be satisfied with any one day in which this maximum has not been obtained. Should any defect in the engine or the crusher make it difficult or impossible to obtain the maximum output, it is more economical to stop the crusher at once and make the necessary repairs. A crusher with a daily capacity of 80 tons requires two wagons and drivers, four men to help the drivers to load stone, and three good men feeding stone to the crusher.

Mixer is Organization's Keystone

If the crushed stone is to be transported a mile from the crusher, there will be needed four good teams with dump wagons of at least 1½ yds. capacity, to keep the crusher going. I am supposing that the road is approximately level. Three men will be sufficient to spread the stone.

On a concrete job the capacity of the mixer will be the keystone of the organization. It will be necessary to see to it that the preparation of the sub-grade and the supply of material shall be such that the mixer will never be idle and run at all times to its full capacity. Have just the right number of men and no more to feed the mixer. The same rule will apply to the construction of a road to be built of bituminous concrete. The capacity of the plant for drying the stone and heating and mixing the bitumen will determine the number of men in each gang in such a way as to obtain the maximum output from the plant.

In the construction of a gravel road, the rules are not quite so well laid down. Everything will depend generally on the number of teams and men which can be obtained in the municipality. Given a certain number of teams to transport gravel and the distance the material must be transported, one need only put on the road the exact number of men necessary to spread the gravel which this number of wagons can transport, and in the pit just the number of men necessary to load the wagons.

For example, if the pit is 1½ miles from the job to be gravelled, using twelve two-horse wagons, carrying 1¾ yds. per load, each wagon should make six trips a day, amounting in all to sixty trips, or a total of 105 cu. yds. To spread this quantity of gravel in proper shape should not take more than five men. Any other men available can be used to clean or dig ditches, prepare subgrade, etc.

Economize in Skilled Labor

In special work, such as bridges, culverts, walls and drains, if it is necessary to use craftsmen such as carpenters, masons, etc., two things must be borne in mind: First, to use only the exact number required; next, economize as much as possible on this expert labor by letting these men do only work requiring such training and knowledge. In building concrete bridges do not let the carpenters, who are building forms, do any work outside of this. I mean, do not let them carry planks or saw or nail them. In other words, do not let them do a number of jobs which can be done just as well and more cheaply by unskilled labor.

The choice of tools and plant well adapted to the job has also a great deal to do with the efficiency of the work. It is not possible to give a complete list of work which is done by hand on a construction job, but this can be considerably reduced by a judicious use of plant and machinery. The essential part is that the machines shall be carefully chosen.

There are three classes of work in which large sums of money are uselessly spent by the lack of adoption of up-to-date methods. The first includes all excavation work. There are on the market a number of machines for all classes of excavation, both in rock and in earth. Among these are some which are designed for large work and which can be economically employed on small jobs, but there are others with a capacity of not over four to ten cubic yards per hour which can be very economically used to replace pick and shovel work.

In rock work it is often advantageous to use small mechanical drills instead of hand drills. For drying and unwatering an excavation, use gasoline or electric pumps wherever possible instead of hand pumps. The second class of work under this heading comes in the mixing of concrete. For small jobs there are on the market a number of very good small mixers run by gasoline engines. These mixers can be economically used even where the consumption of concrete is only a few yards per day and can also be used on large work as an auxiliary to the larger mixers.

Transporting and Placing Materials

The third kind of work where manual labor is usually used, is the transportation and placing of construction materials. Cars and scows are loaded and unloaded by hand; wagons are also usually loaded by hand, although nowadays most of the wagons dump automatically. For all these things there are machines to do the work that will save sums proportionate to the quantity of materials to be moved. It is true that machines cannot always be used, but my point is that they should be used whenever at all possible and even on the simplest jobs the work can be so planned as to reduce to the lowest possible amount the manual labor expended. That is rule laid down in "Modern Management Applied to Construction," by Hauer.

Road construction requires a great deal of shovel work. Much can be said on the kind of shovels which should be supplied to the men, varying with the kind of work; the horizontal and vertical distances through which the shovel must handle the materials, etc. This study would take up too much space. It is very true, however, that very few laborers understand the correct use of a shovel. It is astonishing how very few men have ever been shown the proper handling of their tools; it has been demonstrated that a man using a shovel correctly can handle easily three more shovelfulls per minute than the man using an incorrect method of handling the shovel. We know that a man loading a wheelbarrow or a cart can handle approximately fifteen shovelfulls a minute. The incorrect method of shovelling, resulting in a loss of three shovelfulls per minute, means a net loss of 20%, with just as much energy expended by the workman.

Quality of the Work

The foreman's responsibility does not cease with the organization of the job; he must see that the completed work shall be as perfect as possible to insure permanence. Aside from the plans and specifications furnished him, there is always a mass of details not shown therein but to which he must give his careful attention, because these details inevitably affect the quality of the finished work.

The plans and specifications may give the dimensions of the work, and an outline of how it shall be carried out, but they cannot possibly go into details. The plans and specifications presuppose that those whose business it will be to interpret them and to carry out the work, shall have the necessary knowledge and experience. The specifications do not generally go into explanations as to why the work must be carried out in the specified manner.

It is necessary, therefore, that the foreman shall know the reason for the specifications and for the precedure outlined therein, so that by understanding their importance, he shall willingly conform to them. Anything which the foreman does not fully understand, he must discuss with the engineer. It is his duty to find out the reason for anything he does not understand. The foreman should never forget that everything in the specifications is put there for a good and sufficient reason and usually as the result of the experience of several generations of engineers and contractors.

When a specification requires that macadam shall consist of stone as uniform as possible in size, and not of a mixture of 2-in. stone, ¾-in. stone, and stone dust, it is done for a good and sufficient reason. Stone of a uniform 2-in. size will intermesh under the roller and a certain