pieces of reinforcing, or let the metal footing extend well down toward the bottom of the foundation.

The cost of footings of this kind on a line run through average country such as will be found between a hydro-electric plant in the mountains, and a distributing centre in the valley, that is, where the route is about equally divided between mountains and valley, is, approximately, $90 per tower, divided as follows: Labor, $40; material, $16; hauling material, $34. These prices are based on labor at $2.50 to $3 per day, and concrete mixed by hand at each tower; average haul for material 6 to 8 miles.

In a country that is not too steep, the most economical way of erecting towers of this size is to assemble them on the ground and end them up in position. One very easy and satisfactory way of doing this is to set a 30 or 35-ft. gin pole just outside of the footings holding it in position by three guys fastened to iron stakes driven into the ground for anchors. Over an open sheave on the top of this gin pole is carried a 0.5-in. flexible steel cable one end of which is connected to the tower at the lower cross-arm, the other to a set of triple blocks made fast to another anchorage 300 or 400 feet from the base of the tower. Where the ground around the footings is not well packed, it is advisable to use hold-back anchors on the ground legs, as otherwise the heavy pull against the footings when the tower starts to raise is liable to damage them. A back guy should also be provided to prevent the tower dropping into place as it comes up to a vertical position. Ordinarily side guys are unnecessary, but during windy weather it is well to have them held loosely as the tower raises. The best motive power for this work is a 3-ton motor truck which can be used not only for raising the towers, but also for transporting tools and equipment between towers. A crew of nine men with a truck will raise and fasten to the footings an average of 9 towers per work day of 8 to 9 hours. The insulators are attached to the tower while it is on the ground and raised with it.

While there are few, if any, tower lines that have been in service long enough to determine the relative merits as between galvanizing and painting of steel structures of this kind, there is every reason to think that hot dip galvanizing when properly done will prove the more satisfactory in the end. The first cost of painted towers is less than galvanized, but at the very best, the painting will last only a few years. As an offset to the lower first cost of painting, there would be the increased maintenance cost. Moreover, the tops of the tower could not be painted with voltage on the line. To do this part of the work, service would have to be interrupted. This objection alone would in many instances be a most serious one, and doubtless, would oftentimes be the determining factor in deciding in favor of the galvanized structures.

There is nothing, thus far, to indicate that there is any appreciable deterioration of the galvanizing when set either in the concrete or directly in the ground. Galvanized tower bolts are not entirely satisfactory. It has been found that almost invariably the bottom of the threads will be so filled up with the galvanizing that the nuts cannot be run on. Sherardizing overcomes this trouble, but is open to the objection that this process is inferior to hot dip galvanizing, and it is often only a matter of a short time when the sherardizing will disappear and the bolts rust. After the tower is erected is should be gone over carefully, all bolts tightened and the threads upset, so that the nuts cannot work loose.

Unless this is done the vibration of the tower due to the wind will, within a few months or a year, cause the nuts to loosen and back off a turn or two, thus materially reducing the rigidity of the tower. The same thing will happen on the clamp bolts holding the conductor, unless lock washers, or some other means, are provided to prevent it.

DETERMINATION OF PRESSURE ON BINS AND WALLS.

A PAPER, read by Mr. J. H. Smith at the recent annual meeting of the American Society for Testing Materials, comprises the description of a special apparatus for determining the point of application, line of action, direction, and intensity of resultant pressures on walls and bins; also the results from several series of tests. Since it is possible with this apparatus to determine all the elements of a force, it it suitable, not only for the determination of pressures on walls and bins, but the principle may also be used in many other ways for laboratory testing, where unknown forces are to be determined.

Tests were made, using river sand and river gravel as fills, the depth of fill being varied from 6 in. to 4 ft. on the retaining wall or weighing gate. The thickness of fill ranges from 6 to 18 in. The fills were also varied by changing the amount of moisture, the method of packing the material, and changing the angle of the surface from horizontal to the angle of repose.

It is shown that the pressure increases with the thickness of fill, and that moist or wet material gives a higher resultant pressure than dry material. As would be expected, packed material gives the highest pressure of all conditions tried, with the centre of pressure in many cases above the centre of the retaining surface.

There seems to be no definite relation between the angle of surface and the line of action of the resultant pressure, as deduced by well-known theoretical formulas. Without very much more exhaustive tests, the author would not attempt to reduce these experimental results to the form of formulas for designing. The tests were started last year, and are still being carried on, but it is only a beginning, and it is hoped that something more definite may be written into a report in the future.

For a proposed design, an excellent method would be to test out a sample of the fill in an apparatus similar to the one described, with the retaining surface arranged as the proposed wall or bin is to be built. From data thus obtained, the structure could be more intelligently designed.

RAILWAYS IN NEW ZEALAND.

All the steam railways in New Zealand are owned and operated by the Government. There were 2,945 miles in operation on March 31, 1915, which earned $1,459,801 during March this year, at an operating expense of $1,235,911 for the same period. New lines are under construction and others are contemplated, and railway development is one of the important items of internal improvements now before the government.

Of the 15 coal briquetting plants in operation in the United States during 1914, five used anthracite culm as a raw material; two, semi-anthracite; one, bituminous slack; two, a mixture of anthracite culm and bituminous slack; two, petroleum residuum; two, semi-bituminous slack, and one, a mixture of anthracite culm, bituminous slack, coke and lignite. Eight plants used coal-tar pitch for a binder, four used secret binders, and one used petrolastic cement. No binder is required in the briquetting of carbon residues from oil-gas works.