structed are slippery under certain conditions, and here again is need for co-operation between road engineers and vehicle builders in securing a material for road surface or a material for tire construction which will do away with most of the difficulty which exists. Experience shows that by far the greater number of accidents to motor vehicles are caused during slippery weather by the failure of chains or non-skid devices to control the motion of the car, and, in passing, it may be said that the highway engineers are in duty bound to find a proper road surface, even at some additional cost, that the risk to the public will be reduced materially.

Fourth: The road must be of reasonable cost, which should be determined, not so much by the yearly financial cost of maintenance (although this is a prime requisite) as by a co-ordination between the needs of traffic as best judged by the engineer and the amount of money which can be put reasonably into the construction of the pavement.

In general, the width of these hard surface roads should be sufficient to carry at least two lines of vehicles, say, not less than 18 ft., except through the centres, where there should be extra widths to accommodate necessary standing vehicles used locally. The shoulders or berms should be hard and reasonably safe to travel at moderate speeds when turning out to pass safely. Much has been said of the necessity of increasing widths of road to accommodate four lines of vehicles, but it would seem reasonable that before the expenditure for highway systems are doubled, there should be proper restrictions to the traffic using the road so as to make it unnecessary to spend this extra amount of money. In general, the tendency of automobile traffic has been toward unreasonable speed without regard to the results, but a proper regulation would make a two-line width of road satisfactory for the operation of four thousand vehicles per day, even with the inevitable congestion at certain hours.

An endeavor has been made to prove the need for hard-surface city-type pavements on state highway systems outside of cities, and the chief problem which then comes to the engineer, as indicated above, is the selection of the best type of pavement. There is nothing so difficult at present for the engineer as to select the proper type of pavement even if he is left unhampered by outside influence. Virtually no data are available which would aid in determining mathematically the type of pavement to be chosen. The choice of pavement is generally a local engineering problem which can be worked out at the present time only by the use of judgment, opinion and data from a moderately small amount of experience, since the construction of these highway systems has been carried on only through a comparatively short time. It is evident that even with the best of intentions and the use of proper judgment, mistakes will be made, but the following general ideas would seem to be of value in the selection of type of pavement. These are in addition to the general requirements stated previously.

In the first place, the road surface and material should be chosen so as to give the best service to the traffic using the road, with a reasonable first cost. On this account, so far as possible for Portland cement concrete bases or surfaces or for bituminous foundations or surfaces, the local material should be used for aggregate so long as it gives a suitable result. Other types of surface, such as blocks, either brick, wood or stone, should be selected with a view to using the nearest source of supply, not only on account of the reduction of cost, but because of the need of conserving supplies of material and using everything which is available.

REPORT OF COMMITTEE ON SERVICE PIPES

F OLLOWING is an abstract of the report of the committee appointed by the New England Water Works Association to investigate waterworks service pipes:—

The requisites for a good service pipe are, in order of their importance, (I) that it should not affect the water passing through it in such a manner as to make it injurious to the health of those using the water; (2) that it should not have a deleterious effect on the appearance, taste, or odor of the water even though not injurious to the health; (3) that it should have a sufficient capacity to give adequate service at all times; (4) that it should be strong and durable; (5) that it should be easily laid; (6) that it should be inexpensive.

To meet the first condition, that portion of the service pipe which comes in contact with the water should be of some material which is either not acted upon by the water standing in contact with it, or, if acted upon, produces no compounds which would affect the health of those using the water.

To meet the second condition, the material of which the inside of the service pipe is composed should not be acted upon by the water to produce rust or other substances which may come away with the water; it should not be composed of any material which will disintegrate; it must not be coated with any substance which will impart a taste or odor to the water.

These first two conditions should be considered absolutely essential in any system, for, as Mr. FitzGerald so well expresses it in his discussion, "of what use is it to spend millions and millions on the quality of your water and yet allow services which affect that quality materially?"

To carry a sufficient quantity of water for good service, the pipe should be of suitable size, dependent, to some extent, on the available pressure, and should not become coated on the inside with rust or other material so as to diminish the flow to such an extent as to make the service unsatisfactory. The requirements of the water takers as to the rate of use of water are ever increasing, and these requirements should be met.

Strength and durability should be assured chiefly as a matter of economy. Where services are laid in streets having expensive paving, the digging up of a service pipe is a serious matter. The service should, therefore, be constructed of material that will stand the pressure which may be put upon it, and will not be corroded by the action of the water on the inside or the action of the atmosphere, or of substances which may be contained in the soil on the outside.

It is desirable to have a flexible pipe which may be bent around any obstructions which are likely to be encountered in the street and one which is not liable to break with any settlement which may take place.

The first cost of the service pipe is the last point which should be considered, for it is a very small item as compared with the cost of maintenance and the cost of renewals. In fact, it may be said that the service pipes cost the least to install of any portion of the waterworks system and are capable of giving the greatest amount of trouble.

The service pipe which perfectly meets all of the above conditions has not been put on the market, and after many years' experience waterworks men are not yet agreed as to the materials which most nearly meet them. The com-