

any rate, it would be necessary to consider to what extent in any case it is practicable to carry the investigation. For instance, the classification number 6 might well, in many cases, be omitted, since it should be feasible to estimate an average weight and speed of the pleasure motor cars, considering that such cars are generally standardized as to weight and that the speed is limited by law. This average could be obtained accurately enough for our purposes, and would curtail the work involved in taking the census to a considerable extent.

From the data obtained in making these preliminary studies a general tentative plan can be made. This plan will include any changes in location from the original layout that may be considered advisable as well as any changes in width. The considerations governing choice in these respects will, of course, be the class and amount of traffic and the topography of the ground.

The next work in order will be the preliminary surveys to consist of a proper alignment of the street as decided upon for mapping purposes and the taking of elevations for cross-sections and profile. This work should be carefully and accurately carried out, and the records taken will, in the end, be used for estimating purposes. The methods involved in this work are simple and familiar to all engineers. Suffice it to say that sufficient levels are taken to determine accurately the amount of material necessary to be handled in grading the street for improvement and for fixing the grade to suit probable requirements and existing conditions. The plan and profile will then be placed on the same sheet of profile tracing linen. In general, the scales preferable for use in profiles are forty feet to the inch longitudinal and four feet to the inch vertical. The scale for the plan will then be made to conform to the longitudinal scale of the profile, and the one will be placed directly below the other. With this data collected, we are now prepared to begin the detailed scientific study of the problem, and it is this portion of the work which is too often sadly neglected.

The first consideration affecting the question of the proper width of the street should be its classification as regards present or probable future use. The usual classification is placed under three heads, viz.: main thoroughfares, secondary thoroughfares and residential streets. The classification may be carried farther under a number of sub-headings. The traffic census and an estimate of future development, after careful study of the tributary territory, will be used in making the classification. It will be necessary to determine as best we can what facilities will eventually be required for the purpose of rapid transit. In large cities and on certain streets our conclusions will cause us to provide for underground or elevated railways, in other places the surface street railway only will be necessary. With the estimate of the amount of this traffic it is not difficult to calculate the width necessary to provide for taking care of it. For instance, the width required for single track street railway operation is eight to nine feet and for double track from nineteen to twenty-one feet. The general traffic should, as far as possible, be kept off of the railway allowance. Other public utility accessories that present a probability of being required on the street, such as pole lines, pipe lines, conduits, etc., will require consideration as to how much width will need to be excluded from other uses for them. Then the necessity or desirability of considering the ornate side of the problem as affected by planting spaces or parking strips should be given its proper place as going hand in hand with the scientific design. It may be considered that a width of four feet will be necessary for planting one row

of trees, but the widths and arrangement of these spaces should not be fixed until after the width of roadway, sidewalks, etc., have been determined in order that the correct division or breaking-up of the space may be made. It might be noted here that the practice of placing sidewalks against the curbs where the roadway is less than fifty feet in width results in an improper division of the space.

The width of roadway exclusive of street railway allowance is a vital feature of the design. This is the point where one of the greatest aids of the traffic census comes in, though we will need to estimate the width that will be necessary for all future requirements as well as those of the present time. This may not call for the entire width being covered with pavement at first, but the estimated requirements should be provided for. After we have made a careful estimate of the amount and character of the traffic the problem of supplying the necessary width for its accommodation is of a more elementary character. It should be remembered that the principal purpose of the street is to provide efficient means for the necessary movement of the public and the opportunity for transporting the commodities required by it. To accomplish this necessitates providing the proper width to prevent congestion or inconvenience. We will need to fix a definite width to allow each vehicle on the street. Some authorities advise a width of eight feet, others nine feet. It would seem that on account of the tendency toward motor cars of wide bodies that where a preponderance of motor traffic is to be taken care of, the greater width should be used. Where it is estimated that most of the traffic will be composed of horse-drawn vehicles eight feet is sufficient. For calculating the widths of sidewalks required two feet is assigned to each pedestrian. Care will need to be exercised here that places where many people gather and leave at certain fixed times do not overtax the sidewalks. In all cases where feasible, however, the widths of the improvements necessary for the present use only should be adopted, with provision made for increasing them from time to time as needed.

The question of limiting gradients requires to be gone into carefully. The points affecting our decision in this matter are the maximum loads to be expected in the street car, motor and horse-drawn traffic, climatic conditions causing slipperiness, the damage accruing to existing improvements along the street by cutting below or filling above the level convenient for their use and, in some cases, the desirability of having the floor levels of large buildings at a distance not too varying from the street pavement. We will also need to begin thinking at this point about the class of paving materials that will be used in the construction, particularly with regard to their slippery tendencies. The grades should not be too steep to prohibit the ordinary desirable heavy loads being transported economically unless the interest value of the cost of reducing them, including all damage to abutting properties, would exceed the loss in cost of transportation. This problem should be figured out in detail where it is evident that large expenditures will require to be made in order to get the desired grades. In general, we may consider that a maximum grade of five per cent. is a desirable limit upon heavy traffic streets, and this maximum should only be employed wherever absolutely necessary and at infrequent intervals. A possible way of reducing the rate of grade upon a street is to have the roadway wind from one side to another. This method, when used, will probably necessitate a greater width of street and a different arrangement of the parking scheme. In this connection it may also be well to consider making detours from the