SOME FEATURES IN THE DESIGN OF SEWER SYSTEMS.

THE design of a sanitary sewer system for a town having a combined system serving approximately 2/3 of its area and 9/10 of its population and the subsequent construction of parts of the system and of some storm sewers is the subject of a paper read recently before the Association of Civil Engineers of Cornell University and appearing in the February number of The Cornell Civil Engineer. Mr. C. F. Fisher, of the Fairport (N.Y.) Sewerage System, is the author.

In the particular case which Mr. Fisher selected the existing sewers had been built without regard to any particular outfall, and the problem was that of combining them into a system which should serve the entire community and deliver the sewage at some outfall convenient for the treatment of the sewage.

Before proceeding to the actual design of a sewer system, the factors of future growth of the town, the character and quantity of its sewage, the conditions of its present sewers and the local topography must be considered. In estimating future growth not only the corporate area should be included, but the areas which are liable to be developed during the period it is assumed to care for. The railway facilities will usually indicate in what direction new industrial works may be expected to grow up, but the development of residential districts does not admit of such accurate forecasts. In the smaller cities and towns the main highways which are susceptible to improvement as state roads are the more likely avenues of development.

The character of the sewage will govern somewhat in the selection of the minimum grades to be used. Where manufacturing wastes of a fibrous or a gritty character occur it will be necessary to provide for a higher velocity of flow, preferably not less than three feet per second, than where domestic sewage only is expected. This requirement becomes more important where the discharge is periodic in sewers maintaining only a small normal flow. A dilute sewage admits of a lighter grade than a heavy one, and more especially so if its diluteness is due to the infiltration of ground water in old sewers, since that fact insures a steadier flow. In a separate system the problem of street grit can be eliminated by the use of tight manhole covers, or, if perforated covers are necessary to provide ventilation, by the use of dustpans in manholes.

In estimating the amount of sewage per capita per day to be expected recourse will be had to the records of water consumption for the community in question. These records, if pumping records, or records made at the intake of the water system, will show a consumption which will be in excess of the flow of sewage by the amount of leakage in the waterworks lines. However, other facts concerning the water supply may be large factors in the expected sewage flow. At Fairport, N.Y., the water consumption from pump records for the winter months, when sprinkling, etc., was zero, was 65 gallons per capita per day. This water is obtained from shallow wells in shale and is highly mineralized. In consequence, the use of cisterns to catch roof water is universal. No records were available showing what the actual per capita consumption of this roof water was, and in the absence of any definite data, an allowance of twenty gallons per capita per day was made, as being sufficient to cover general domestic uses. The cisterns in which this water is collected drain into the sewers, which will form a part of the sanitary sewer system, and, during heavy rains, all the overflow from the cisterns will pass through the sanitary sewers. The amount of this overflow is difficult of estimation. A computation of the amount to be expected by means of roof area and rainfall data, assuming that only 10 per cent. of the cisterns would overflow at once, gave an amount of water manifestly too large to provide for in sanitary sewers. It was not possible in this case to observe the increase in flow due to rains because a great many surface laterals were connected to the sewers and contributed to their flow. It was advisable to make some allowance for this water because of the limited extent of the storm water system and the probability that it would not be extended to cover the town for some time. The total amount of sewage proper to be expected was determined as 80 gallons per capita per day and the maximum flow on the maximum day as 170 gallons. An allowance of 100 gallons was made for cistern overflow in addition to the sewage flow. This amount seems liberal, and the sewers were not designed to carry this amount flowing half full but practically three-quarters full. In case future experience should show this amount to be too small an allowance for cistern overflow, the remedy will lie in connecting the overflow to the storm sewers, whose construction should be assured before the main trunk sanitary sewers carry the flow from the full estimated population for which they were designed.

The condition of the existing sewers is sometimes hard to determine, especially where no maps have been filed or manholes built along the line. The grade of many of them is an indeterminate thing as they have frequently laid over an uneven bottom. The fact that they are discharging sewage is presumptive evidence that they are in fair condition. However, when it is designed to lay pavements over them, it is necessary to dig up the sewer at several critical points before assuming its efficiency, and manholes should then be built along the line.

The proper layout of the system to take advantage of the local topography, can only be finally determined by making actual estimates of cost of the best of the apparent locations. The inclusion of the old sewers complicates the problem as they were frequently built in short sections at a time, following the growth of population, and do not take advantage of the steepest grades available. Theoretically, the most economical type of layout is that in which the main trunk sewers follow the steepest grades, since the smaller laterals seldom carry their full capacity, even on light grades.

Before proceeding to the layout of any comprehensive sewer system it will be economical to make a good topographic map of the area to be sewered and any probable extensions to that area. Such a map should include all probable sites for disposal plants and all areas contributing surface drainage. A scale of 100 feet to the inch shows detail enough for fairly smooth country where the slopes do not exceed 10 per cent., but in rough topography and in locations which a preliminary examination shows to be likely routes for intercepting sewers a scale of 50 feet to the inch is preferable. A contour interval of 2.5 has been found satisfactory in smooth country, and ten feet is close enough for long, steep slopes. It is advisable to write in the actual elevation at street intersections and abrupt changes of slope. The amount of detail it is advisable to show on these maps depends somewhat on the probable time of construction. If the investigation is only preliminary in character and actual construction is liable to be long deferred it is useless to take a large amount of detail, which may change materially before actual construction. But where it is expected to build shortly, it is a matter of economy to locate the houses and all structures, even if they do not actively govern the location of the sewer. From these large scale maps a map of a smaller scale, 200 or 300 feet to the inch, can be prepared as an index map, or for