

THE RAPID TRANSIT PROBLEM IN PITTSBURGH.

Abbreviated from a Preliminary Report by Bion U. Arnold, C.E., Chicago, U.S.A.

The problem of transporting the people of a modern city from home to office and shop and back again is the most difficult of the various questions that arise.

Mr. Bion U. Arnold in his report to the city of Pittsburgh, Pa., considers three means.

I. The Improvements Available at the present time to provide better "rapid transit" facilities for the District are

- (a) Elevated roads,
- (b) Subways, and
- (c) Electrification of suburban terminals of steam railroads.

II. Elevated Roads.—The only available location for an elevated system in the down town business district would be upon the outlying streets along the rivers, as the structure would not be tolerated in the narrow streets of the more congested central areas. This out-of-the-way location would place an elevated road at a disadvantage.

Elevated structures designed to carry the surface cars around Herron Hill would be expensive and the operation of single car units would so limit the capacity of the tracks that it is doubtful if sufficient additional car miles could be operated to justify the investment.

III. Subways.—A subway between the down town business district and certain centers in the outlying districts appears to be a natural development. It is probable that one section of the city will be ready for a subway before the other sections, but eventually all parts of the city should be connected by some unified system of sub-surface transportation.

A subway is admirably adapted to overcome the natural divisional obstacles, such as hills, ravines, and rivers which now separate the various communities. And as a civic improvement, the building of a subway will eventually become a necessity in order to remove the increase in passenger traffic from the surface of the streets. The present questions however, are where and how soon should subways be built and under what financial restrictions.

IV. Technical Elements of Subway System.

(a) First Cost.—The first cost of a double track subway, fully equipped, may be estimated as between \$1,000,000 and \$2,000,000 per mile of single track, depending upon the physical difficulties, size, elaborateness of design, number of stations, amount of rolling stock and other equipment, value of real estate necessary for stations, terminals, shops, yards, etc. A subway system for Pittsburgh should hardly be undertaken unless an expenditure of at least \$30,000,000 is contemplated, half of this amount, at least, to be spent for the sections first built.

(b) Operating Expense.—Experience has shown that the ratio between operating expenses and gross earnings, under subway conditions, varies between 40 and 60% with a fair average of 50%. The average operating expense of a surface system is from 60% to 70% of passenger earnings, and it is the fact that subways can be operated at a relatively lower percentage that justifies the larger investment in situations where the density of traffic is great.

(c) Earnings.—The annual earnings from operation should amount to not less than 10% of the first cost, and seldom will amount to more than 15%, for before reaching this latter figure there no doubt would arise demands for extensions. These figures indicate on what narrow margins enterprises of this character must be financed. Under Pittsburgh conditions, I believe that average annual earnings

from passengers equal to at least 12% of the first cost of the system will be necessary to make a subway practicable.

(d) Earnings per Capita.—If the first section of the subway must earn an amount equal to 12% on \$15,000,000 or \$1,800,000 per year, the question is when will it be possible to build it?

The earnings per capita of the surface system are now about \$10.00 as an average, but certain residence sections of the city run as high as \$28.00 per unit of "sleeping population" of the district.

Earnings per capita increase at a rate not less than the rate of increase in population, and often at a greater rate, depending on the riding habits of the community. Therefore at \$10.00 per capita, the subway must serve 180,000 people in order to earn \$1,800,000 yearly; at \$20.00 per capita, only one-half this number or 90,000 people would be required. A conservative estimate would be that if a subway can be designed to serve 150,000 people contributing \$12.00 each per annum to the subway in addition to their use of the surface system, then an initial investment of \$15,000,000 would be justified, or at the rate of \$100 per person served.

(e) Density of Population.—At present the maximum density of population in Pittsburgh over any considerable area is about 100 persons per acre, although one ward, the old Seventh, had a density of nearly 200 per acre; but in many residence districts, such as the East Liberty section, the density is as low as 30 per acre. In New York the density per acre for the lower "East Side" is about 700 per acre, and in Harlem, which is the best contributing district for the New York subway, the density is 150 per acre, which is the same as the average for the entire island of Manhattan.

At 100 per acre, 150,000 people would occupy 1,500 acres or 2.35 square miles, while at 50 per acre, the district required for 150,000 people would be twice as much or 4.7 square miles. It is very probable that, with the opportunities which Pittsburgh has of spreading out, that there will not be sufficient increase in land values to justify whole blocks of high apartment buildings such as are found in New York City. But there, no doubt, will be considerable development in the line of apartment dwellings, which will raise the present average density of population in many sections, although it will not be safe to count on large contiguous residence areas where the average density will reach as high as 100 per acre. This would indicate that the first section of the subway should be designed to serve an area of about four square miles.

(f) Combined Surface and Subway Systems.—In order to reach the amount of territory that will secure patronage to justify a subway, it will be wise to count on a combined system using the subway as a main trunk line and the subway railway as a means of collecting and distributing the passengers over a wide area. Furthermore, in order to use the tubes to best advantage, they should be located and designed so as to accommodate suburban trains coming into the city over the various lines of the present railroads, which may be electrified eventually. With these two auxiliary systems contributing to the earnings of the subway, it will be unnecessary to be so dependent upon the earnings of the territory directly contiguous to the main trunk line.

However, to secure this "transfer" and "through" business, it will be necessary to design a subway for real rapid transit by eliminating the stops in the short haul territory just outside the business center of the city and to operate trains instead of single car units.

(g) Successful Subway Design in Pittsburgh will apparently involve the location of the subway in territory which is capable of being built up with apartment houses, the selection of station sites convenient to transfer to a surface system, and the design of terminals which will make connections with