Notes on electric railway economics and preliminary engineering

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NOTES
ON
ELECTRIC RAILWAY ECONOMY
AND
PRELIMINARY ENGINEERING

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PREFACE.

This book is based upon a series of lectures which I delivered at Lehigh University, last spring, the subject of which dealt with the economics of the preliminary and other determinations and of the construction and operating of high-speed and heavy traction interurban electric railroads. After the lectures had been delivered, some of the members of the faculty of Lehigh University and others who had heard the lectures, together with other men whose financial and other interests are essentially railroads, including practicing engineers, to whom the notes had been loaned, expressed the desire to have them published, for the reason, as they stated, that the treatment was novel and practical, and that the discussion of the subject, as presented in the lectures, existed in book form. I have, therefore, filled out the lecture notes in some places adding matter thereto, and have rearranged the subjects so as to follow the order in which they would be taken up in the investigation and construction of an electric railway undertaking of the kind herein considered.

With the exception of a few large general maps, prepared for special cases, and some sets of railroad maps showing alignments and profiles, and a few sets of colored Progress Sheets, all of the full size original drawings and diagrams which I used while delivering the lectures have been reduced.
and reproduced for this volume and appear at their proper places in the following pages.

Some time prior to the delivery of these lectures a series of hearings was held by the Railroad Commissioners of New York State to consider the application of the New York and Port Chester Railroad Company for a charter, and during the hearing the practicability from both an engineering and commercial standpoint of interurban high-speed electric railways was fully demonstrated. Although the New York and Port Chester Railroad is not yet in operation, I used considerable of the engineering and other data placed in evidence at the hearing, as well as much other data worked up in developing and demonstrating the commercial and engineering details of the New York and Port Chester Railroad in the Lehigh University lectures, and have also employed some of the same data in this book.

Neither the lectures, or this book, were or are given a treatise or exhaustive treatment of the subject as a whole, of the details as indicated in the chapter headings. The lectures were intended to "point the way," and embody some of the results of twelve years of practice and application. This book is presented with the same object in view.

I desire to express my thanks to Mr. C. O. Mailloux, my associate, and to Mr. H. W. Blake, Editor of the Street Railway Journal, for the help they have given me in completing this book.

W. C. GOTSHALL

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CONTENTS.

CHAPTER

I. Introductory ...........................................
II. Preliminary Office Determinations .................
III. Preliminary Field Survey ..........................
IV. Detailed Office Investigation of Track Location...
V. Preliminary Determination of Schedules and Equipment ...
VI. Estimate of Earnings ................................
VII. Estimate of Probable Operating Expenses .......
VIII. The Final Survey ..................................
IX. Track Construction ...................................
X. Overhead or Third-Rail Construction ..............
XI. The Power Station ...................................
XII. Storage Batteries ..................................
XIII. Rolling Stock and Motors .........................
XIV. Securing Rights of Way ...........................
XV. Preparation of the Specifications ................
XVI. The Construction Period ..........................
XVII. The Organization of the Operating Department...
XVIII. Economic Considerations ......................

APPENDIX

I. Specifications for Moderate-Sized Interurban Railway ........................................
II. Bibliography ...........................................
ELECTRIC RAILWAY ECONOMICS AND PRELIMINARY ENGINEERING.

CHAPTER I.

INTRODUCTORY.

The purpose of this book is not to discuss in detail the intricate electrical and other engineering problems connected with the location and construction of interurban electric railways. While a knowledge of such details is of great importance to the constructing engineer, indeed is essential to success, their consideration exceeds the proposed scope of this volume, and the reader is referred to the special, detailed works on civil, electrical, mechanical, and steam engineering. It is the intention here to consider rather the subject broadly and as a whole, to outline the work of the electric railway engineer during the inaugural and constructive period of a proposed road, and to give a general way some bases upon which the costs of construction, probable present and future traffic, and ultimate economic results of the proposed railway can be gauged. In this discussion I will consider some of the technical details of interurban electric railroading which are not now to be found in the text-books, and will also, as the better understanding of the subject, take up certain concrete examples of the different subjects treated.

Success in the inauguration, construction, and operation of railways of the character discussed in these pages requires, on the part of the railway engineer, a combination of engineering and commercial skill. He must not only be conversant with those purely technical matters required of the civil and electrical engineer, but he must also
thoroughly awake to and skilled in those commercial matters relating to finance, conditions affecting and governing the securing of business, retention of business, cost handling a given volume of business, and the causes which influence and determine traffic.

The relations of the railway engineer to his clients are essentially fiduciary. His responsibilities are precisely those of trust company officers or trustees having in hand the investment of the funds of others. The engineer is expected to advise his clients whether the proposed enterprise will be a safe investment, and he is also expected to give the reasons for his conclusions. Upon his opinion and conclusions large sums will probably be staked, and for the reason he has no right to recommend any investment which will not pay either at once or in the near future.

The era of rapid transit, or high-speed electric roads operated at such speed and headway of train units that people can live well beyond the congested commercial centers and daily pass between their homes and the commercial centers or places of their occupation or business without suffering the prohibitive loss of time and inconvenience entailed by the use of surface roads operating upon and along public streets and highways, is now here. Populations of our large cities have been increasing for years, but traffic facilities have, by no means, kept pace with the development. In consequence, the natural tendency to spread out over larger areas has been checked, as evidenced by the increase in the number and size of apartment and tenement-houses in our large centers of population during the past five or six years. Too much had been expected of a transportation agent of electric street railways. The actual demonstration of their speed limitations, as shown by their schedules, and rendered imperative by the paramount consideration of public safety, has developed:

First. The interurban railway operating upon public highways.
Second. The high-speed interurban railroads operate upon their own rights of ways, and, therefore, free to make the fastest practicable schedules.

Both of these have their province and both have come to stay. The latter, however, will undoubtedly have the greatest future and must receive that concentrated attention always accorded to an indispensable economic necessity, for such it certainly is.

The sun of the high-speed railroad, reaching out into the country, is now risen, but, as yet, is far from its zenith. The street surface or tramway systems will continue to do a short-haul business in the cities and other population centers for many years to come, while the suburban extensions of these lines will supply a service for those so close to the larger cities that the element of time taken in the average trip does not figure as a very large factor. Both classes of road will soon be commonly recognized as feeders to the high-speed trunk lines and systems. Each will be a necessary adjunct to the other. The sun of the street surface railway is well beyond its zenith and while some development may be expected in the suburban or rural railway on public highways its future is more or less limited. In the matter of the transportation prerequisites, viz., speed and comfort, neither class of road can offer much more than it is now giving account of conditions not within its control.

At the present time, the determination of railway projects is essentially along the lines of heavy traction and interurban development. The latest projects, both existing and proposed, of interurban electric railway installations involve not only features entering into their preliminary determinations, but features of construction and operation differing from those which have heretofore been controlling factors in electric railways.

It is my purpose in this discussion to devote considerable time to the investigation of preliminary conditions, as well as to the determination of those characteristics of constru
tion and operation which should be followed in the high class of interurban electric railway projects.

In approaching this subject, it will be taken up in the following order:

I. PRELIMINARY DETERMINATIONS. (Chap. II–III.)

(a) First or preliminary determinations of the probable revenue and the general investigation of the physical characteristics of the territory proposed to be served.

(b) Investigation of the commercial and other characteristics of the territory proposed to be served.

(c) Preliminary surveys and fixing of preliminary lines and data on which to base relative and ultimate determinations.

(d) Prerequisites in connection with preliminary field work.

II. LOCATION OF LINE AND ENGINEERING. (Chaps. IV–VII.)

(a) Controlling considerations, such as connecting centers of population, alignment and gradients, termini and stations, and prerequisites for high speeds and safety of the public, etc.

(b) Making of paper locations of probable routes, showing approximate line and profile of each route.

(c) Estimates of cost of superstructure, etc.

(d) Determination of cost of equipment. Preliminary plotting of schedules for the purpose of ascertaining approximate details of equipment.

(e) Determination of probable gross earnings.

(f) Determination of fixed charges and cost of operation and maintenance upon schedules as proposed.

III. FINAL ENGINEERING WORK. (Chaps. VIII–XVI.)

(a) Final consideration of the details of construction of superstructure, and details of engineering, such as power stations, rolling stock, etc.