THESIS
on
The Design of an Interurban Electric Railroad
Submitted to the Faculty
of the
OREGON AGRICULTURAL COLLEGE
for the degree of
Electrical Engineer
by
W.A. School.

APPROVED:

Redacted for privacy

Department of Elec. Eng.

1909
The Design of an Interurban Electric Railroad.

The problems involved in designing an electric railway must necessarily be treated in conjunction with the cost of construction, operation and maintenance. The first thing the capitalist desires to know is "will it pay", and thus the engineer is immediately confronted with the problem of providing the best service and equipment at the least possible expense. It is not the province of the engineer in designing railways or power plants to design each machine or piece of equipment, but to select wisely from the many different makes so as to obtain a complete unit with every device performing its particular function in the most economical manner.

No designer should copy completely the scheme of an existing installation since what might be economy in one case would perhaps be useless waste in another. Evidently it would be a hopeless and useless endeavor to attempt to standardize the design of electric railroads. However, it is well for designers to adhere, in a general way to the methods of the best and most recent practice.

The designing engineer should make an accurate and conservative estimate of the income which can be derived from all possible sources of revenue, including freight and passenger receipts, amusement resorts, freight, express and mail and electric light and power. This estimate can
be very accurately arrived at by comparison with what other roads are doing.

To be successful in the inauguration, construction and operation of railroads the engineer must have not only technical skill but must also be thoroughly skilled in commercial and financial matters. Upon his opinions and conclusions large sums will be staked and it is absolutely essential that he recommend only such investments as will be sure to pay.

The most uncertain of all estimates is that of gross earnings. At present the passenger receipts of most interurban railroads constitute the greater portion of the total gross earnings. In making an estimate of the passenger traffic it is advisable to obtain reliable information on the amount of traffic by vehicles and stages between the different centers of population. From this information and by comparison with the traffic of existing roads in similar conditions a fairly satisfactory estimate can be secured. In such cases the "population served" is generally taken as that residing within about one and one-half miles of the proposed line.

In addition to the passenger earnings, estimates should be made of the probable gross revenue which will be derived from the carrying of freight, express and mail. This can be worked out in a manner very similar to that used in determining the gross passenger revenue. If a steam road is already doing this business it is advisable
to ascertain the extent of their freight and express business. Should there be no existing road, it would be necessary to ascertain the total production and consumption of the territory proposed to be served. Another way to proceed is to consult the statistical data, published by the United States government, showing consumption and production per capita of the given localities. In this way an estimate of the probable railroad tonnage for the proposed road can be secured. In making an estimate of the operating expenses and fixed charges it is necessary to determine the detailed cost of each item for the proposed conditions.

The railroad under consideration in this discussion, will be approximately sixty two and one-half miles long. The railroad to be built commences at the city of McMinnville and runs thence westerly through Yamhill County into Tillimook County to a point about one mile east of the village of Osegown and thence northerly to the city of Tillamook. The railroad is to be built upon a private right of way except where it becomes necessary to cross public avenues, streets or highways. All crossings of public avenues, streets, or highways shall be of such character and construction as to insure all possible safety to the public and also to interfere as little as possible with the movement of trains. In addition to the sixty two and one-half miles of main line there will be approximately five miles of
siding. The length of siding at each station will be
determined by the amount and character of the freight
or express which will be handled at the given point.

A private telephone line shall be installed along
the right of way with the latest improvements at every
station. The Hydro-Electric Power Station will be
located near the town of Dolph. There will be three 1000
K.W. single phase alternators. The current is to be
generated and supplied to the trolley at 13600 volts.
Power will be transmitted to the substations under a
pressure of 33000 volts. There will be two substations
one at Bellevue and the other at Nastocton. There
will be ten stations (see map) including terminals and
enough Platforms or smaller stations to facilitate the
handeling of the traffic.

Not having been over the ground to make personal
observation of the surrounding country and the conditions
which will have to be met in the building of this road,
it is quite improbable that the estimate as made will
be accurate in every particular. But with the inform-
atation and data available it has been the aim to treat
the subject in the light of a reality as much as possible.

Cost of 67.5 miles of Electric Railway, with all
necessary equipment, including Power house, substations
etc.
Cost of Track.

135 miles, #60 rails, @ $35 delivered $222075.00
Grading @ $2200 per mile 148500.00
Rock Ballast @ $2000 per mile 135000.00
Ties, @ $1000 per mile 67500.00
Joint Plates, Bolts, and Spikes @ $600 40500.00
#4-0 Bonds and Cross Bonds @ $250 16875.00
Labor for construction @ $1000 67500.00 697950.00

Cost of Catenary Construction & Transmission Line.

2970 - 35ft. poles @ $5.50 set 16335.00
4752 - 33000 volt Insulators @ $.68 3231.00
4752 - Pins @ $.20 950.50
2376 - Cross Arms with Braces & Bolts@ $.75 1782.00
67½ miles, 3-0 grooved Trolley @ $.20 36274.00
67½ miles, 7 strand messenger @ $.015 5346.00
108 - miles #6 wire for Transmission @ $.20 9050.50
3700 - Brackets with Hangers etc. @ $4.00 14800.00
Telephone System Complete 2500.00 91269.50

Cost of Power Plant & Sub-Stations.

40' x 80' Brick Cam and Power House 40000.00
2 - Brick Substations 14' x 14', $500 1000.00
3 - 1000 K.W. Turbines $4650, 13950.00
3 - 1000 K.W. Single Phase Generators  
@ $38000  
114000.

8 - 750 K.W. Transformers $7500  
60000.

1 - 50 K.W. Lighting Transformer Switchboards, Oil Switches Instruments & Auxiliaries. 
7000. 236450.

Cost of Rolling Stock.

4 - Intersurban Passenger Cars @ $13500  
54000.

2 - Express Cars @ $11500  
23000.

1 - 1000 H.P. Electric Locomotive  
23500.

1 - Steam Locomotive  
8000.

20 - Box Cars @ $800  
16000.

20 - Flat Cars @ $700  
14000.

10 - Dump Cars @ $800  
8000. 146500.

Superintendence etc. 5%  
58608.50

Total cost 1230778.00

The above figures do not include any allowance for right of way, franchises, and legal expenses, not for interest during construction.

Maintenance and Depreciation.

67.5 miles of track at $200 per mile  
13500.

67.5 miles of overhead construction $20  
1350.

Rolling Stock @ $.014 per car per mile  
3832.50

Power House & Substation Equipment @ 1.5%  
on $1894.50  
2841.75 21524.25
Operating Expenses.

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary of Superintendent</td>
<td>$1500</td>
</tr>
<tr>
<td>&quot; &quot; Chief Engineer</td>
<td>1200</td>
</tr>
<tr>
<td>&quot; &quot; Assistant Engineer</td>
<td>1000</td>
</tr>
<tr>
<td>&quot; &quot; Auditor</td>
<td>1000</td>
</tr>
<tr>
<td>&quot; &quot; Two Dispatches</td>
<td>2000</td>
</tr>
<tr>
<td>&quot; &quot; &quot; Clerks</td>
<td>1600</td>
</tr>
<tr>
<td>2 Switchboard men at $2.75 per day</td>
<td>2007.50</td>
</tr>
<tr>
<td>2 Turbin tenders at 3.00 &quot; &quot;</td>
<td>2190</td>
</tr>
<tr>
<td>2 Generator tenders at 3.00 &quot; &quot;</td>
<td>2190</td>
</tr>
<tr>
<td>2 Oilers &amp; Cleaners at 2.25 &quot; &quot;</td>
<td>1642.50</td>
</tr>
<tr>
<td>2 Repair Men</td>
<td>2007.50</td>
</tr>
<tr>
<td>10 Station Agents at 60.00 &quot; Month</td>
<td>7200</td>
</tr>
<tr>
<td>Train Crews</td>
<td></td>
</tr>
<tr>
<td>General expenses &amp; supplies</td>
<td>3000</td>
</tr>
<tr>
<td>Taxes on cost @ .015</td>
<td>46628.50</td>
</tr>
<tr>
<td>Total yearly expenses</td>
<td>68152.75</td>
</tr>
</tbody>
</table>

Probable Yearly Earnings.

<table>
<thead>
<tr>
<th>Revenue</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Revenue at $.40 per car mi.</td>
<td>73000</td>
</tr>
<tr>
<td>Freight &amp; Express at 1500. &quot; mi. of track</td>
<td>93750</td>
</tr>
<tr>
<td>U. S. Mail</td>
<td>5000</td>
</tr>
<tr>
<td>Total yearly Earnings</td>
<td>171750</td>
</tr>
<tr>
<td>Total yearly Expenses</td>
<td>68152.75</td>
</tr>
<tr>
<td>Net Earnings</td>
<td>103597.25</td>
</tr>
</tbody>
</table>

This will allow a $2000000 capitalization with $1000000 in preferred stock at 6% and $1000000 in common at 4%.
Plan of 3000 Kw. Hydro-electric Power Station

Scale 12" = 1'
Overhead Construction

Scale 1/4" - 1'