

paratus. The moulding and cleaning shops are equipped with compressed air.

It is hoped to be able to give some more detailed results of the process in the near future. There is no doubt that the problem of handling Canadian ores has been solved in this process. The steel made in the furnace, as intimated above, supports all the predictions and published results up to the present as to the superiority of electro-thermic steel.

HIGHWAY ACCOUNTING, WITH SPECIAL REFERENCE TO MAINTENANCE.*

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THE time is at hand when accounting and cost-keeping methods that have proved so effective in the management of private enterprises will also be universally applied to public works. There is fundamentally no economic difference between a road and a railway. Hence accounting methods that have been developed in the construction and operation of railways should prove efficacious in road construction and maintenance.

Every well-managed railway has an itemized plant or property account. How many ledgers relating to a system of highways will show the itemized investment in the entire mileage? Every well-managed railway has an itemized maintenance account that shows the monthly and annual maintenance expenses by divisions. Of how many road systems can the same be said? Every well-managed railway is careful to distinguish between expenditures that add to the investment in plant and expenditures that merely renew superseded and worn out parts of the plant. How many road ledgers show equal care in this vital matter? And it is vital, economically, not to confuse renewals with betterments; yet we all know of many recently published statements of road maintenance costs wherein more than half the cost was not maintenance at all.

When an old waterbound macadam is scarified and enough new metal added to bring it to its *original* thickness, the cost thereof is a maintenance expense. But if metal is added in amount sufficient to make the macadam 8 ins. thick where it was 6 ins. thick at the time of original construction, then the added 2 ins. is not a maintenance expense, but is an addition or betterment which should be charged to the property account. Even to a more marked degree is this true when a waterbound macadam is given a bituminous surfacing.

The editor of at least one prominent engineering periodical has recently written about the almost prohibitive cost of road maintenance, and has cautioned the public against bonding for road construction because of the short life of modern roads. This serious editorial error is the result of inadequate knowledge of proper accounting methods, for published road maintenance data are apt to deceive those who think that "maintenance" means what it should mean. As a matter of fact "maintenance," as commonly used to-day in reference to roads, means true maintenance and betterments combined, and is, therefore, a deceptive term.

Maintenance expense should never include anything else than repairs and renewals. Any expenditure that adds to the inventory cost of a road is an addition or betterment and should be charged to the property account.

By this criterion it follows that if a worn 6 in. macadam is scarified and increased in thickness to 8 ins., the first cost of a 6 in. macadam is deducted from the first cost of an 8 in. macadam, and this difference is charged to the property account. The balance of the expense involved in scarifying, metalling, rolling, etc., should be charged to the maintenance account under the head of renewals.

The writer prefers to keep distinct the two kinds of maintenance—repairs and renewals. Under repairs are charged patching, patrolling, and other small or continuous maintenance expenses. Under renewals are charged general resurfacing and all renewals of large parts or units. Thus, in the case of a bridge the cost of painting is a repair expense; but the replacement of an old bridge by a new one is a renewal.

Since it is rare that a highway official will find a properly kept set of construction and expense ledgers left by his predecessor, the question arises whether it is worth while to inventory or appraise the existing roads. Most emphatically it is worth while. One of the best ways of rating the annual maintenance cost of any structure or machine is as a percentage of its first cost. Obviously this cannot be done where the first cost is not even vaguely known. Estimates of future maintenance expenses are often best determined by taking percentages of the first cost of each item. These reasons alone warrant making an appraisal of any plant, but, in addition the owners of a plant are entitled to know how much capital is invested in it. Who can tell, with any degree of accuracy, how much capital is now invested in the roads of any large State in America?

The writer has made a rough estimate of the investment in roads in each State, and it serves at any rate to disclose sad disparity in capital invested in roads compared with railways. Accurate figures of this sort for each State should serve to awaken the public to realization of its past niggardliness in road improvement. Now that the Interstate Commerce Commission has begun the appraisal of all the railways, it will soon be possible to contrast the investment in railways with the investment in roads, provided we begin soon to appraise our highways.

In opening a property account for a system of roads, it will be well to study the printed instructions to railway accountants issued by the Interstate Commerce Commission; also the printed instructions issued by various State public service commissions.

The writer would suggest a property account for roads as follows:—

Road Property Account.

1. Engineering, Superintendence and Inspection.
2. Administration and Legal.
3. Real Estate and Right-of-Way.
4. Clearing and Grubbing.
5. Grading.
6. Retaining and Slope Walls.
7. Bridges, Culverts and Drains.
8. Fences and Signs.
9. Trees, Sod and Foliage.
10. Paving.
11. Buildings and Fixtures.
12. Furniture and Instruments.
13. Stores and Supplies.
14. Tools and Machinery.
15. Miscellaneous.
16. Bond Discount.
17. Interest During Construction.

All existing roads should be appraised at the cost of reproduction *new*. The depreciated condition may be

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