creased wear of tires and possible depreciation and maintenance due to collisions or other accidents.

Roadway Wearing Courses

The forces due to motor truck traffic which should be given consideration in the selection of a roadway wearing course are the direct load-causing compression in the wearing surface, impact forces and sheering forces of the driving wheels (the amount of which will be a function of the weight of the vehicle and the speed at which it travels). If all of these forces have not been given proper consideration, the wearing course will wear rapidly or will disintegrate. The wearing course is of particular interest to motor truck users, because of the variations in resistance to traction on different types of roadway surfaces.

Statistics are meagre relative to traction, especially as concerns motor trucks. Investigations made to date are merely a drop in the bucket as compared with the amount of research which should be undertaken in order to have available reliable data. At the present time, only the most general conclusions can be drawn, as was the case with the tests carried on by the White Co., cited above.

Highway transport interests should give careful consideration to the effect on motor trucks due to travel on different types of roadway wearing courses. The mistake is too often made of considering wearing courses in their ideal state or during the first six months after completion. All types wear under traffic, and hence the character of the surface of a roadway after two to five years' life is generally more important than its condition upon completion of an improvement. Not only is resistance to traffic increased as the surface becomes worn, but furthermore, the effect on the motor truck through impact forces caused by travel on rigid monolithic pavements will result in a material advance in depreciation and maintenance charges.

Bridges

A bridge is an integral part of a highway. It is to be regretted that this fact usually has not been recognized by law-makers. Many highways are built of sufficient strength to carry the motor traffic to which they are subjected, while the bridges are so weak that their condition prevents the use of the highway by a part of the motor truck traffic. Many citations may be given of highways which have had to be abandoned as commercial transportation routes due solely to the weak conditions of the bridges. One reason for this condition is that many state laws provide for the construction and maintenance of roadways by the state, while the bridges are under the jurisdiction of counties or towns.

It is self-evident that bridges of trunk highways connecting municipalities should be designed for loads of not less than 30,000 lbs., and it would appear advisable, considering the character of the structure, to follow the practice of the Pennsylvania State Highway Department and design highway bridges for loads of 40,000 lbs.

The clear width of the roadway of a bridge should comply with the requirements pertaining to roadway width cited above. In addition, the vertical clearance should be given consideration, and in this connection the overall height of 12 ft. 2 ins. for motor trucks should receive attention. This is an important factor, not only in the design of through truss bridges but likewise in providing for clearances underneath railway bridges.

Highway transport companies should thoroughly investigate permissible loads, clearances and roadway widths of highway bridges on transportation routes. Many instances have come to the attention of the writer where bridge load limits of two or three tons occur on highways whose surfaces are capable of carrying 5-ton motor truck traffic.

English Practice

A discussion of the relation of highways to operating cost would be incomplete without reference to the large fund of general information which may be found in the motor truck literature of England, where highway transport outside of municipalities has been under development for several decades. The status of motor transport in England in 1909 is aptly described in the following statement by Col. R. E. Crompton:--

"Although our roads come first, and their development occupied the best thoughts of our leading engineers at the time of Telford, when railways were introduced, road development took a second place until quite recently, when it was seen that the general introduction of motor vehicles was rapidly bringing back the roads into favor, not only for carrying passengers and distributing materials for short runs, but to act as feeders to the railways, and in many cases to become rivals to the railways themselves for short hauls, or, in fact, in all cases where economies in the terminal charges and in the packing of goods, especially those of a perishable character, can be effected by these goods being loaded at the starting point into a vehicle which carries direct to the consumer without transhipment or intermediate handling.

"The economical advantages of this last consideration are so great that many business firms have now found that they prefer to deliver direct in their own vehicles goods which they had hitherto to send by their horse-drawn vehicles to the railway stations and which had to be twice transferred, first from their vehicles on to those of the railway, and again from the railway vehicles to the railway vans.

"A study of the statistics of increase of traffic on roads radiating distances of at least 30 miles from our large business centres, has shown us that, as the vehicles and as the roads themselves are improved, this radius of direct haulage is likely to increase, and will probably have a very important effect on the distribution of the population, and must with absolute certainty be reckoned with in considering all questions of construction and upkeep of the roads themselves."

Conclusion

The foregoing discussion indicates that the probable cost of transport over highways outside of municipalities is not susceptible of an exact mathematical analysis. Although this situation is far from satisfactory, it does not mean that highway transport should not be based on as definite analysis as our present fund of information and experience warrants.

The inter-relationship between highways and the cost of highway transport is so interwoven and complex that many highway transport managers have literally thrown up their hands and simply taken a chance upon the results to be secured from organizing transportation companies.

Based on the meagre investigations made to date, taken in combination with the combined experience of English and American highway transport authorities and highway engineers, it is evident that certain general conclusions may be drawn as a result of a careful highway transport survey for any proposed transportation business. A consideration of these deductions will usually warrant the installation of a highway transport business or the positive rejection of the proposition. This is particularly true when it is considered that the installation of highway transport in a given community should not be based on a narrow margin of profit. There are too many uncertain factors, such as competition with other transport companies and common carriers by rail and water, state regulations pertaining to weights, dimensions and speeds of motor trucks, legislation pertaining to licenses, franchises and rates, snow removal practice, and variations in the volume of business, to justify a highway transport engineer or manager figuring profits and losses from a business standpoint in thousands of dollars and the variations in operating cost due to the several highway factors in thousandths of a cent.

Next winter the Toronto-Hamilton highway will be kept clear by means of snow plows operated from Toronto, Oakville and Hamilton.

The architects of British Columbia have introduced a bill in the Legislature of that province incorporating the Architectural Institute of British Columbia.