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# HIGHWAY RESEARCH

# CIRCULAR

Number 42

Subject  
Classification: Maintenance

August 1966

Highway Research Board  
DEPARTMENT OF MAINTENANCE

## Maintenance Management

Report of a Conference Session Sponsored by Committee on Maintenance Costs, 45th Annual Meeting of the Highway Research Board, January 1966

INTRODUCTORY REMARKS BY M. B. CHRISTENSEN

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There has been an almost annual demand for additional portion of the highway dollar for maintaining and operating the nation's highway and street systems. Because of this, some, but only a relative few, highway administrators have taken serious action to find ways and means for either obtaining larger maintenance appropriations or accomplishing more work within the limitations of presently approved budgets. Prospects are generally not very good for securing needed additional funds so it has been necessary to explore more thoroughly the second alternative--that of accomplishing more work with the funds available. It is common knowledge that since the beginning of World War II there has been an almost steady upward trend in wage rates, and in the cost of equipment, labor, and overhead. How then can the upward trend in unit maintenance costs be reversed or reduced? Let us take a look at the situation with respect to Federal-aid highway construction.

Figure 1 illustrates the composite mile construction price index trend for the years 1923 to 1964, inclusive. It is computed from the actual unit prices bid for the construction of Federal-aid projects. You will note that the base index of 100 is for the years 1925 to 1929. The upper curve is computed on the basis of utilizing the same number of hours for labor, the same quantities of materials, and the same number of hours of equipment rental required to produce each unit of construction each year. Under this assumption the only variables involved in developing this curve are the wage and equipment rental rates and the purchase prices for materials. The lower curve, however,

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indicates the price trend as it actually occurred. It represents the bid prices as awarded, for construction-in-place, including all construction processes. This curve reflects not only the changes in wage and equipment rental rates and materials prices, but also the changes in quantities of labor and equipment used in producing the same units of completed construction as compared to previous years.

Figure 2 has been developed on the same basis as Figure 1. This curve is for excavation. You will notice that if the same quantities of labor, materials, and equipment have been used in 1964 as were used in the period 1925-1929 and continuously throughout the range of the chart, the curve would have looked like the upper curve in Figure 2. The bid prices accepted for the award of contracts were used to develop the lower curve. The difference between the two curves clearly demonstrates the results of increased productivity particularly in regard to the labor and equipment parts of the work.

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### EFFECT OF IMPROVED EQUIPMENT ON HIGHWAY CONSTRUCTION PRICES, 1925-1929 = 100

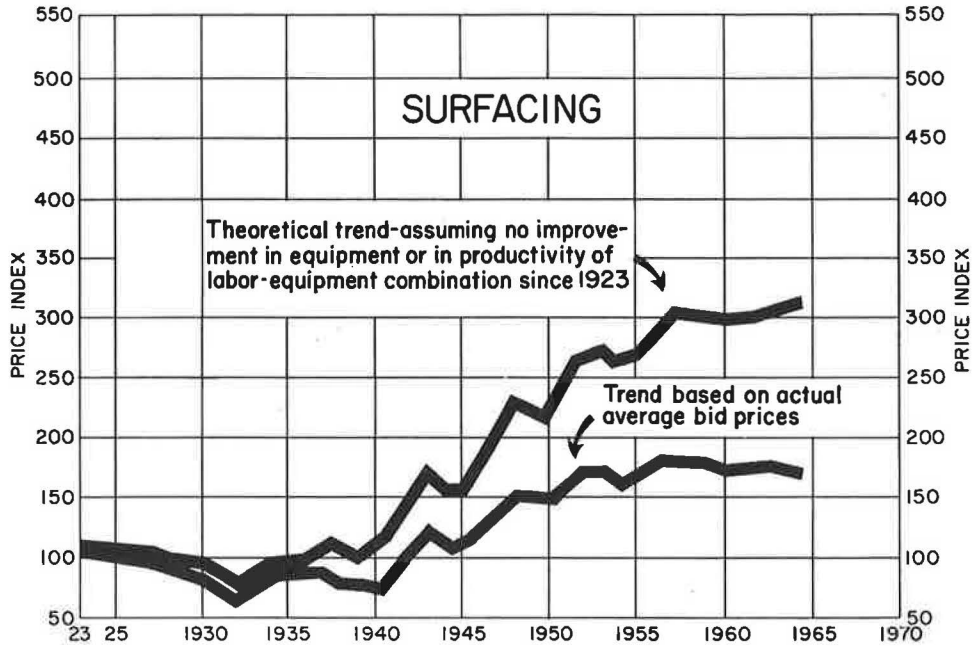


Figure 1.

### EFFECT OF IMPROVED EQUIPMENT ON HIGHWAY CONSTRUCTION PRICES, 1925-1929 = 100

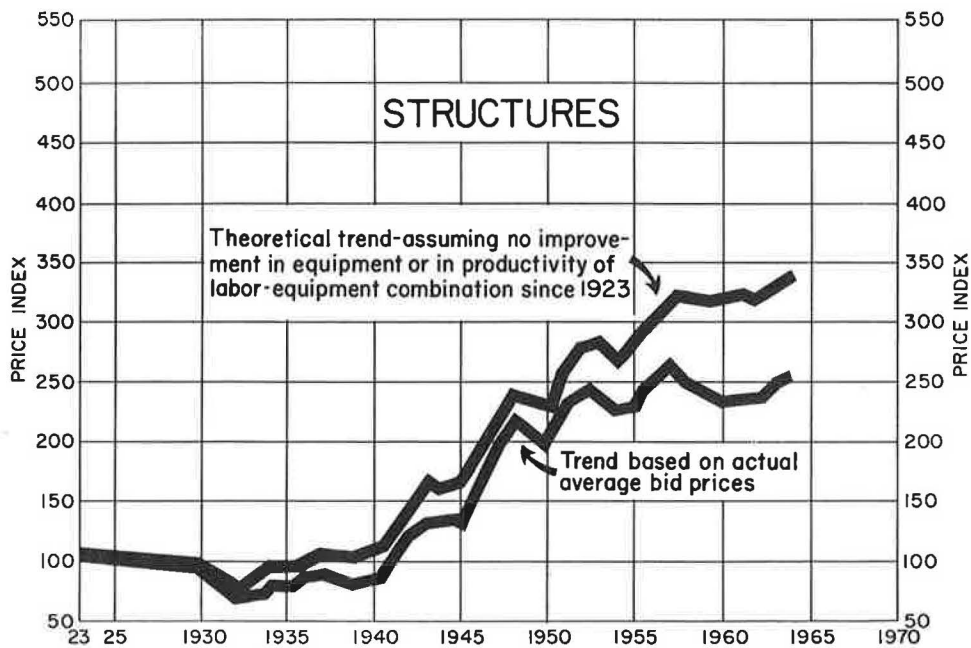


Figure 2.

### EFFECT OF IMPROVED EQUIPMENT ON HIGHWAY CONSTRUCTION PRICES, 1925-1929 = 100

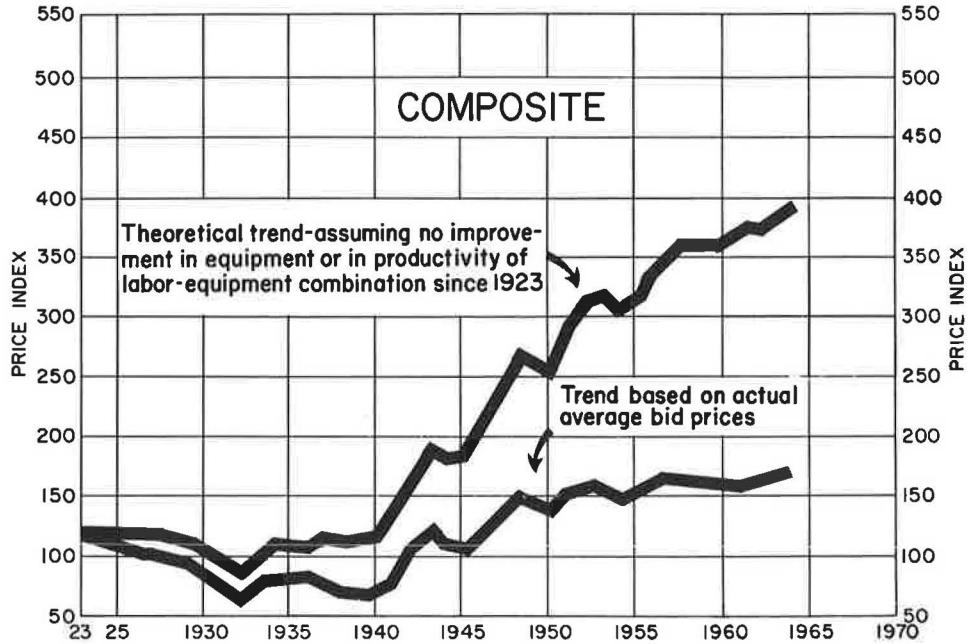


Figure 3.

### EFFECT OF IMPROVED EQUIPMENT ON HIGHWAY CONSTRUCTION PRICES, 1925-1929 = 100

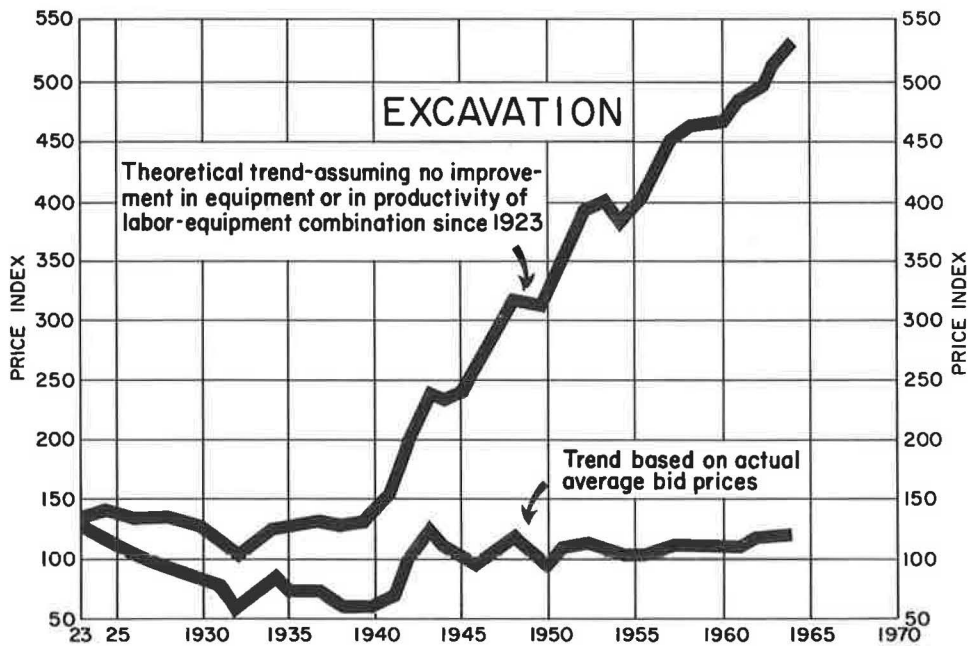


Figure 4.

Figures 3 and 4 reflect similar differences in construction costs for surfacing and for bridges, respectively.

The principal reason for the wide variation between the upper and lower curves of Figures 2 and 3 is that there has been a great deal more mechanization and increase in the productivity of the labor-equipment team in the areas of excavation (Figure 2) and surfacing (Figure 3) than there has been on structures, (Figure 4). In the latter, materials and labor are predominant with considerably less usage of equipment.

The increased divergence of the "construction" curves clearly demonstrates the tremendous influence on unit prices that occurs from greater mechanization, from improvements in equipment and in labor usage, and from the resulting increase in the productivity of the labor-equipment team. Much of this increased productivity has occurred because competitive bidding in highway construction contracting has compelled each contractor to continually record and analyze all cost data, study the output of his organization, and strive diligently to find ways and means of improving the efficiency of his operations. If he is to survive, he not only has to obtain the best men and equipment available, but must also constantly find methods and procedures for improving his management practices.

As somewhat of a contrast, Figure 5 shows a curve for cost trends that pertain to highway maintenance and operations. This curve is based on the assumption that the same quantities of labor, materials and equipment, plus overhead, used in 1935 to maintain 10,000 miles of composite highway types, have been, and still are required. The only variables, therefore, are the wage and equipment rental rates and the purchase prices for materials.

The curve on Figure 5 corresponds approximately to the upper curve of Figure 1. In Figure 5 there is no second curve based on costs of actual work performed. This is due to the fact that there has not been developed for nationwide or universal acceptance, a reliable and uniform method of determining the in-place unit costs of the multifarious tasks performed by maintenance organizations. For this, and many other reasons, it has not been feasible to develop a lower curve for Figure 5, and for the present what form such a curve would have is unknown. It is probable, however, that it would follow much more closely the curve based on labor, equipment, and materials costs than does its construction index counterpart.

### HIGHWAY MAINTENANCE AND OPERATION COST INDEX 1957-1959 = 100

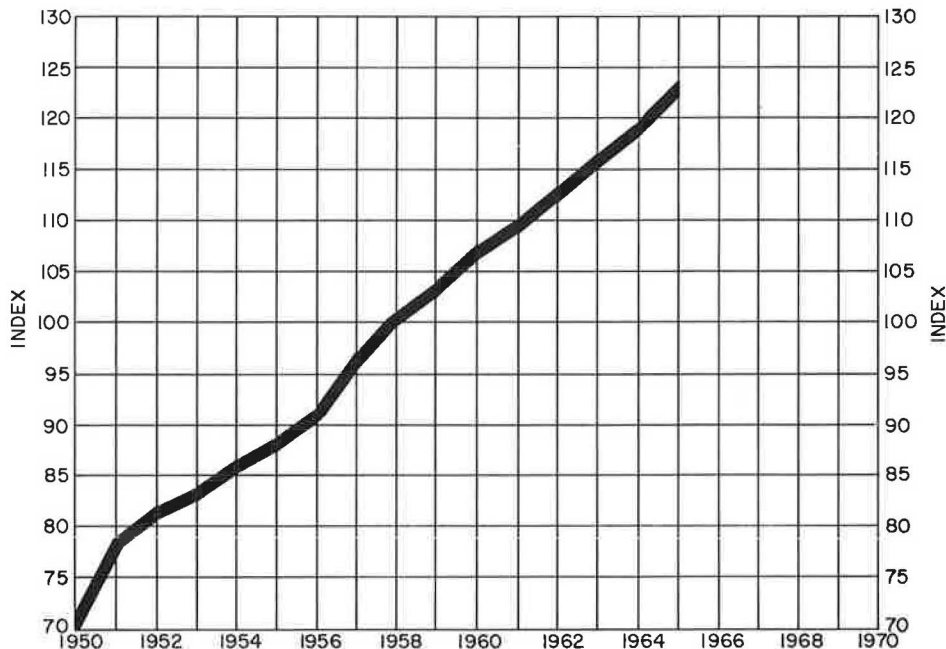


Figure 5.

In highway maintenance, we have not had to the same extent the incentive of bidding competition to necessitate making every reasonable effort to introduce more economy and efficiency and improved methods and equipment into the maintenance operations. It is not suggested that the solution to the maintenance cost problem is to perform the work on the basis of competitively-awarded contracts, although perhaps more use could be made of this method with some cost savings. Instead, the objective is to point out the need for delving more deeply into the factors responsible for maintenance costs, the need for more thoroughly and critically examining maintenance organizations, equipment, methods and operating practices, and the need for finding and putting into use better and more economical ways of doing the job. In other words, it appears likely that much of the solution to the problem of reducing unit costs of highway maintenance may be found in improved maintenance management, and that is a subject for discussion in this session of the Highway Research Board Annual Meeting.