HIGHWAY BRIDGES—A MAJOR PROBLEM

J. R. Burkey,
Chief Engineer of Bridges,
Ohio State Highway Department, Columbus, Ohio

Assuming that highway bridges *are* a major problem, our first obligation is to have all the information possible. For fifteen years our department operated co-operatively with counties in a relationship which made the state responsible for maintenance of only those structures or portions of highway which the state had built. All other structures and portions of highway had remained the obligation of the respective counties. In 1928 the department became responsible for all highways and appurtenances thereto on the state highway system outside municipalities. We had no detailed information as to thousands of structures which were suddenly inherited by legislative act. We set about making a detailed inventory of all structures on the state highway system and compiling this information in visible record form so that not only the details of each structure were available but that there was immediately available at a glance the service which each structure could render or fail to render as a part of a highway transport system. This record is developed in duplicate, one copy being kept in our central office, covering the entire state, the other, for the structures on the highways under the jurisdiction of the respective divisions, being kept in the division offices throughout the state.

On the 12,200 miles of state highways there are 7,405 bridges with a span of more than 10 feet, and approximately 63,000 culverts. The cost of the survey, the equipment, and the clerical work involved in its installation was approximately $40,000. Now that the record is available we wonder how we ever got along without it. Its principal uses are for (1) intelligent programming of structures for reconstruction or reconditioning; (2) the basis of factual discussions with delegations visiting the department in behalf of certain projects; (3) knowledge at a glance of structural restrictions on transport on any given highway route; (4) the granting or denial of permits for the movement of unusually heavy loads over the highways; (5) a framework on which to hang the inspection and maintenance of structures; (6) intangible benefits by way of improved morale with the knowledge that we are no longer working blindly with problems that are so serious in their nature.

INADEQUATE BRIDGES

Aside from the fruitful results of the large winter-relief bridge-program which was carried on early in the depression, our progress in getting rid of some 2,000 structures which are

too weak and too narrow has been discouragingly slow. Our Director, Mr. Jaster, has been much interested in ridding the highways of these hazards, but shortage of funds has hampered our progress. At the present time one cent of our gasoline tax in Ohio is being used for purposes entirely foreign to highway work. Until such time as all gasoline taxes, which are in effect a direct measure of road use, are used exclusively for highway purposes, our progress will be disappointing.

A special duty as regards structures is imposed upon those who are responsible for allocation of highway funds. In our form of government, public officials must give heed to public clamor. The traveling public is immediately conscious of a rough or narrow pavement or of a dangerous alignment on highways, but the weak or hazardous bridge of horse and buggy days may be used daily under conditions that threaten many lives, and so long as the fatal mishap is postponed the seriousness of the situation is apparently brushed aside by the general public.

Another enterprise related to structures which may be of interest to this audience is the study which we have been making in conjunction with the Engineering Experiment Station at Ohio State University in "Predetermination of Piling Requirements for Bridge Foundations". *Bulletin No. 90,* obtainable from the Engineering Experiment Station at the university, describes the manner in which these studies are made.

This research has consisted primarily of developing equipment for the driving of rods by the application of a known force and of measuring the resultant penetration. As a result of many comparisons, this penetration is calibrated in relationship to the penetration of piling driven at the same site. As may be expected, it is found that this relationship varies widely with extreme variations in soil characteristics. Each year we are making better progress in interpreting this relationship; and, while the results may fall far short of perfection, our advance estimates of piling lengths required, in general, are in much closer conformance to final construction than was possible before this study was begun.

The troubles that arose from the distortions involved in the welding were disheartening. Ultimately resorting to heroic methods, we believe that the structure was put in satisfactory condition and that lessons were learned which should enable us to avoid a repetition of this experience. This subject matter was covered in an article in the *Engineering News-Record* of October 3, 1935, and it is believed that a short description should interest both designers and field engineers.

The great majority of bridges on our rural highways must be built with strict attention to economy. Occasionally, however, in populous regions or in settings where nature smiles with beauty, the public will still support expenditure of funds for the aesthetic development of our structures. As an ex-

ample, the recently constructed Lorain Road Viaduct designed by the Bureau of Bridges in the Department of Highways, State of Ohio, for erection over the Rocky River Valley at the west edge of Cleveland, completed in 1935, was adjudged by the American Institute of Steel Construction as the most beautiful steel structure in its class erected in the United States during that year.

In closing I wish to congratulate Purdue University, the State Highway Department of Indiana, and those who are in attendance at this gathering on the co-operative development of this wonderful Road School, which has become so widely known among highway engineers of the midwest.

PROGRESS IN RAILWAY GRADE SEPARATION AND PROTECTION WORK IN INDIANA

J. V. Smythe, Engineer of Bridges,
State Highway Commission of Indiana,
Indianapolis

Grade separation and protection work in Indiana falls more or less naturally into three phases, both chronologically and in regard to the method of financing.

The first phase covers the work done in this state before the formation of a State Highway Department in 1919. This work was financed by the railroads and counties (or other political subdivision) either jointly, or wholly by one or the other.

The second phase covers the work done by the state under the 1916 Federal Aid Act, the 1919 State Law creating a Highway Department, and their subsequent amendments. In time, this period extends from 1919 to 1933.

The third phase extends from 1933 to the present time and represents that period during which large federal appropriations were made for carrying out this type of work. These appropriations differed from the normal Federal Aid appropriations in that they required no matching with state funds.

The first and second phases will be discussed in only enough detail to sketch in the background necessary for a proper conception of the development and progress that have been made in Indiana on railway grade separation and protection work. The third phase, because of its complexity and importance, will be more fully covered.

FIRST PHASE (PRIOR TO 1919)

The overhead structures built during the first phase are, in general, entirely inadequate when judged by modern requirements as to the design of the structure itself and as to the width of roadway, alignment, and grades on both the struc-