Summary of the Work of the Bridge Department

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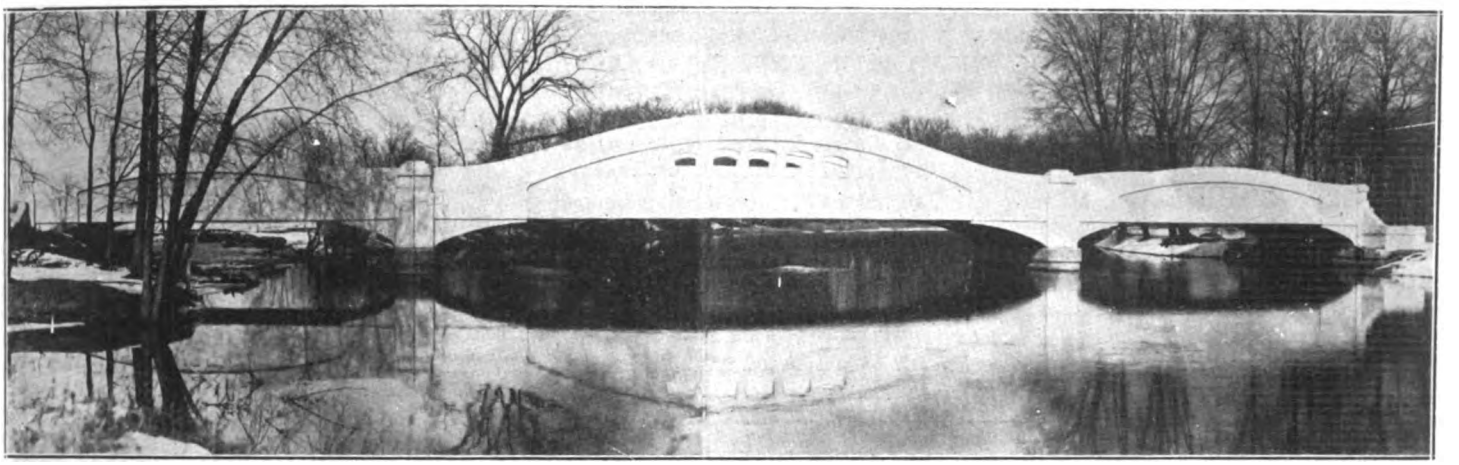
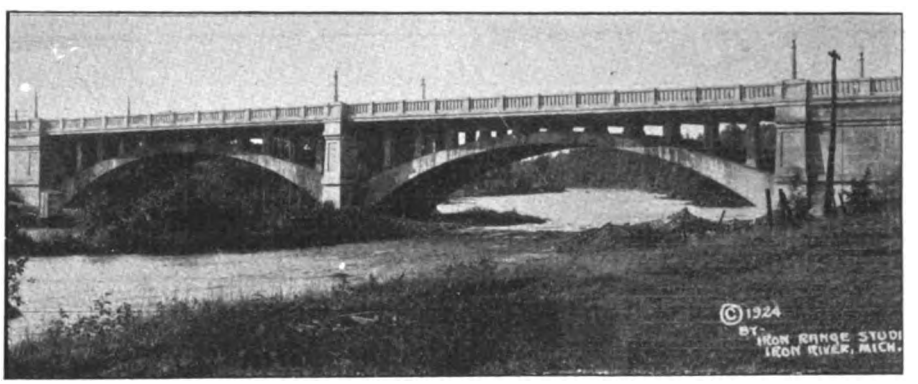


Reinforced Concrete Girder, 60, 90, 60-foot Spans; 22-foot Roadway, Crossing Kalamazoo River, Galesburg, Kalamazoo County

The history of bridge construction and maintenance, undertaken by the State Highway Department prior to the year 1913 when the so-called Trunk Line Act No. 334 first went into effect, is rather hazy although not mythical. Such activities were confined to engineering advice furnished freely by the commissioner and his deputy to the township and county officials of the state. Standard or special plans, beyond the ideas which could be conveyed by preliminary drawings were out of the question and financial assistance or direct supervision was practically of little consequence. There have been two powerful impulses in the bridge activities of the state which have been provided by the Legislature. One the Trunk Line Act of 1913 requiring the commissioner to construct and maintain, entirely at state expense, all trunk line bridges of over thirty feet clear span demanding his attention, and the other, the so-called State Reward Act of 1919, providing that the commissioner may pay one-half of the cost and supervise the work on non-trunk line bridges on State Reward roads within the financial limitations to be set by each succeeding legislature for the corresponding biennial period. The Covert act and the Federal Aid act have each had their influence on bridge activities, but insofar as increasing the volume or accelerating the rate of such activities, these acts have been of minor consequences. However, the Federal Aid Act of 1919 has been a wonderful stimulus to the grade separation activities of the department, particularly in recent years.



Crystal Falls Bridge, Iron County, Crossing Paint River; Two 120-Foot Open Spandrel Arches; 24-Foot Clear Roadway

The appointment of a bridge engineer, made necessary by the Trunk Line Act of 1913, was a timely step in freeing our highways of the activities of the so-called "Tin Bridge" construction, so prevalent at that time. The demand for bridges was necessarily keen considering the natural neglect preceding 1913 and the sudden shifting of responsibility and resources. C. V. Dewart as bridge engineer, wisely chose a standard type of concrete girder and substructure design which could be put out with the minimum of field information and drafting room requirements, structures so plain and simple as to be readily constructed by ordinarily skilled workmen any place in the state, drawings illustrated by perspective sketches so plain as to be understood by any ordinary inspector and structures made of materials easily secured locally in nearly any part of the state and requiring little or no preliminary handling before being placed in the structure. At this time, these concrete structures were wisely limited to fifty-foot spans and the sections made plain and massive so as to provide for deficiencies which might arise from faulty construction. These plans were almost a standard at the time with various other states for highway work.

Steel Bridge on M-13 Near Manton, Wexford County, Crossing Manistee River; 18-foot Roadway, 5-foot Walk

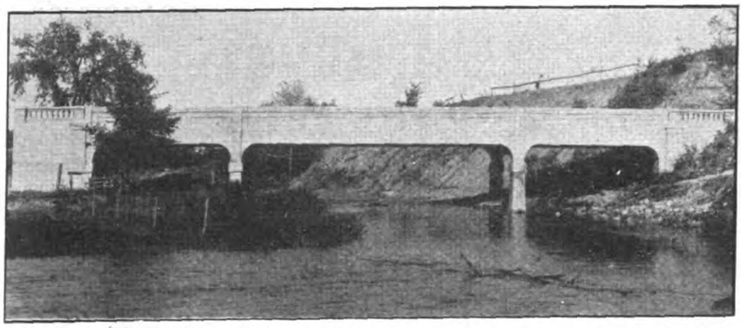
Mr. Dewart early encountered a few large jobs for which it was not desirable to place piers in the stream and for such cases worked up a series of Pony Truss standards in spans up to one hundred and twenty feet. These structures were in conformity with the practice of surrounding states and were a great stride forward in comparison with previous steel highway bridge design. In more recent

years as the supervision and inspection facilities of the department have increased, the tendency has been to give a little more attention to details and appearance of the structure as well as to the economy which necessarily results from making a special study of each job on its merits. The concrete spans have been increased with economy to ninety feet in girder types and the low truss types have been designed more conservatively and with greater attention to rigidity, durability and economical disposition of metal.

The development of traffic and highway design has several years since caused the earlier bridge plans to be abandoned; the widest roadway provided in these plans (nineteen feet) being less than provided at this date even for State Reward structures. The state's program for Bridge Construction has gradually developed a type of bridge contractors which has encouraged the use of more economical even though more complicated designs.

Much has been said in the past criticising the use of concrete bridges but after all this is rather a foolish matter to argue, since the superstructure is the only portion of the bridge kept in mind in such arguments and in both cases they are supported by substructures of concrete, universally acknowledged to be the only satisfactory material for such purposes, and the superstructures are almost entirely free of those water, frost, seepage and ice actions to which the substructures are subjected. It seems to be a trivial argument indeed when we bear in mind that from two-thirds to three-fourths of our entire cost is in the substructure. Our oldest bridges, now a little over ten years, were built of unscreened gravel from local pits, with little attention to stripping of top soil—never washed—little attention to grading—of weaker cement proportion under little supervision, meagre specifications and using cement more coarsely ground than at present. Yet we find that our old structures as a rule are apparently as good as ever except in a few instances where gross ignorance, incompetency and carelessness are now revealed. In no case, however, have these failures been of vital consequences nor have any repairs to such failures been required in all this time. No one ever heard of failure of a concrete girder in this state's work and all local defects in these structures as a rule can be repaired at but trifling expense.

In reviewing our accomplishments we note that our first bridge was the Peshekee bridge on Trunk Line 15 near Michigamme in Marquette county. This is a 6-span concrete girder bridge of 41-foot spans with 15-foot roadway built in 1913. Our first arch bridge was a 50-foot span with 36-foot roadway built in 1914 on Trunk Line 13 on Plaster Creek in Kent county just outside of Grand Rapids. Our first I-beam bridge was the two 24-foot span with 22-foot roadway on Trunk Line 17 on Chovin Creek in Wayne county on Michigan avenue just outside of Detroit. Our first 50-foot concrete girder was built in 1915 on Trunk Line 12 over Paint River in Iron county near Elmwood and had a 17-foot roadway. Our first 75-foot concrete girder was built in 1922 on Federal Aid 3 over Sturgeon River in Baraga county about 12 miles south of L'Anse. Our first 90-foot concrete girder was built in 1922 over the Raisin River on Trunk Line 50 in the village of Tecumseh, Lenawee county. Our first 100-foot low truss steel span was built in 1917 on Trunk Line 16 over Grand River in Kent county near Ada and had a 17-foot roadway. Our first 120-foot low truss was built in 1921 on the Bad River near Brant in Saginaw county on State Reward road. Our longest single span is a 265-foot through truss over Dead River on Trunk Line 35 near Marquette, with 20-foot roadway built in 1922. Our longest span arch bridge is the two 120-foot span structure over Paint River in Crystal Falls just completed in 1924 and has a 24-foot roadway and two 5-foot walks and is of the 2-rib type with open spandrels. Our highest job is the Eagle River bridge near Eagle River on Trunk Line 15 in Keweenaw county with a height of bridge floor above water surface of about 50 feet. Our most expensive structure is no doubt the swing bridge over Grand River at Grand Haven on Trunk Line 11, estimated to cost when complete about $250,000. This bridge has 24-foot roadway, two 5-foot walks and is electrically operated and is now nearing completion. Our first swing bridge was an advice structure handled for Ottawa county crossing Grand River near Eastmanville. It was built in 1916, has a 15-foot roadway, no walks and is hand operated. The first and only Bascule bridge built by the state is on Trunk Line 16 over Spring Lake outlet in Ottawa county and has a 20-foot roadway, two 5-foot walks and cost approximately $200,000. The first concrete cantilever bridge built by the state is now in progress of construction over the Rai-



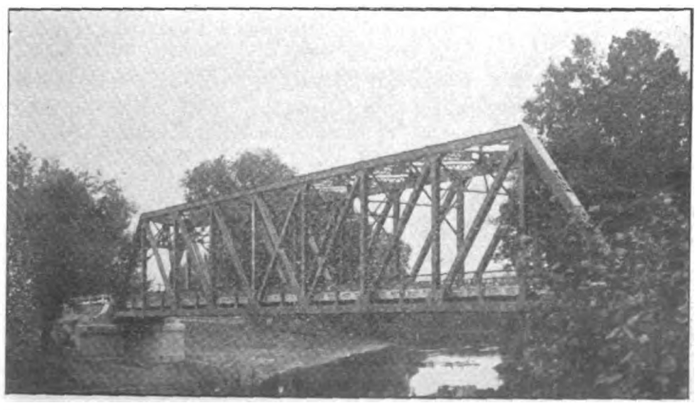
Bridge at Avoca, St. Clair County; Concrete Viaduct, 30, 60, 30 Foot Spans; 20-Foot Clear Roadway

90-Foot Reinforced Concrete Girder, Whitehall, Muskegon County, Crossing White River

sin River at Monroe on Federal Aid 73 on the Dixie Highway and has a 42-foot roadway, no walks and a total of seven spans aggregating about 450 feet in length. Photos representing typical designs are represented by the Manton, Fosters, Crystal Falls, Avoca, Whitehall, and Galesburg jobs. An example of grade separation is represented by the Leoni job.

The extent of the work done by the department as well as its growth is well represented by the number of contracts completed in two-year periods as follows: To July 1st, 1914—3; July 1st, 1916—28; July 1st, 1918—45; July 1st, 1920—89. The number of contracts awarded in progressive 6-month periods from July 1, 1920, are as follows: 1920, second half—21; 1921, first half—26, second half—34; 1922, first half—33, second half—44; 1923, first half—32, second half—53; 1924, first half—27; second half—40, to date of Nov. 23, 1924.

The program shows approximately 150 bridges and about 20 grade separations in line for 1925 construction with almost a certainty that some of these projects will go over 1926 with such increase in program as may accrue within the coming year.



Fosters Bridge, Steel Structure, Crossing Flint River, Saginaw County, 175-foot high Truss; 18-foot Clear Roadway

Leoni Grade Separation, Jackson County Traffic Under M. C. R. R.

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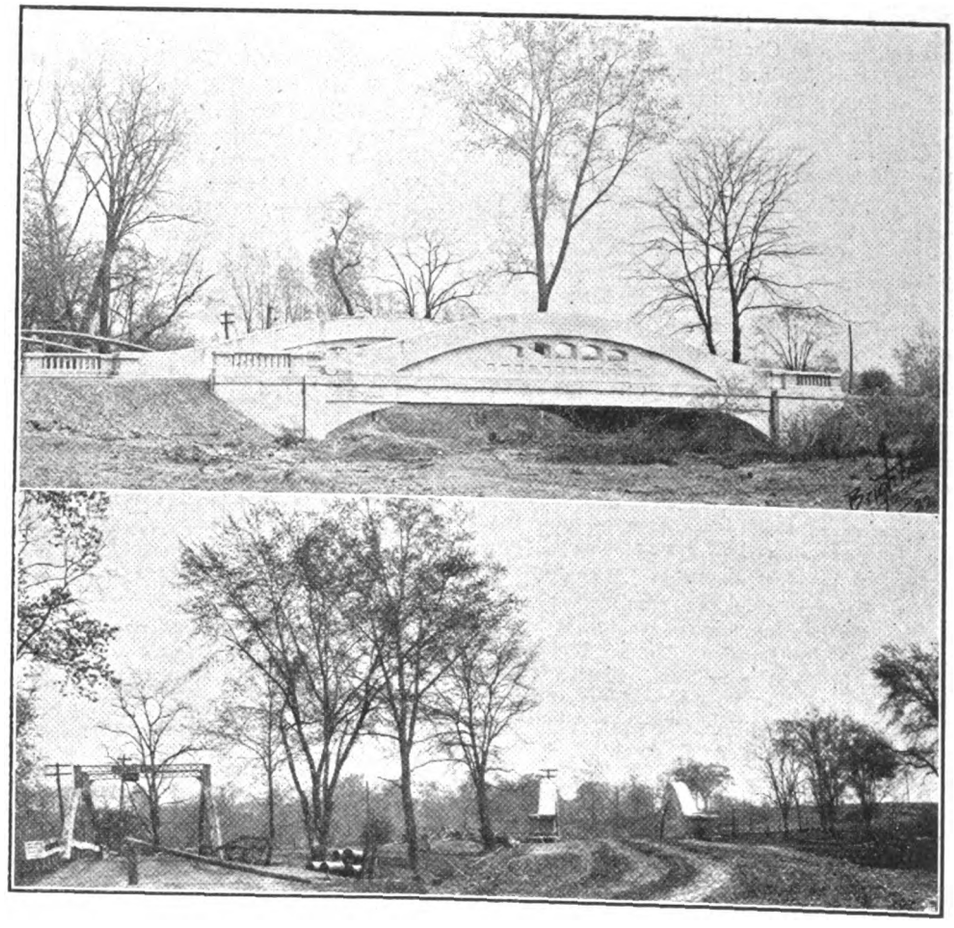
Curved Chord Girder Bridge, Tecumseh, First of Type in State

The State Highway Department has, during the past year, been building several 90 foot concrete girder span bridges of the Curved Chord type. The pioneer job of this class was a bridge built at Tecumseh, in Lenawee county, and recently completed. This bridge is on Federal Aid Road Project No. 44. The structure spans the Raisin river in the southeastern part of the city.

This particular bridge consists of a 90 foot span reinforced concrete girder with 13 foot approach wing on U abutments at each end, and provides a clear roadway width of 20 feet inside of curbs, with provision for future addition of two five foot cantilevered sidewalks. The bridge is on an angle of 50° with the thread of the stream. Reinforced concrete abutments and wings are seven feet high from bottom of footings to bridge seats, these are founded on four timber caissons 10x24x6 feet deep, and filled with 1:7½ —1600 lbs. concrete. The distance from bottom of footings, or top of caissons, to bed of stream is 2½ feet, while height from bottom of caissons to crown of roadway is 21 feet.

One of the features of this bridge is the provision for future addition of sidewalks. This may be accomplished by means of U shaped precast blocks, reinforcing steel being so placed that by the removal of the blocks at the time of building the sidewalks, the horizontal bars in the floor notch may be slid to one side to provide for fastening securely the bars in the cantilevered walk slab. The walk slab and connections are designed to carry a reinforced concrete railing.

One of the views shown herewith furnishes a striking comparison of the new structure with the original light bowstring truss, the new bridge being on a short relocation of the road at this point. Many people have remarked on the fact that few would guess in passing over this structure that the span was 90 feet. The girders extend to a height of 11 feet above the crown of roadway. These girders are more economical than steel structures of equal capacity and in addition possess all the advantages of concrete bridges over steel—viz only one contractor, materials readily available, short construction period, great capacity for increased live loading and impact, practically no maintenance, superior aesthetic quantities, cheaper than an arch independent of soft foundations where an arch is unsuitable, maximum waterway, economical abutment design, susceptible to standardization, and easily adapted to skew crossings.



This particular bridge is unusual in the design of the footings. Each abutment rests on a pair of "pigeon-toed" rectangular caissons, thus giving increased stability for both abutment body and wings.

The structure is designed, without extras involved in the course of construction, contains a total of 639.70 cubic yards of concrete 100,-484 lbs. of reinforcing steel, 3392 lin. feet of lumber for caissons and 1144 drift bolts. Foundations were of hard material and no piling was necessary. The contract was awarded on April 26, 1921, to the Benjamin Douglas Construction Company, of Ann Arbor. The completion date was set at September 15, 1921. However, due to difficulties encountered time was extended to April 1, 1922. The contract price for the work, exclusive of extra or diminished claims was $19,995. The Federal government paying 50% of costs, and Lenawee county and state each paying 25%.

MARSHALL-BATTLE CREEK ROAD TO BE 20 FOOT PAVEMENT.

State Highway Commissioner Rogers has decided to build the Marshall-Battle Creek road 20 feet wide instead of 18 feet. Frederick Brothers, the contractors will be paid in proportion to their bid for two feet extra width. The increased width will cost the county about $8,000 more, or one-fourth of the cost. The work of laying concrete on the east end of the road has begun, the mixer having a capacity of 400 feet per day. Large new mixer will be used on west end.