1925

Report on General Bridge Survey Made by State Highway Commission as Ordered by the Eighty-First Legislature of the State of Maine, 1925

Maine State Highway Commission

Report

ON

General Bridge Survey

MADE BY

State Highway Commission

AS ORDERED BY THE

Eighty-First Legislature

OF THE

State of Maine

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To The President of the Senate and The Speaker of the House of Representatives:

The accompanying report embodying the results of an investigation and survey of the bridges on the public highways of the State is submitted in conformity with an Act of the Eighty-first Legislature, Chapter 202, Public Laws 1923.

Respectfully,

FRANK A. PEABODY, Chairman,
WILLIAM J. LANIGAN,
CHARLES H. INNES,
Maine State Highway Commission.

Augusta, Maine, February 5, 1925.

Report on General Bridge Survey Made by State Highway Commission

This report embodying the results obtained in an investigation and general survey of the bridges located upon the public highways of the State of Maine is made in pursuance of an Act of the Eighty-first Legislature (1923), as follows:

CHAPTER 202

Be it enacted by the People of the State of Maine, as follows:

"The State Highway Commission is hereby authorized and directed to make a complete investigation and survey of all bridges on public highways in the state, securing such information as it may deem necessary, for the purpose of establishing a future policy for bridge maintenance, construction and reconstruction.

This work is to be completed before December first, nineteen hundred and twenty-four, and all information obtained shall be tabulated, printed and available for the use of the eighty-second legislature.

The Commission is authorized to employ such additional aid as it may deem necessary to effectively carry out the work prescribed by this act, and all salaries and expenses shall be paid from the fund provided for maintenance and administration. The total cost of the work shall not exceed twelve thousand dollars."

Approved April 5, 1923.

The above Act became effective July 6, 1923 and the work of accumulating information and data was begun without delay. It was recognized that the appropriation made available by the Act was not adequate to secure all the information for each bridge that might be desired and accordingly due consideration was given to the securing of such items of information as appeared to be (1) pertinent to the main object as expressed in the Act and (2) of service value to both the bridge and the highway divisions of the State Highway Commission's activities. In connection with the latter it was considered especially important that the survey records contain a considerable amount of practical information not especially relevant to this report but possessing instead inherent value as records containing information of possible use in the future. Naturally enough, the actual cost involved in securing this supplementary information was comparatively small.

PREVIOUS LEGISLATIVE ACTION

In connection with the present investigation it is of interest to note that the Seventy-third (1907) and the Seventy-fifth (1911) Legislatures each passed "Orders of Legislature" authorizing and directing the Commissioner of Highways "to make an investigation to ascertain the length, physical character and condition, original cost and annual cost of maintenance together with such other information as he may deem pertinent or necessary concerning each and every bridge within the State." These orders further provided that the result of the investigations be published for the use of the next legislature and the results of the 1909 investigation were so published. The results of the 1911 investigation were never published but the original information secured is on file among the records of the State Highway Commission. To a limited extent this information has been referred to in the tabulation of the data contained in this report.

The information contained in the above described investigations was almost entirely obtained through the cooperation of the municipal officers of the cities, towns and plantations. Naturally enough, there are many discrepancies in the records due to intertown bridges, lack of uniformity in taking measurements, etc.

SCOPE OF INVESTIGATION

Cursory consideration of the Act of the Eighty-first Legislature clearly indicated the necessity for securing information rather more complete and accurate than was probably contemplated by the "Orders of Legislature" mentioned above. In order to procure this information it was decided to place survey parties equipped with automobiles upon the work, each party to consist of two men. The records of the previous investigations indicated the number of highway bridges having a clear span length of six feet or greater to be over six thousand. It was, therefore, clearly evident that each survey party must average for each working day the securing of data relating to fifteen bridges or more with the further condition that these bridges must be those having a clear span length of six feet or over. Assuming a nine hour day the average time devoted to travel between bridges and the examination of each structure would be only thirty-six minutes.

It is a matter of record that the survey parties practically fulfilled the "fifteen bridges per day" requirement but in order to accomplish this amount of work they quite commonly exceeded the nine hours per day assumed in the preliminary computations.

In order to facilitate the field operations, printed forms were provided having blank spaces in which the dimensions and other data secured for each structure were recorded. A bridge record fully completed is shown in Fig. 1. These printed forms contemplated the securing of available information and data relating to the following:

1. Character and extent of the watershed.
2. Information relating to stream, stream bed, and flood and drift conditions.
3. Contour of the stream bed and its banks in relation to the contour, elevation, etc., of the highway on the bridge and its approaches, together with the general alignment of the highway adjacent to the structure.
4. Composition, physical condition, general dimensions, etc., of bridge substructure.
5. Type, physical condition, clear span length, width, underclearance, etc., of bridge superstructure.
6. General information and notations relating to possible improvements in stream alignment, and the alignment and grade of the highway to be involved in case of reconstruction.

Each of the above general divisions of the investigation were subdivided to facilitate the securing of information and data at the bridge sites. This is shown in the accompanying reproduction of a complete bridge record. See Fig. 1.

The proper identification of the survey records in their relation to the bridges represented thereby was given due consideration and each record provides this information three ways, viz:

1. By showing the local name or other identification of the highway on which a given bridge is located.
2. By showing the local name of the stream on which the bridge is located.
3. By giving to each bridge its local name.

It will readily be recognized that in many instances streams bear no local names, the local residents, if there be any, knowing them by such designations as "The Brook," "The Run," etc.;

likewise, bridges frequently bear no local names, they being designated as "The bridge in the village," "The bridge near the woods," etc. The survey parties were, therefore, instructed to ascertain so far as possible the local names of streams and

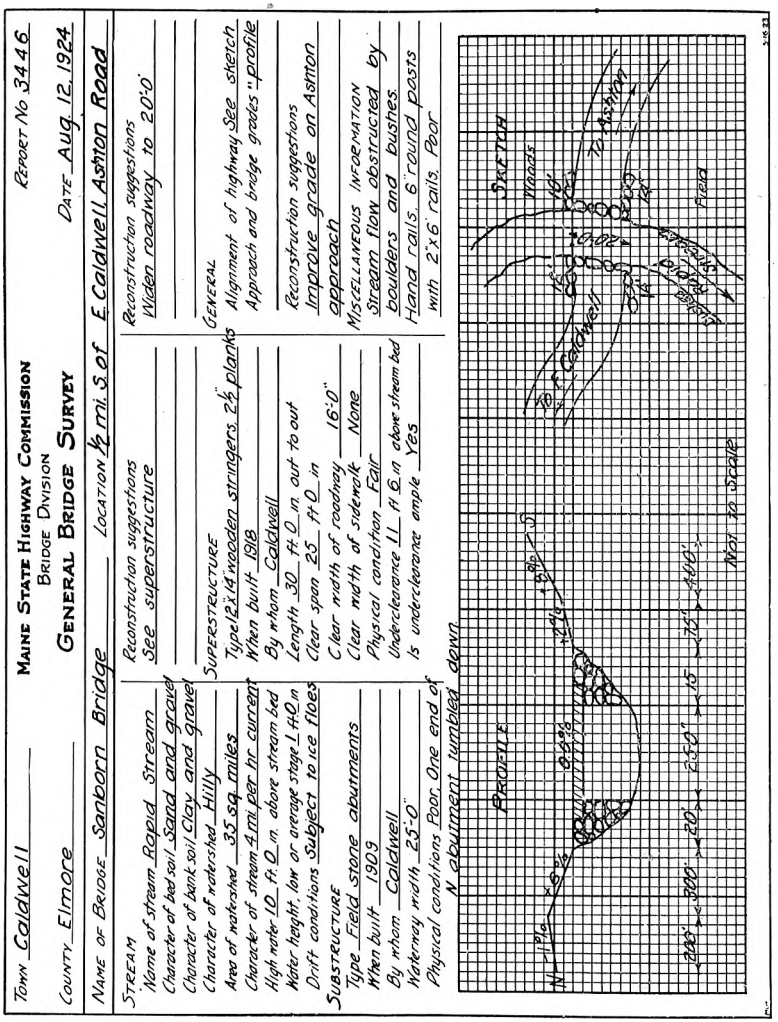


Fig. 1. A typical bridge record. Sketches show general alignment of highway and of stream, also the relation of bridge to the grades on the adjacent highway.

bridges and in the absence of these to apply the names of nearby residents and of abutting land owners or other appropriate names such as "Willow" brook, "Clay Hill" bridge, etc.

Incidental to the field work each survey party was supplied

with a camera and photographs were taken of approximately 4100 of the total number of bridges surveyed. In this connection it must be borne in mind that conditions were at times involved which rendered it impossible to secure photographs of all structures. Dark, cloudy days, lack of adequate light in early forenoon and late afternoon hours, the existence of bushes on stream banks, etc., rendered it impossible to secure photographs possessing value for record purposes.

It is important to note that the information secured in relation to water ways of bridges and the areas of watersheds when systematically studied in conjunction with the U. S. Geological Survey maps and other maps and charts on file in the Bridge Division of the State Highway Commission will supply valuable information in relation to the sizes of waterways required for bridges over streams located in level, hilly and mountainous areas of the State. This study of actual waterways which have provided satisfactory service for a period of years will indicate the waterway sizes, required for given conditions and will render it possible to construct bridges which fulfill stream requirements rather than those which are inadequate for that purpose or on the other hand involve excessive expenditure by being larger than service conditions demand. Unquestionably very many structures now existing provide larger waterway sizes than are required by the streams they span. However, the study of waterways above suggested will indicate these cases.

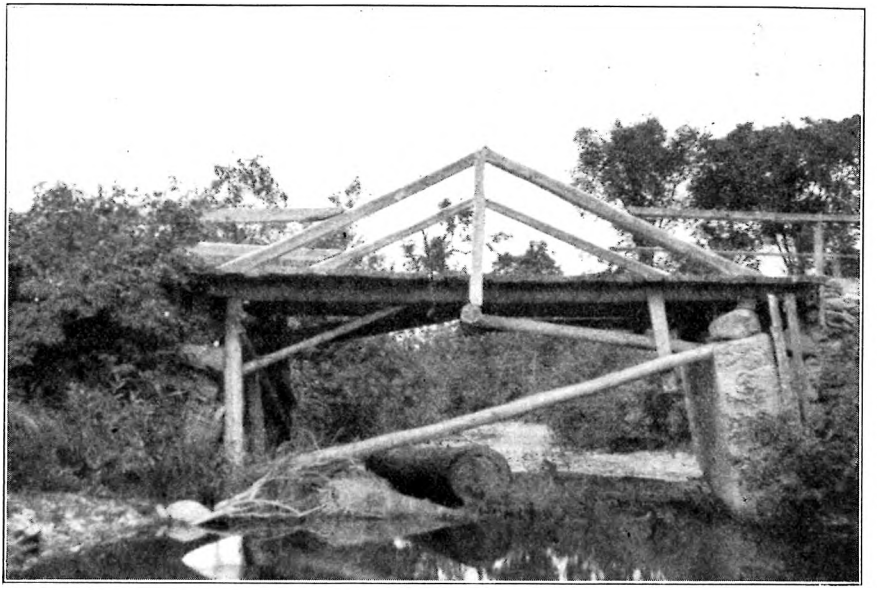
Another detail of importance involved in the field work was the securing of information relating to discontinued highways. Many highways constructed within comparatively recent years which were not shown upon any existing highway maps were also recorded.

GENERAL

The object or purpose of the survey is defined in the Act to secure information for use in "establishing a future policy for bridge maintenance construction and reconstruction." With this end in view the Commission has endeavored to coordinate and analyze the survey data and present in tabulated form the elements essential to the ultimate end or intent of the investigation.

The survey shows that the number of bridges having a clear

span length of six feet or more located wholly or in part within the State is 6763. Of this number 18 bridges are interstate structures on the boundary between Maine and New Hampshire and 7 bridges are international structures on the boundary between Maine and New Brunswick.



Bridge abutments in unsatisfactory condition for service. Deformed by frost action and stream scour. Right abutment "jacketed" with concrete intended to prevent the collapse of its original breast wall.

TOWN TABULATIONS

In Table No. 1 there are listed the bridges located in each city, town and plantation together with a general description of each structure. There is also included in the table, for purposes of ready reference, the following items of information relating to valuation, taxation, etc.:

1. Valuation of each city, town and plantation as fixed by State Board of Assessors, 1925.
2. Total tax rate, 1924.
3. Appropriation for roads and bridges, 1924.
4. Tax rate for roads and bridges, 1924.

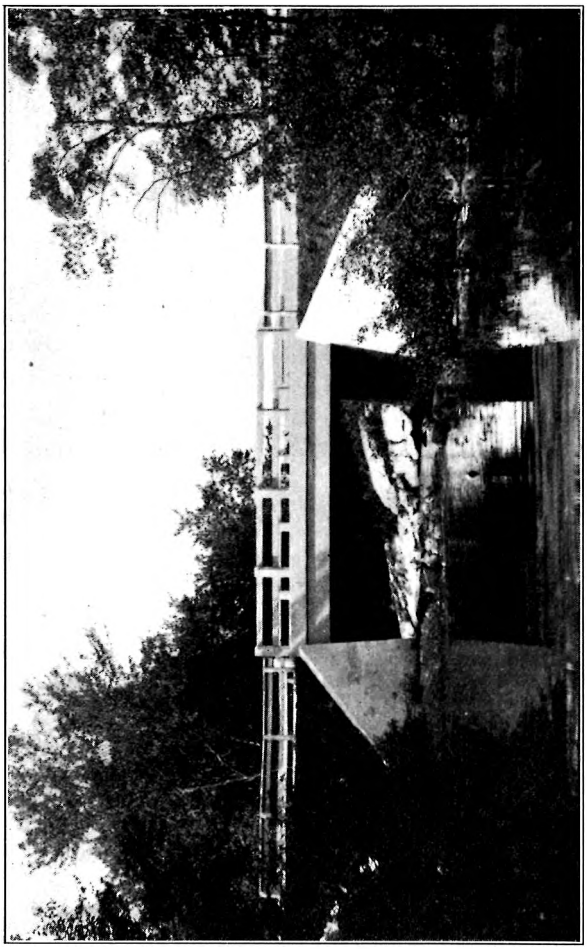
In order to secure a general check on the work of the field parties these town tabulations have been submitted to the municipal officers concerned with the request that they examine the listed data and report any errors or omissions found therein.

The Commission desires to here record its appreciation of the cooperation accorded to it in this way. Out of a total of five hundred and seventy-two tabulations sent out, five hundred and fifty-one have been returned with corrections where errors or omissions were discovered or approved when found to be O. K. It is important to mention in this connection that a small number of errors reported have not been investigated due mainly to the impracticability of making trips to widely separated bridge locations during the late fall months. However, the bridge records involved constitute a very small proportion of the total number of surveys made.

In relation to the recorded physical condition of bridge substructures and superstructures, reference is made to the fact that the time allotted to the examination of each bridge structure permitted the making of rather limited visual examinations only. It is a well known fact that in wooden bridges timbers showing little exterior evidence of weakness may prove to be, through internal decay, altogether unreliable for the support of highway traffic. Likewise bridge abutments which have rendered service for many years, especially those composed of field boulders, have become deformed by the annually recurring action of frost to an extent that they become unstable and likely to collapse. It follows, therefore, that the recorded condition of bridge substructure and superstructure may in any individual case prove to be in error.

The character of the information which might be required by the Legislature for the purpose described in the Act was not readily determined. However, it was fully recognized that the two elements, time and cost, must certainly become basic factors in any study involving the information made available by the survey. Accordingly the bridges in each town tabulation with few exceptions have been classified or rated in relation to their probable future service life here termed their "reconstruction period" and opposite each structure has been placed a so-called "reconstruction estimate" indicating the cost which may be assumed to be involved in its future reconstruction. The "reconstruction estimates" for intertown bridges have been proportioned in relation to the valuations of the towns involved. The main exceptions to the foregoing conditions are found in cases wherein the existing bridges involve metal superstruc-

tures. To have determined whether or not these metal superstructures are satisfactory for existing traffic service would have involved in many cases the determination of the sections of truss and floor system members by calipering or the securing of the original shop detail plans from the bridge companies which fabricated and erected the metal work. Practically all



Great Brook Bridge—Stoneham. Bridge consists of mass concrete abutments with flared wing walls and reinforced concrete superstructure of T-beam type with railings of "precast bar" type.

"reconstruction estimates" for metal structures have been omitted although there can be no question that many of these structures possess inadequate strength to satisfactorily support present day motor vehicle traffic.

Reference to the tabulations will show that the ratings of probable service life or, so termed, "reconstruction periods" involve divisions varying by five years each; that is to say, assuming ordinary service repairs, a given bridge structure is recorded as probably satisfactory for five years or less of future service, or from five to ten years of future service, etc. Wherever a structure has been rated as probably satisfactory for twenty years or more of service it has been treated as a permanent structure and no "reconstruction period" has been assigned to it. Likewise, no "reconstruction estimate" has been prepared therefor. The reconstruction periods are designated in the tabulations by the notations: 5 yrs., 10 yrs., etc. The possibility of errors in the bridge records described above is here involved in rating the probable service life of the individual bridge structures.

As a part of the work of analyzing the data secured in the survey 5381 "reconstruction estimates" have been prepared which have involved a great deal of time and labor. However, in order to facilitate this work, diagrams were prepared for mass concrete abutments and piers of varying heights; for reinforced concrete superstructure slab and T-beam spans of varying lengths; for metal beam spans, etc., which considerably reduced the amount of labor involved and doubtless the results secured by the use of these diagrams are equally as consistent and reliable as the data of the survey assumed as the basis for the computations. Apart from this use of the diagrams the work involved considerations of special conditions for which cost diagrams were not and could not be prepared. Unquestionably the "reconstruction estimates" shown in the Town Tabulations partake somewhat of the nature of "premodeled conjectures" rather than of the nature of "raw guesses" unsupported by assumptions tending to aid and assist in adjudging values.

The major function or purpose of the "reconstruction estimates" pertains more properly to considerations involving groups of bridges, as for example those located within a town, a county or other, so-called, political division of the State rather than to specific structures, since within a group the irregularities and uncertainties involved in one estimate are offset, balanced and compensated by those involved in others of

the group. Group "reconstruction estimates" are made use of in the tabulated data shown in Tables Nos. 3, 4 and 5.

In order to define more clearly the limitations of the reliability of the "reconstruction estimates" for individual structures special attention is directed to the following germane conditions or factors involved therein.

1. The material, whether wood, steel, stone or concrete assumed to be used in making the individual estimates was that which from considerations of locality, importance of structure, service conditions involved, etc., appeared to be adaptable to the local and other service requisites of the structure. It is not to be anticipated or assumed that a more complete and careful consideration of the factors to be involved in the actual reconstruction of any given bridge might not disclose the importance of other considerations not taken account of in the present instance.

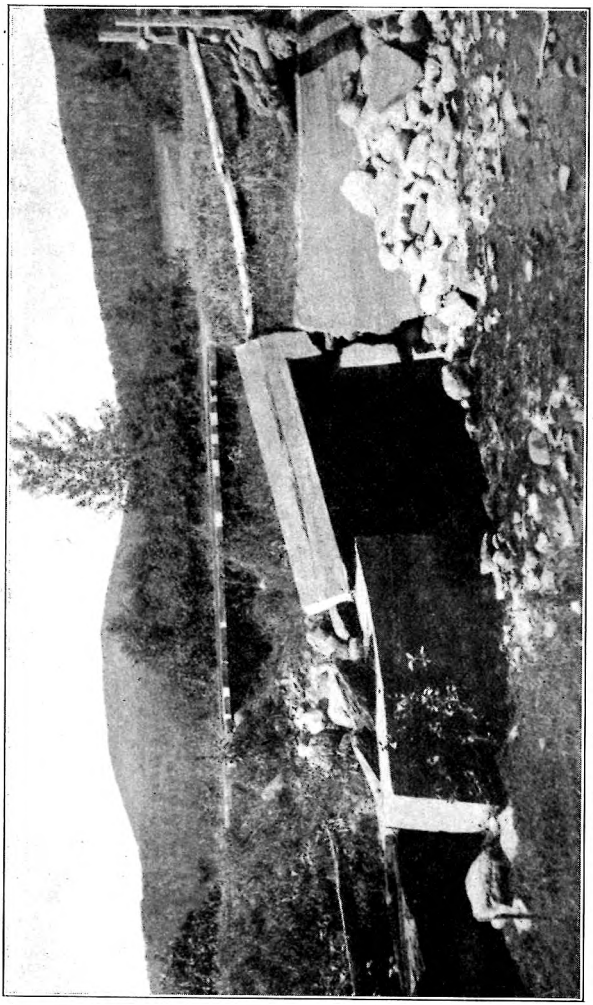
2. The bridge survey record for any given structure shows in a general way the character of the material composing the stream bed. Further investigations of the material underlying the stream might disclose that at the depth of foundation assumed in the "reconstruction estimate" unsatisfactory foundation material would be encountered and deeper excavations required; that the foundation must be reinforced by the driving of piles; or on the other hand it might disclose the existence of ledge or other entirely satisfactory foundation material at less depth below the stream bed than that assumed in the estimate.

3. The waterway widths, except in cases where the bridge survey records have suggested increases or decreases, have, in general, been assumed to be those of the existing structures. The building of bridges providing excessive waterway widths constitutes one of the most common economic wastes involved in the construction of present day structures having reinforced concrete and metal superstructures.

4. The roadway width involved in the reconstruction estimates has almost invariably been assumed at twenty feet. Doubtless the actual reconstruction of many bridges, especially those located upon highways involving excessive volumes of traffic and those located in villages and other compactly populated areas should involve greater widths. Likewise in many cases the estimates have not made provision for placing side-

walks upon structures where the safety of pedestrian traffic constitutes an important factor to be considered. In very many such instances the present structures have no sidewalks.

5. The fact that many existing bridge structures involve unsatisfactory conditions of highway alignment and grade upon



Bridge wrecked by stream scour. Abutments built on bed of stream instead of on foundation below range of frost and probable erosive action of stream at its high water stages.

and adjacent thereto has been given consideration in the estimates. However, the survey reports cannot possibly supply adequate information for the full consideration of this important detail and in consequence, even in these cases when con-

sidered, the quantities of excavation, fill, rip-rap, guardrail, etc., are likely to be greatly in error.

6. The costs of the materials to be involved in the reconstruction of bridges are dependent upon the location of sources of supply and the costs of transportation as well as upon other factors necessary to be considered in relation thereto: Likewise the cost of labor is dependent upon local conditions of subsistence and supply and demand. It has not been possible to give to these factors their due weight in preparing the estimates. Unquestionably these factors vary and vary widely in their relation to ultimate costs.

7. The stream conditions involved at bridge sites constitute a widely varying factor in the costs of construcing bridge substructures. The construction of bridges over tidal bays and inlets involves conditions entirely unknown in the construction of inland structures located in hilly and mountainous areas where swift, quickly changing streams are involved or in comparatively flat prairie-like areas where the streams are slow and sluggish.

The highways upon which the bridges are located have been divided into three classes, viz.:

1. State Highways (S. H.).
2. State Aid Highways (S. A. H.).
3. Other Highways (O. H.).

Doubtless there are errors involved in this portion of the tabulations since the bridge records designate certain highways by local names unidentifiable in some cases in relation to the three classes described above.

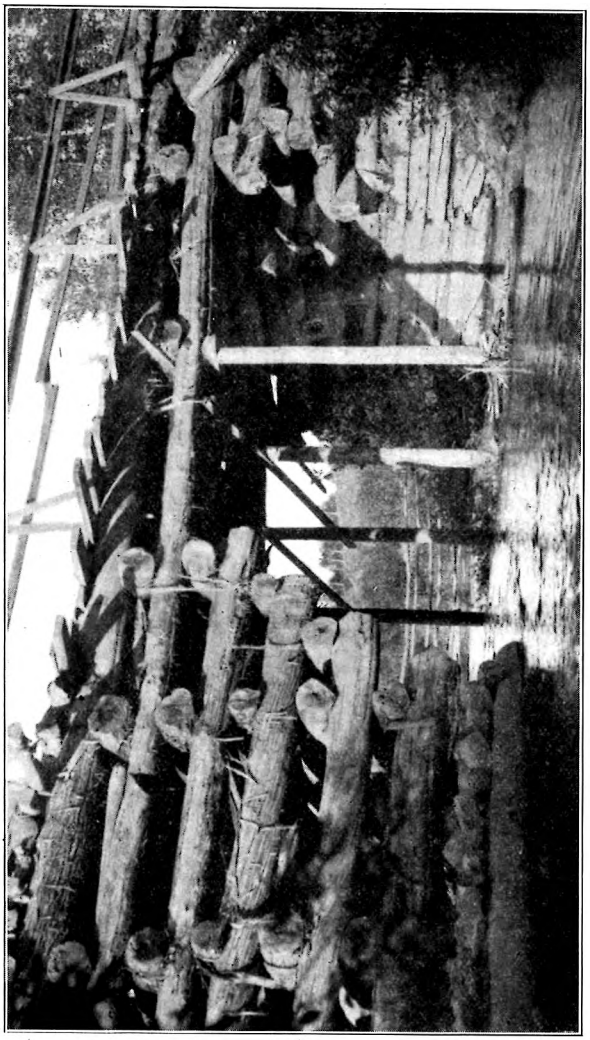
COUNTY TABULATIONS

Table No. 2 is a composite tabulation showing not only the number of bridges in each town of each county, but also the general distribution of these bridges in relation to their span lengths between abutments. Furthermore, this tabulation shows the corresponding grand totals for each county and also for the entire State.

In Table No. 3 there is given in summary form for each town the information contained in the town tabulations. The distribution of the bridges in relation to the materials entering into their composition, whether concrete, stone, steel or wood,

permits at a glance a general concept of their permanency and reliability.

In all cases where individual bridge superstructures are made up of combinations of metal and wood spans, combinations of



Bridge with substructure composed of field stone filled log cribs and superstructure having log stringers and plank floor. Settlement and deformations mainly due to "mushing down" of decayed logs.

metal and concrete spans, or other combinations of spans involving different construction materials, the lengths of each element of the structure have been distributed in Table No. 3 under its proper heading. It will be noted that the tabulation

shows only one bridge for each of such combinations, the credit being given the element which constitutes the major portion of the structure.

It will be noted that the summary distributions of the "reconstruction periods" or ratings of probable service life are totalled to provide not only an abstract idea of the amounts involved but also to permit for each city, town and plantation a direct comparison of this amount with its valuation as determined by the Board of State Assessors. The "reconstruction-valuation" relation herein above referred to is fundamental to the purpose of the Act since it visualizes on a percentage basis factors and details pertinent to bridge maintenance, construction and reconstruction.

For any given city, town or plantation the "reconstruction-valuation" relation describes in a measure its ability to reconstruct the bridges located therein or when viewed from a slightly different angle, this relation may quite properly be regarded as its so-called "Bridge Burden" more clearly defined and allocated than has hitherto been possible. However, it is a well known fact and worthy of note in passing, that in many instances the change in the weight and volume of the traffic upon the highways has imposed a "bridge burden" for maintenance alone, very greatly in excess of that which existed a quarter of a century ago. The importance of this radical change in the weight and volume of traffic in its relation to bridge structures, we venture to believe, has not yet been fully realized by municipal officers and others having direct contact with bridge construction and maintenance work.

Reference to that portion of Table No. 3 involving a single county will show that within that county the "bridge burdens" of the towns vary within rather wide limits. Likewise a comparison of the "reconstruction-valuation" relations for the sixteen counties within the State show a considerable variation. In this connection it is important to note that the "bridge burden" for cities, towns, etc., ranges from zero to one hundred thirty and four tenths per cent (0.0% to 130.4%).

The summary tabulation of Table No. 3 shows for each county the distribution of the bridges therein and in addition gives the summary of the town "reconstruction estimates" and the "reconstruction-valuation" relation or "bridge-burden" cor-

responding thereto. It will be noted that this range varies from one and nine-tenths to eighteen and four-tenths per cent (1.9% to 18.4%).

STATE TABULATIONS

Although Table No. 3 is nominally a county tabulation, it contains as a part of its summary tabulation for counties a grand summary for the entire state, which gives in addition to a distribution of the total number of bridges in relation to the materials entering into their composition as described in the first paragraph under "County Tabulations," the distributions of "reconstruction estimates" in relation to the "reconstruction periods." It is of interest to note, in this connection, that the "bridge burden" of the entire State is five and nine-tenths per cent (5.9%) of its total valuation.

In Table No. 4 there is given a summation by counties and also for the entire State of all bridges located on the State Highway System, State Aid Highway System and on the Third Class and other highways. This tabulation shows the distribution of the "reconstruction estimates" in relation to the "reconstruction periods" described in the third paragraph under "Town Tabulations."

In Table No. 5 a portion of the information contained in Tables Nos. 1 and 3 has been summarized to show the distribution of the total numbers of bridges located on the State Highway System, State Aid Highway System and on the Third Class and other highways in relation to the reconstruction periods of their probable future service life. The table shows summations of "reconstruction estimates" for each "reconstruction period" with grand totals for each class of highway and for all highways.

MAINTENANCE

In connection with the submission of each of the Town Tabulations to municipal officers for approval, an inquiry was made having for its object the securing of data relating to the cost of maintaining bridges. The information so secured was too meager and indefinite to permit systematic study. In general, towns do not keep the maintenance expenditures for bridges separate from those for highways.

CONCLUSION

The information and data secured in connection with the General Bridge Survey and presented herewith in tabulated form has developed certain facts which, in the opinion of the Commission, warrant special mention. Furthermore, certain rather vaguely recognized facts relating to present day motor propelled vehicles should, we believe, be given due consideration with relation to the maintenance, construction and reconstruction of bridge structures. However, the latter can be only briefly discussed here.

There exists a rather common notion or belief that towns having within or partially within their borders one or more long bridges or a considerable number of bridges having moderate span lengths are over-burdened with bridges and, to use a common expression, are "bridge poor." A rather cursory examination of Table No. 1 will show quite conclusively that both of these notions may or may not be true for individual cases but that in general they are misleading. It seems pertinent to state here that quite apart from the cities in the State, the town which possesses the greatest total bridge length bears a "bridge burden" of smaller size than at least 104 other towns. Likewise the town which possesses the greatest number of bridges could finance its total reconstruction in so-called permanent structures with the expenditure of a small percentage of its valuation, its "bridge burden" being smaller than that of 291 other towns. It is believed that, other conditions being equal, the "reconstruction-valuation" relation discussed in the body of this report and shown in detail in Table No. 1 constitutes a criterion by means of which the "bridge burden" borne by any city, town or plantation may in general be judged.

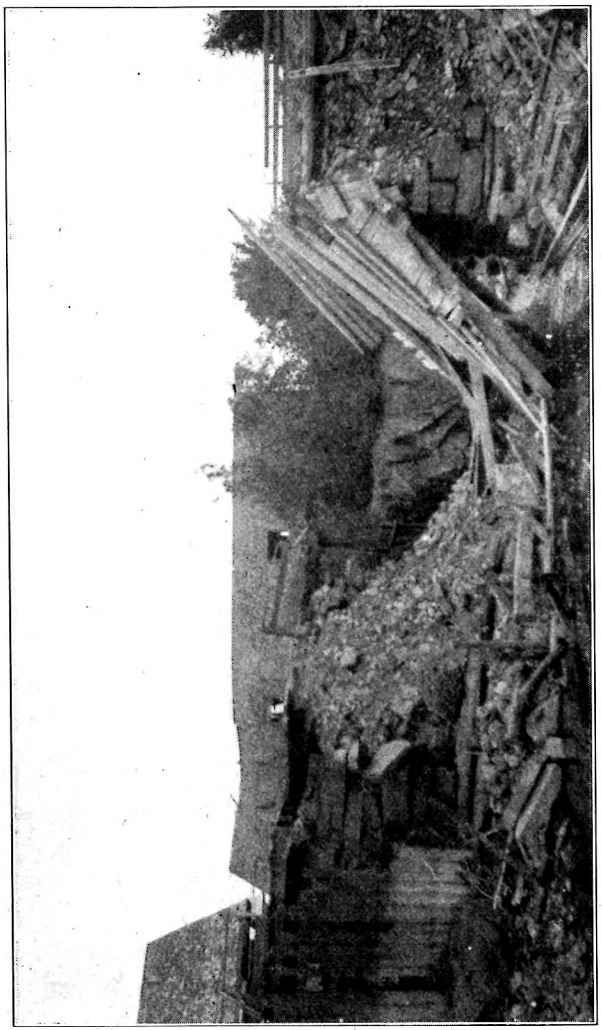
In this connection it is of interest to note that the greatest "bridge burden" borne by any town in the State is one hundred thirty and four-tenths per cent (130.4%) of its valuation as determined by the Board of State Assessors. Naturally enough, it is difficult to determine the dividing line between a normal "bridge burden" and an excessive one. However, the following tabulation indicates the range involved.

Reconstruction-Valuation Relation	Number of Towns Involved
From 00% to 10%	246
From 10% to 20%	131
From 20% to 30%	81
From 30% to 40%	58
From 40% to 50%	27
From 50% to 60%	16
From 60% to 70%	6
From 70% to 80%	7
From 80% to 90%	4
From 90% to 100%	2
From 100% to 110%	—
From 110% to 120%	—
From 120% to 130%	—
Over 130%	3

Although not always so recognized, it is nevertheless a fact that the construction costs of many bridges bear comparatively little relation to their clear span lengths. This condition is due to high construction costs involved in the bridge substructures resulting from unsatisfactory foundation conditions requiring deep excavations, difficult stream or other water conditions, excessive heights involved in substructure abutments and to various other physical and local conditions too numerous to mention here. The data contained in Table No. 2 is, therefore, of little importance from a bridge construction point of view. However, it shows the relations between number of bridges and span lengths to be as follows:

Number of Bridges	Span Lengths
2410	6 ft. to 10 ft.
1542	10 ft. to 15 ft.
909	15 ft. to 20 ft.
760	20 ft. to 30 ft.
307	30 ft. to 40 ft.
152	40 ft. to 50 ft.
233	50 ft. to 75 ft.
116	75 ft. to 100 ft.
87	100 ft. to 125 ft.

Number of Bridges	Span Lengths
47	125 ft. to 150 ft.
34	150 ft. to 175 ft.
26	175 ft. to 200 ft.
63	200 ft. to 300 ft.
30	300 ft. to 400 ft.
13	400 ft. to 500 ft.
34	over 500 ft.



Failure immediately followed the passage of an automobile. In bridge language this structure had "talked" for years giving ample evidence and warning: "Danger here!"

The total number of cities, towns, plantations, etc., for which bridge records have been secured and compiled is 581, while the total number of bridges involved in the survey is 6763. The distribution of these structures upon the three classes of highways is as follows:

On State Highway System	620
On State Aid Highway System	1541
On Third Class and other highways	4602
Total	6763

The "reconstruction estimates" involved in Tables Nos. 1, 3, 4 and 5 are distributed upon the three classes of highways as follows:

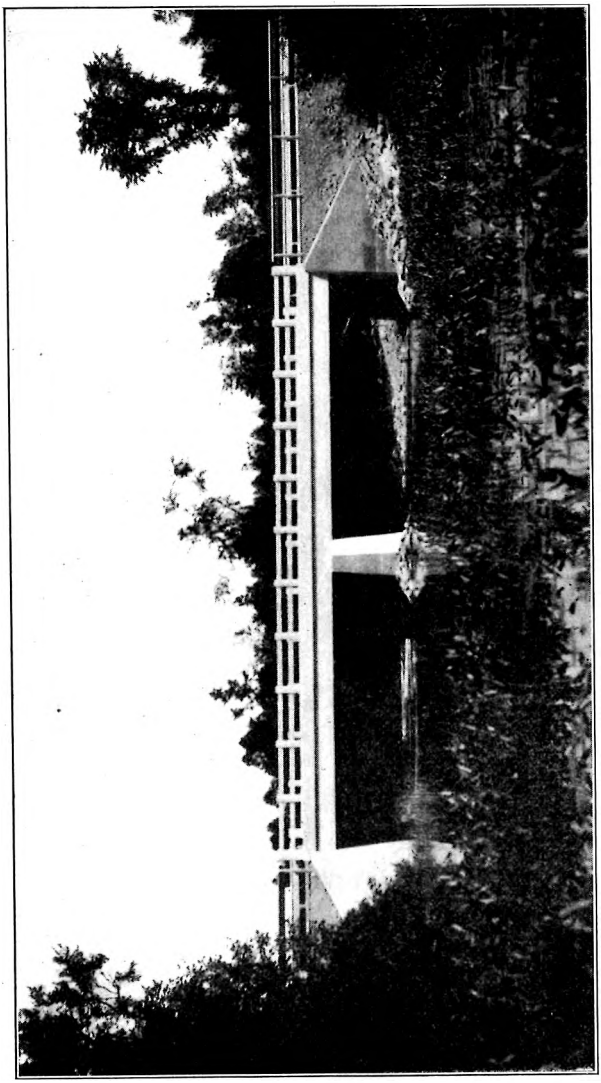
On State Highway System	$3,193,900
On State Aid Highway System	9,878,900
On Third Class and other highways	28,711,600
Total	$41,784,400

There exists within the State approximately 23,100 miles of highway, of which 1,630 miles are incorporated within the State Highway System and 4,200 miles within the State Aid Highway System. The remaining 17,270 miles being the Third Class and other highways of this report.

Based on the information secured from the "bridge records" of the survey the distribution of the total number of bridges and the corresponding "reconstruction estimates" involved in each of the "reconstruction periods" are as follows:

Reconstruction Period	Number of Bridges	Reconstruction Estimate
5 years	2497	$18,010,800
10 years	1954	15,466,900
15 years	739	6,168,900
20 years	191	2,137,800
Over 20 years	1382	
Total		$41,784,400

In general, municipal and county officers recognize that many of the bridge structures under their direct charge not only possess inadequate strength to be considered reliable for present day motor vehicle traffic, but also that the physical condi-



15 Mile Stream Bridge—Benton. Two span bridge having mass concrete abutments and pier and superstructure spans of T-beam type with railings of "precast bar" type.

tion of many of these structures is unsatisfactory for more than comparatively short periods of future service. The foregoing tabulation is of special interest in this connection since

it indicates quite clearly the general situation throughout the State.

The "bridge burden" for the entire State as adduced and described under "State Tabulations" amounts to five and nine-tenths per cent of its valuation. The above tabulation makes possible a distribution of this percentage to each "reconstruction period" as follows:

Reconstruction Period	Bridge Burden
5 years	2.5%
10 years	2.2%
15 years	0.9%
20 years	0.3%
Total	5.9%

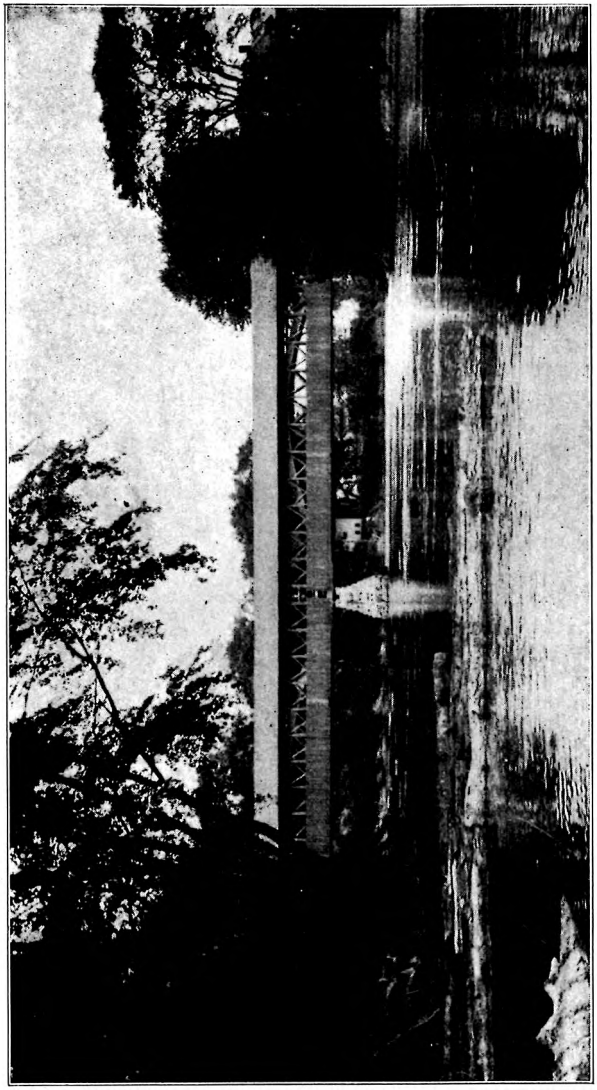
The so-called "Bridge Act" which became effective in 1916 has provided during the past eight years a means by which cities, towns and plantations could secure State and County aid in the construction and reconstruction of bridges. Under the provisions of this act the number of bridge construction projects have gradually increased. The act was developed and reported by the Committee on Ways and Bridges of the Seventy-seventh Legislature as a committee measure intended to provide a means whereby towns could secure aid in the construction and reconstruction of bridges without recourse to special legislative resolves. It was adopted by the people in a referendum vote to take effect in December, 1916. It has been amended from time to time to render it better adapted to the conditions found to be important to its practical application and operation.

In order to discover the general result which would be secured through the application of the "Bridge Act" to the reconstruction of the bridges contained in the four "reconstruction periods" described in this report its application has been considered in relation to thirty-six towns ranging in valuation from $3,193,700 to $77,800 and to 170 bridges by selecting from two to eight "reconstruction estimates" from each tabulation providing thereby a wide general application of the act. The State's portion of the "reconstruction estimates" as determined from the group so chosen averaged thirty-eight per cent

(38%). Assuming the percentage to apply to the $41,784,400 "reconstruction estimate" contained in Table No. 5 by proportioning it in its proper relation to the reconstruction periods, the following results obtain for the group:

Reconstruction Period and Estimate		State's Portion
5 years,	$18,010,800	$7,844,104
10 years,	15,466,900	5,877,422
15 years,	6,168,900	2,344,182
20 years,	2,137,800	812,364
Total,		$16,878,072

In the body of this report reference has been made to the marked evolution in the weight and volume of highway traffic resulting from the adoption of motor propelled trucks and tractors and to the resulting effects upon bridge structures which were not built to sustain loads of this character. In 1922 the State Highway Commission's Bridge Division investigated over one hundred motor trucks of different manufacture and varying capacities. This investigation showed that 5-ton trucks vary in weight from 19,000 lbs. to 30,000 lbs., with wheel base lengths varying from 11 ft. to 17 ft. and with the total concentrated load on the rear axles when loaded to their rated or normal capacity varying from 11,500 lbs. to 28,000 lbs. An investigation involving seventy-nine (79) different 5-ton trucks loaded to normal capacity showed the average rear axle concentration to be 16,291 lbs. and when subjected to a 50 per cent overload this average concentration became 21,162 lbs. When converted into percentages of the total load (truck plus load) we find these concentrations 76.8 per cent and 80.7 per cent respectively. When we consider, in addition to the foregoing conditions, that the impact effect of truck traffic upon bridge structures, due mainly to irregularities in roadway surfaces and vibration of the body springs, increases very greatly the stresses produced in bridges, we can readily understand how bridge structures which possessed ample strength for the traffic of a comparatively few years ago weaken and disintegrate under the traffic of today. The sign found rather commonly on old wooden bridges, "Three Dollars Fine for Driving Faster than a Walk," is indeed a relic of other days.



Covered wooden truss bridge. Unquestionably the most reliable type of wooden structure built for highway traffic of a quarter century and more ago.