STATE OF WASHINGTON

THIRD BIENNIAL REPORT

OF THE

HIGHWAY COMMISSIONER

FOR THE

Period Ending September 30, 1910.

OLYMPIA, WASH.:
E. L. BOARDMAN, PUBLIC PRINTER
1910

WENATCHEE BRIDGE.

The legislature of 1909 empowered and directed the highway board to purchase the bridge across the Columbia river at Wenatchee from the Washington Bridge Company, provided that the bridge should first be examined and tested to the satisfaction of the highway board, and the title thereto approved by the attorney general. An appropriation of $10,000 was made for the first payment on the bridge.

The following reports were submitted to the senate and the governor. No further action has been taken by the board.

REPORT TO SENATE.

To the Honorable Senate of the State of Washington:

GENTLEMEN—Pursuant to your resolution of June 25, relating to the Wenatchee bridge, the state highway board has the honor to present the following report:

On May 11, 1909, the Washington Bridge Company filed with the state highway board a complete exhibit of the cost of the Wenatchee bridge, accompanied by the necessary vouchers. They also filed an abstract of title to the right-of-way covering the approaches, and a copy of the act of congress granting to the said Washington Bridge Company the right to construct a bridge over the Columbia river at the point where the bridge now stands.

It was discovered that the waiver for the right-of-way over the Great Northern railway was defective, and it was referred back to the Washington Bridge Company. This matter of the right-of-way was properly corrected, and the highway board then took up the examination of the accounts, checking them carefully, and finding that they agreed with the vouchers submitted. The cost of the bridge, as set forth in the account submitted, is as follows, viz.:

Cost of construction		$178,233 07
Operating expenses		196 97
		$178,430 04
Interest to April 15, 1909		20,094 92
Grand total		$198,524 96
Less individual subscriptions collected from citizens of Wenatchee		16,317 41
Balance to be paid by state		$182,207 55

There are certain items in the account, such as operating expenses, cost of brackets which carry the flumes across the bridge, and a charge for organizing the Washington Bridge Company, which should be disallowed, and will reduce this amount slightly, but the exact extent

of this reduction cannot now be definitely stated, as the weight of steel in brackets has not yet been determined.

In the matter of a comparison between the actual cost of this bridge and a bridge built under contract at the present time, we desire to say that the steel structure could probably be delivered at the present time for approximately $5,500.00 less than it cost, due to a reduction in the base price of steel. A careful comparison of the cost of the cement used at the time of the erection of this bridge and the present price of cement in the open market leads us to believe that practically no reduction could be made in the cost of the piers.

The condition of the bridge seems to be good with the exception of the floor, which is nearly worn out by the heavy traffic thereon, and the floor system is also defective in that the floor stringers are spaced too far apart, the distance between centers being much greater than is used by the state in its standard bridge construction. This can easily be remedied, however, when a new floor is to be laid.

The highway board employed Mr. J. W. Bowerman, consulting engineer, of Seattle, to make an expert examination of this bridge, and in company with him the board visited the bridge on the eighteenth and nineteenth of June, 1909. The examination made at that time was in the line of a preliminary examination, and developed the fact that further and complete detailed examination would be necessary in order to determine the efficiency of the bridge.

To this report we append a statement of the consulting engineer.

Very respectfully,

J. G. LEWIS,
C. W. CLAUSEN,
JOSEPH M. SNOW,
State Highway Board of Washington.

Dated at Olympia, Wash., June 30, 1909.

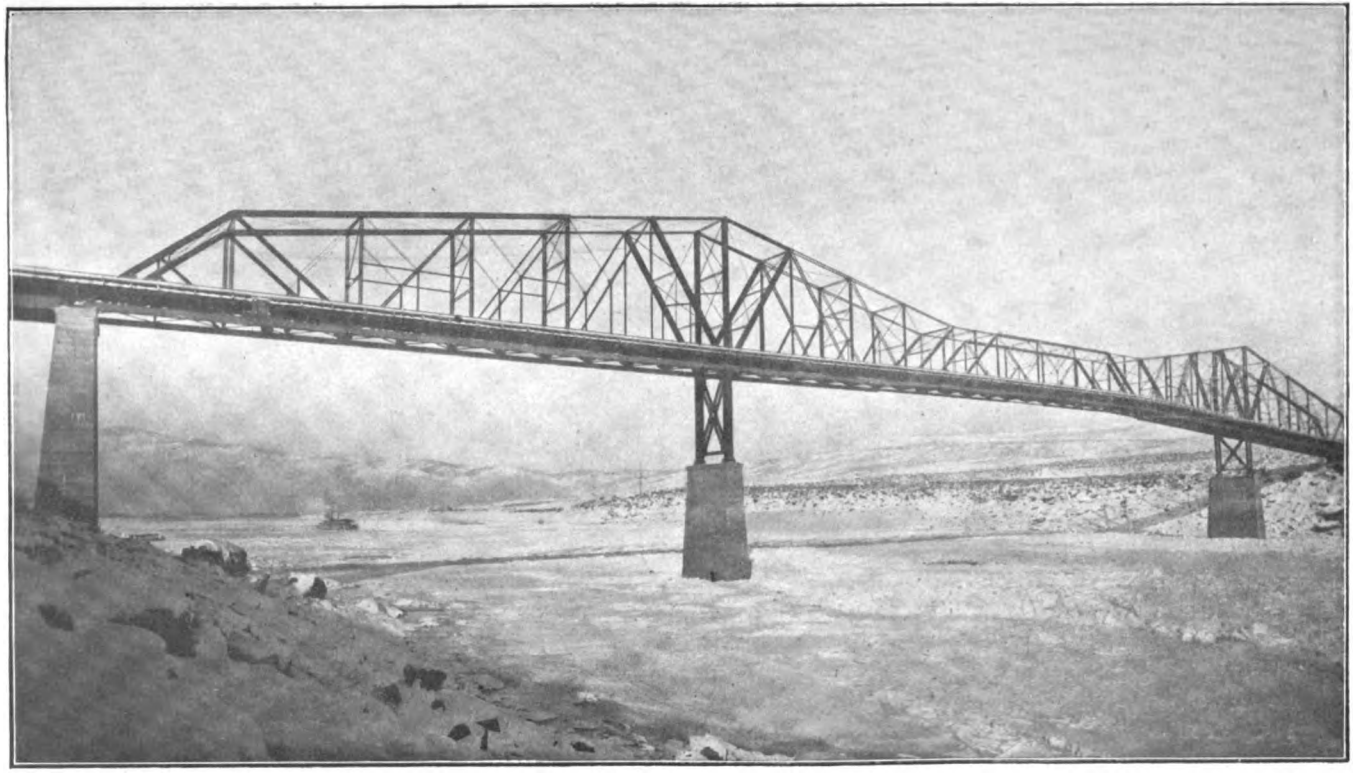
REPORT TO GOVERNOR.

Hon. M. E. Hay, Governor, Olympia, Washington:

SIR—Under the provisions of section 1, chapter 78, Laws of Washington, A. D. 1909, the state highway board has examined and tested the Wenatchee bridge, and the title thereto has been examined and approved by the attorney general, and the vouchers covering the cost of said bridge have been examined and checked up and found to be correct; but certain items included in the statement of cost would be objected to by the board if the purchase were to be made.

The cost of the bridge, as set forth in the account submitted by the Washington Bridge Company, is as follows, viz.:

Cost of construction	$178,233 07
Operating expenses	196 97
	$178,430 04
Interest to April 15, 1909	20,094 92
Grand total	$198,524 96
Less individual subscriptions collected from citizens of Wenatchee	16,317 41
Balance to be paid by state	$182,207 55



Wenatchee Bridge.

The entire highway board visited said bridge on the nineteenth day of June, 1909, and made an examination of the superstructure. They were accompanied by their appointed engineer, Mr. J. W. Bowerman, of Seattle, who at that time made a superficial examination of the piers. It was found that the entire superstructure, with the exception of the floor system, is entirely satisfactory and in good condition, and capable of carrying the maximum load shown upon the strain sheets. The floor system is not equal to that demanded by the state's specifications; that is to say, that the floor joists are spaced from 24 to 33 inches centers, where the state's specifications call for them to be spaced 18 inches centers. Also, that the floor is badly worn in many places, and that it would be necessary to renew the same within a few months. It was also found that the leakage from the water pipes of the Wenatchee Canal Company drips upon the lower chords of the bridge, thereby causing corrosion of the metal, and materially increasing the cost of maintenance and possibly shortening the life of the bridge.

On July 28, 29, 30 and 31 the engineer of the highway board conducted a careful test of the holding power of the anchor bolts, which secure the bridge to the piers. A lifting strain of from thirty to thirty-five tons was applied to each of these bolts, and in no case could they be moved. As the maximum stress which these bolts are required to hold with the full live load placed upon the center of the bridge is twenty-seven and one-half tons, this test was entirely satisfactory, and the bridge was found to be perfectly safe.

A careful examination of all of the piers developed the fact that all of them except the east shore pier, that being the pier on the Douglas county side of the river, had been cracked by the use of dynamite when the holes were drilled to receive the anchor bolts. These cracks extend, generally, in a vertical direction from the top of the pier, in some cases lengthwise and in other cases crosswise of the piers, for a distance of from six to approximately twenty feet. As there are three double lines of steel bars extending laterally and longitudinally through these piers for re-enforcement, there is, in the judgment of the highway board, no danger of the piers collapsing or crushing, and it is the belief of the board that the safety of the bridge is in no way endangered thereby; but, owing to the fact that this is a defect that may materially reduce the value of the bridge, the highway board does not feel justified in completing the purchase thereof as set forth in said chapter 78.

The highway board is of the opinion that the bridge would be of great value to the state, inasmuch as there is a very heavy traffic over it, and this traffic will rapidly increase as the orchards on the east side of the Columbia come into bearing; and were it not for the defective piers, the purchase of the structure could be consummated, with some provision for changing the floor system and providing for taking care of the leakage from water pipes.

The report of the engineer is hereto attached.

Respectfully submitted, STATE HIGHWAY BOARD,
J. G. LEWIS,
C. W. CLAUSEN,
JOSEPH M. SNOW.

Dated at Olympia, Washington, this 31st day of July, 1909.

REPORT OF J. W. BOWERMAN.

To the Honorable State Highway Board:

Complying with your report of recent date, for either a progress report or a complete report on the Wenatchee bridge before August 1, I have the following to offer

CHAPTER 78.

[S. B. 67.]

Providing for the purchase of bridge across the Columbia at Wenatchee.

AN ACT for the purchase of the highway bridge across the Columbia river at Wenatchee, Washington, by the State of Washington, from the Washington Bridge Company, providing means, methods and time of payment thereof, and the manner of future maintenance and supervision thereof, and making an appropriation for said purchase.

Be it enacted by the Legislature of the State of Washington:

SECTION 1. The state highway board of the State of Washington is hereby empowered and directed to purchase from the Washington Bridge Company at once the highway bridge across the Columbia river at Wenatchee: *Provided,* That said bridge shall first be examined and tested to the satisfaction of said state highway board, and the title thereto shall first be examined and approved by the attorney general.

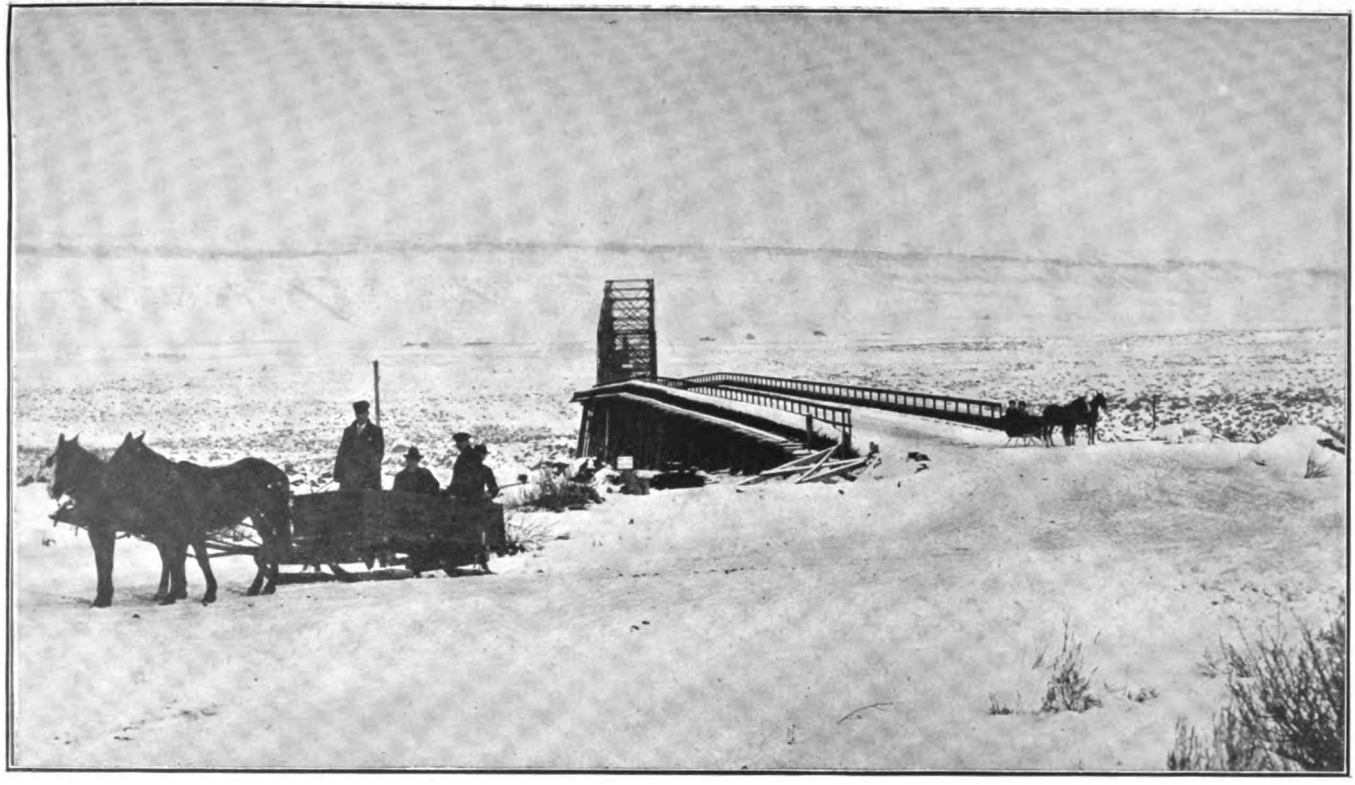
SEC. 2. Said state highway board shall pay for said bridge the actual cost of construction thereof, plus six per cent. interest, to be computed from the time money has actually been paid out by said bridge company, up to the date of the transfer thereof, less the amount actually paid toward the construction of said bridge by citizens of Wenatchee: *Provided,* That the amount to be paid therefor by the State of Washington shall not exceed the amount of the appropriation hereinafter made.

SEC. 3. For the purpose of determining the cost of construction of said bridge the state highway board shall examine the original vouchers of the Washington Bridge Company, and may employ such other means as they may deem necessary.

SEC. 4. Said purchase shall be made subject to a contract heretofore entered into between the Washington Bridge Company and the Wenatchee Canal Company, whereby the latter is given a perpetual right to lay two pipe lines, each of 36 inches internal diameter, over or suspended from said bridge, for the purpose of carrying water for irrigating lands on the east side of the Columbia river, in Douglas county: *Provided, however,* That so long as its pipe line shall be carried upon said bridge the Wenatchee Canal Company shall be liable for and shall pay one-third of the necessary expense for the maintenance of said bridge.

SEC. 5. From the time said bridge becomes the property of the State of Washington it shall be and remain free from all charges or tolls for highway crossings, and shall be and remain a portion of the public highways of the state, and shall be maintained in the same manner as all other state highways, under general provisions of law.

SEC. 6. The state highway board is hereby authorized and empowered to grant franchises for the laying of rails and other necessary facilities for a single railway track across said bridge, and the operation thereon of street and suburban railways and for the laying thereon or suspending therefrom pipes for the carrying of water, gas and other substances, and wires and cables for the conducting of electricity for telegraph, telephone, lighting, power, heating and other purposes, but no such franchise shall be exclusive nor shall any preference be granted thereunder. Any street or suburban railway laying rails and other necessary railway facilities thereon shall do so at its own expense, but



Wenatchee Bridge in Winter.

said rails and other necessary railway facilities shall thereupon become the property of the State of Washington, and shall be maintained and replaced at the joint expense of all lines using the same. Said franchise or franchises shall require such payment or compensation as said state highway board may deem equitable, without preference or discrimination, and all such payments shall be made into the public highway fund of the state.

SEC. 7. For the purpose of carrying out the provisions of this act, the sum of $190,000, or so much thereof as may be necessary, is hereby appropriated out of the state highway fund, against which fund warrants shall be issued therefor: *Provided, however,* That none of said warrants shall be issued before the issuance and sale of the bonds hereinafter provided for. To make or replace in said fund the amount necessary for payment of such warrants, state coupon bonds to the amount of $190,000, payable to bearer, are hereby authorized to be issued bearing interest at the rate not to exceed four per cent. per annum, payable semi-annually, and to run for twelve years, save that any of said bonds may be redeemed upon any interest date upon call of the state auditor, and that not less than ten per cent. of said bonds shall be redeemed annually, beginning with the biennial term of the year of 1911, and be payable, principal and interest, out of the state highway fund. Such bonds shall be numbered in series, consecutive numbers from one upwards, be issued in denominations of one thousand dollars ($1,000) each, and shall each contain upon its face the date of issue, the number, the rate of interest, into what fund the proceeds are to be paid, where payable, time to run and the provision for redemption. Such bonds shall be signed by the governor and attested by the secretary of state under the seal of the state and countersigned and registered by the state auditor, and shall be offered for sale by the governor and state auditor. The coupons shall be authenticated by the facsimile signatures of the governor and secretary of state and be payable to bearer, and need not be under seal. Such bonds shall not be sold by the state at less than par, and upon sale the proceeds shall be turned into the state highway fund. Such bonds shall be a valid and binding indebtedness against the state, and shall be redeemed in numerical order; and any such bonds outstanding and not redeemed at the expiration of twelve years from the date thereof shall be paid out of the state general fund.

Passed by the senate February 25, 1909.
Passed by the house March 8, 1909.
Approved March 11, 1909.

Description of Bridge.—The highway bridge across the Columbia river at Wenatchee consists of a steel cantilever structure having two anchor arms 240 feet in length, two cantilever arms 160 feet in length, a suspended span 200 feet in length, and one plate girder 60 feet in length, making in all 1,060 feet of steel spans, supported on concrete piers, together with 565.7 feet of timber approach, giving in all a structure 1,625.7 feet in length. It has a roadway twenty feet and six inches in width in the clear; is designed for a single-track street railway, ordinary highway traffic and two water mains of four feet internal diameter, supported on brackets outside of the trusses. There were required approximately 1,100 tons of metal, 270,000 feet of timber, B. M., and 3,800 cubic yards of concrete to construct it. Work was started on the piers (the channel and west anchor piers resting on rock) in February, 1906, and completed in June, 1906. The erection of the superstructure was commenced in March, 1907, and completed in February, 1908, when the bridge was thrown open to traffic.

SUMMARY OF CANTILEVER STRUCTURE.

Length, 1,000 feet.
Roadway, 20 feet 6 inches.
Clearance above high water, approximately 45 feet.
Steel, 1,040 tons; water and water pipe, 520 tons; highway floor, 125 tons; full live load capacity, 1,000 tons; total, 2,685 tons.
Total area of tower shoes, 123 square feet.
Approximate weight of brackets supporting water pipes, 18 tons.
Material, medium O. H. steel.
Safety, steel.
Based on ultimate strength, about 4¼.
Based on elastic limit, about 2½.

WATER LEVELS.

River gauge at G. N. depot, Wenatchee, high water 1894, 59.8; river gauge at G. N. depot, Wenatchee, July 31, 1909, 24.5; difference, 35.3 feet.
Height of channel piers above river surface, July 31, 35.6 feet.

Complying with your instructions pertaining to clause 1, of the provisions in section 1, "that said bridge shall first be tested and examined to the satisfaction of the state highway board," on June 17 I proceeded to Wenatchee and made a superficial examination on the eighteenth and nineteenth of said month, and on June 28 wrote the following letter to the Washington Bridge Company, receiving their answer, also given below, on June 30, and at your request made the progress report inserted herein:

SEATTLE, WASH., JUNE 28, 1909.

Judge. Thos. Burke, President Washington Bridge Company, Burke Bldg., City:

DEAR SIR—The highway board of the State of Washington has instructed me to request of you permission to make such physical tests as may be deemed necessary to ascertain the safety and safe carrying capacity of the Wenatchee bridge, as per act approved March 11, 1909.

The highway board also requests of the Washington Bridge Company a waiver, waiving all damages which may accrue to the superstructure, or substructure, by reason of making the above mentioned physical tests. If possible to satisfactorily so arrange, we would prefer that such tests as we may prescribe be performed by representatives of the Washington Bridge Company in our presence.

Trusting that you will give the matter your earliest attention, I am,

Very respectfully yours,
J. W. BOWERMAN.

SEATTLE, WASHINGTON, JUNE 30, 1909.

Mr. J. W. Bowerman, Consulting Engineer, 649 New York Block, Seattle, Wash.:

DEAR SIR—Your letter of the 28th inst., addressed to Thomas Burke as president of the Washington Bridge Company, has been turned over to me, as I am now president of that company.

The Washington Bridge Company freely grants the permission you ask for, namely, "to make such physical tests as may be deemed necessary to ascertain the safety and safe carrying capacity of the Wenatchee bridge."

The Washington Bridge Company also complies with the request that the company waive all damages which may accrue to the superstructure or substructure by reason of making such physical tests.

I hereby enclose the written authority of the Washington Bridge Company, granting the authority for the examination desired and also granting the waiver asked for.

In order to put beyond any question the fairness of the tests, we would prefer that not only should the tests be prescribed by you, acting for the highway board of the State of Washington, but that such tests should be made by you instead of by us. We desire, of course, to be represented by our engineer when such tests are made.

Very respectfully.
C. W. COULTER.

SEATTLE, WASH, JUNE 28, 1909.

The Honorable Highway Board, Olympia, Washington:

GENTLEMEN—Regarding your inquiry concerning the progress of the report on the adequacy, capacity and condition of the Wenatchee cantilever bridge, I beg to advise you that it is impossible for me at this time to make a complete report, for the following reasons:

It will be impracticable to complete the inspection of the piers until the low water stage of the river, there being at this time some fifty feet depth of water at the channel piers.

Owing to certain derogatory statements concerning the sufficiency of the piers and anchor bolts, said to have been made by a party who may have been more or less in charge of a portion of the work, it will be necessary to make certain physical tests to determine the efficiency thereof.

The checking of the stresses and materials is not quite completed, hence a report dealing only with a superficial examination made on the 18th and 19th inst. can be given at the present and is as follows: The piers were inspected as far as the water line and appear to be of a good quality of concrete. Only slight imperfections, consisting of three minute cracks in the top of the west channel pier and two minute cracks in the top of the east channel pier, being noted. Owing to the manner in which the piers are constructed, it is improbable that these cracks impair their general efficiency. Calculations to determine the efficiency of the piers have not been completed. The holding power of the anchor bolts in these piers must be determined with physical test by means of jacks exerting an uplift equal to that caused by the various loads which may be imposed upon the bridge. The steel work is in good condition and has the appearance of having been well executed. The loadings for which it was figured are adequate, as are also the fibre stresses upon which it is proportioned. The steel work is considerably stronger in proportion than the wooden floor which it supports. The present floor system, in so far as the stringers and planking are concerned, is designed to carry ordinary loaded wagons on the wagon portion of the roadway, the stringers being spaced further apart than those of the standard adopted by the highway board. The flooring is badly worn from traffic, and should be replaced as soon as possible.

A report in detail will be submitted upon the completion of the final examinations, tests and calculations.

Very respectfully yours,
J. W. BOWERMAN.

By permission of the board, testing appliances, shown on the enclosed sheet, were made, and two thirty-ton jacks were secured. The jacks were calibrated by means of a hydraulic press and a spring balance.

Checking the Stresses and Material.—On July 24 the checking of the strains and the proportionment of the members in the structure was completed, and with the exception of a few minor instances found to be correct.

Testing of Anchor Bolts.—On July 27 the testing apparatus was shipped to Wenatchee and on July 30 and 31 the anchor bolts were tested (it having been previously ascertained by calculation that when the highway portion of the suspended span, 200 feet in length, and both cantilever arms, each 160 feet in length, are loaded to their capacity of 100 pounds per square foot of floor surface, a total load of 520 tons, there would result on the end of each anchor arm an uplift of 110 tons, to be resisted by four anchor bolts two and one-quarter inches in diameter, or 27.5 tons to each bolt).

By permission of the owners of the bridge, these bolts were subjected to a strain of approximately 35 tons without any indications of giving way. There is no strain on the anchor bolts of the channel piers, from either a dead load or a live load on the bridge. They are only subjected to strain when the present water pipes, which are three feet in diameter, are empty, and the wind is blowing with such a velocity as to cause a pressure of 50 pounds per square foot on the exposed surface. Under such conditions there would be a slight uplift on the anchor bolts of the west channel pier. One of these bolts, however, was subjected to a strain of 35 tons, and showed no signs of failure.

A further inspection of the piers was made on the 28th and 29th inst., and disclosed two minute vertical cracks in the top of the west anchor pier. A sketch of the piers is attached hereto, showing approximately the location of the minute cracks. The piers are found to be in the proper proportion for stability, the bearing pressures upon them are within the allowable limits of safety for the channel piers, and the anchor piers are of sufficient size for anchorage purposes. The concrete is of good quality as far as it has been possible to examine, there being at this time some forty feet depth of water surrounding the channel piers. There is little doubt, however, as to the quality of the concrete beneath the surface of the water, as the piers were constructed during the low water stage of the river, and the information has been elicited that the same men were employed and the same care taken in mixing and placing the lower portion as that above water. As to the imperfections, consisting of the minute cracks mentioned heretofore, it is not likely that these impair the general efficiency of the piers at the present time. These cracks are alleged to be one of the results of explosives used to assist in forming the holes for the anchor bolts, the piers having been carried to completion before the anchor bolts were set. These minute cracks (see drawing) apparently have the effect of dividing the upper portions of the piers in which they occur into large blocks of concrete, bound together (as evidenced by a vibratory test) by six courses of three-quarter-inch square steel bars imbedded in the concrete at vertical distances of two, four and six feet from the tops of the copings, and spaced horizontally at distances of three inches, nine inches and eighteen inches apart. Inasmuch as these cracks are practically horizontal and vertical in direction,

there is apparently no tendency for the seemingly large blocks of concrete, which are formed by them, to dislodge, and hence these blocks of concrete in themselves are equally as effective as similar-sized blocks of stone built into masonry piers, many of which have been built, some in works of much greater magnitude. However, one of the objects in building piers of concrete is to obtain a monolithic mass, in order to obtain a construction free from open joints in which water can settle, the expansion resulting from the freezing thereof tending to widen crevices and produce greater deteriorating effects with each successive freezing.

While it is improbable that these cracks will widen appreciably within fifteen years or more, however, from this standpoint, they are imperfections, and in case the state purchases the bridge they should be opened up and filled with some suitable waterproof material, or the entire portions affected by them removed and replaced, in which case the cost is estimated at about $10,000.

As nearly as can be ascertained, the noses of the channel piers are a few inches above the extreme high water of 1894. The superstructure, with the exceptions noted in the progress report of June 28, is substantial and capable of sustaining any loads that may be imposed upon it from highway traffic, and is a well executed and acceptable piece of work in so far as the workmanship and materials are concerned. It is suggested, however, that should the state purchase the bridge, the Wenatchee Canal Company be required to prevent the leakage of its pipes being blown upon the lower chords of the bridge.

J. W. BOWERMAN, *Consulting Engineer.*

Dated at Olympia, Washington, this 31st day of July, A. D. 1909.

REPORT OF J. C. RATHBUN.

OLYMPIA, July 31, 1909.

Mr. H. L. Bowlby, State Highway Commissioner, Olympia, Washington:

DEAR SIR—At your request, I have examined the cantilever bridge at Wenatchee and observed the tests made by Mr. Bowerman, of Seattle.

From a superficial examination I find the trusses are of a better class than would be required by the state for a bridge of this size and type. The workmanship seems well done, but one error, and that a trivial one, being noted.

The east cantilever arm is on a six per cent. grade. From a highway standpoint, this is a very bad feature, as all travel has to go up or down this grade and on shore go down or up a hill to get to or from the bridge. If the bridge were designed for highway traffic, this was a serious blunder and should be rectified by raising the piers if the bridge is to be used as a state highway. In freezing weather it is probably very difficult for horses to keep their feet at this point.

The ugliness of the structure is very apparent. No consideration was given to aesthetics in the design of the trusses. The dropping of

the east end has destroyed the symmetry of the structure, so that what might have been a bridge with a pleasing appearance is far from it.

At present the floor system is worn out and requires renewing very soon. Many of the planks are worn through, and all show signs of wear. The plank was originally three-inch stuff, which is altogether too light for the spacing of the stringers. The stringers consist of 7 3x18 and 2 12x18. These timbers do not scale more than about seventeen inches, however. For a twenty-foot panel this would be considered rather light for a small bridge or a trestle, but for a structure of this size, where an accident to the stringers would cause a loss of life, this is extremely light.

If the structure is to be used for interurban traffic, the floor system would probably have to be redesigned to satisfy the weight of the cars going over.

Signs of corrosion are apparent on the bottom chord of the north truss. In some places they are quite pronounced, particularly on the west anchor arm near the tower. The reason this chord should have started to corrode is probably due to the leakage from the pipe line.

The worst feature about the bridge is the pipe line. This leaks badly, causing rusting of the bridge members, which will ultimately determine the life of the bridge. In one place the leakage was bad enough to cause a pool of water to stand on the roadway. The line is braced in a temporary manner where it leaves and enters the bridge and approaches. On the west end it is braced by 6x6 braces, while at the east end a cable is tied to the inclined end post of the bridge, wrapped around the pipe and drawn tight by twisting it with a rod. If the bridge is to be taken over by the state, the pipe line will have to be overhauled very carefully, and the method of running it on and off the bridge redesigned. Even in that case, constant supervision will be needed to keep the pipe line from destroying the bridge.

At present a considerable amount of garbage is dumped from the bridge. This lies on the lower chord, helping to corrode it.

It has been reported to me that the piers were improperly built. An examination of the surface shows a number of cracks, which would indicate a weak condition. The strength of the shore piers might be tested by loading the bridge to its capacity and looking for signs of failure. At the present time I know of no way of testing the river piers. If these piers have had blasts set off in them, they probably are not in a safe condition, but are shattered. If the state or U. S. government had an inspector on the work during the construction of the piers, his testimony would probably indicate their safety. Mr. Shattuck, the inspector for the bridge company, reports that dynamite was used in the piers after they had been erected and the concrete set.

In that case the piers are shattered to a degree which is impossible to ascertain. This dynamite was used in drilling holes in the sills in which to set the anchor bolts. The bolts were set in the holes and grouted in. Tests were made July 30 and 31 of this year on the

efficiency of this grouting, and no movement was found under the stress given. These tests, in my opinion, are of little value in determining the ability of the piers to withstand an upward reaction. The jacks used must have a bearing independent of the pier before an upward reaction that would cause failure can be secured. I enclose a sketch showing the probable condition of the inside of the piers. If the piers are reinforced, this will tend to hold them together, provided they are reinforced properly. A superintendent who would forget to place the anchor bolts is liable not to follow plans in reinforcing. Mistakes made here cannot now be checked.

If the bridge is to be used by the state as a highway structure, the following changes should be made:

First—The flooring should be replaced by four-inch plank or better.

Second—The pipe line should be removed and sidewalks put in its place. In this case the dead weight thus removed could be used in increasing the floor system. If this is impracticable, the pipe line should be repaired over the bridge in a manner that would insure the state against leakage. The patchwork at the approaches should also be removed and replaced by something more sightly and permanent.

Third—As soon as the pipe line is fixed, the lower chords should be cleaned, rust removed and repainted. Steps should be taken to keep these chords in condition.

Fourth—If a state or government inspector, who had charge of the building of the piers, cannot be found, the anchor piers should be torn down until a mass of concrete can be replaced to complete them whose weight is equal to or greater than the maximum upward reaction. The river piers should be repaired by placing a shell of reinforced concrete about them and assurance obtained by test or otherwise that the anchor bolts will not pull out of the pier. In making this test the jacks should *not* have their bearing on the concrete near the bolt being pulled. If the inspector can be found, his testimony should carry weight in the action of the state regarding the piers.

Fifth—When the piers are repaired the east anchor and east channel piers should be raised until the bridge is level or near enough so that it will neither be an eyesore or a nuisance to traffic. An approach should be built to connect it with the shore.

If these changes are made, the bridge will be a very good specimen of a highway bridge, but until they are it will be a poor structure for highway purposes, totally lacking in aesthetics, a constant source of trouble for the maintenance department of the state highway office, of questionable safety, and short-lived for either highway or pipe line.

Respectfully submitted,

J. CHAS. RATHBUN.