Decision No. 977

BEFORE THE RAILROAD COMMISSION
OF THE STATE OF CALIFORNIA.

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ORIGINAL

Decision No. 977

In the Matter of the Investigation of the Failure of the Bridge of the NORTHERN ELECTRIC across the American River, occurring September 9, 1913.

Case No. 473.

BY THE COMMISSION.

The above accident occurred at 9:06 P.M. on September 9th, 1913, and the Commission instructed its Engineering Department to make a thorough investigation and report, which has been done and this report so fully covers the substantial matters to which we believe the Commission should give its attention, that we have decided to adopt this report as the report of the Commission in this matter, and it is so ordered.

A copy of the report is attached hereto and made a part of this order.

Dated at San Francisco, California, this 30th day of September, 1913.

John M. Eshleman

Marshall Beehler

Edwin O. Edgerton

Commissioners.

San Francisco, Cal., Sept.18,1913.

RAILROAD COMMISSION
STATE OF CALIFORNIA
SEP 20 1913

Railroad Commission of California,

San Francisco, California.

Dear Sirs:-

FILE No._____

On Sept. 9th, at 9:06 PM, the south end span of the Northern Electric Railway Company's bridge across the American River, near Sacramento, collapsed while a switching movement of gondola cars, loaded with gravel, was being made, resulting in the death of Engineer H.C.Stevens and the injury by scalding, due to escaping steam, of Fireman A.G.Williams. After an investigation of the causes of this accident, I beg to submit the following report:

This bridge is located between a county highway bridge and the bridge of the Western Pacific Railway Company over the American River, approximately 1½ miles north of Sacramento. It consisted of five 150 ft. Pratt truss spans on pile piers, with short trestle approaches at each end. The tension truss members were of steel, and the compression members of Oregon pine. Pier and truss plans are attached to and made a part of this report as are also four photographs taken of the collapsed span, plat showing track layout south of the bridge and two stress sheets, No.1 showing the stresses of the different truss members under a live load of 4,000 lbs. per lineal foot, for which the bridge was designed, and stress sheet No.2 showing the stresses under a live load of 5,000 lbs. per lineal foot, which was a greater load than the truss was carrying at the time the bridge failed. No unit stresses were higher than allowable safe stresses, and a thorough inspection of the wrecked truss failed to reveal any causes for the bridge failure.

This bridge was constructed in 1906, when San Francisco was rebuilding after the fire, the best class of piling was very expensive and difficult to obtain, consequently, the pier piling secured

and driven was of mountain pine and spruce. Before purchasing this piling, the Railway Company thoroughly tested this class of timber and found same had a tensil strength equal to that of the northern timbers. However, this class of piling does not have the lasting qualities that the timber from the northern woods does, and its life is considerably shorter.

At the time of the bridge failure, a switching crew was engaged in switching gondola cars loaded with gravel from the S.P. transfer track to the Northern Electric Railway Company's yard track south of the river (Tracks A to B on attached track layout plans). In making this switch movement it was necessary to come out over the bridge, as the switch is located very close to the south end of the bridge. The cars were being handled by a steam locomotive which had been leased from the S.P.Co. for freight service. This locomotive was an eight-wheel passenger type locomotive, the gross weights of the locomotive tender and cars, with contents, were as follows:

Locomotive----------	98,000 lbs.
Tender loaded----------	100,400 "
S.P.Car #91050----------	147,800 "
" " #91026----------	146,000 "
" " #91023----------	149,200 "
" "" #91285----------	149,900 "

The train with the locomotive backing had pulled onto the bridge far enough to clear the switch when the air was applied by the engineer and the bridge collapsed. At that time the locomotive, three cars and the front trucks of the tender and also the front trucks of the fourth car were on the south 150 ft. span, which was the span that collapsed. The accompanying photographs show the condition of the wreck. The south pier was totally destroyed; all of the 19 piles were broken off and the next supporting pier was pushed north approximately 12 inches, and two piles were broken off. Immediately after the collapse of the span, the clearing of the wreckage began, and some of the timber of the south pier was burned that night to furnish light for

the workmen. However, the tops of nine of the 19 piles in the south pier were found and all were thoroughly decayed at the point of breakage. Thirteen of the 19 stumps were examined and showed the same condition as the 9 pile tops examined. These piles were so thoroughly decayed that there was no sound wood in them where the fracture occurred. There was from four to six inches of wood in the condition commonly called dry rot where the wood seemed more or less firm, but on close examination proved to be brittle and "punky". After excavating around these pile stumps, same were tested near the point of fracture and it was found that a pick sunk into the center of most of them could be pulled out with one hand bringing with it a piece of decayed wood as large as a 2-inch cube. The other six pile stumps in the south pier were inaccessible on account of wreckage and debris piled over and around them.

The point of greatest danger in all timber bridges of this class is at the ground line where the timber is exposed to the air and is alternately wet and dry. Filling at the south end of the bridge and around the south pier to a depth of two or three feet had been done about three years ago. This filling was made apparent while excavating around the pile stumps, but how much had been done could not be determined exactly. The fracture in the piles occurred at what was undoubtedly the original ground line; two or three feet above the point of fracture, in the nine pile heads examined there was considerable sound wood. With 5,000 lbs. live load and 1600 lbs. dead load per lineal foot of bridge, as shown by the stress sheets, these 19 piles in the pier that failed were each under a load of from 13 to 15 tons, and it is doubtful if in their decayed condition they were able to carry such a load. They could probably resist a considerable direct load while unable to stand even a slight transverse strain.

The failure of the bridge was caused by the decay of the piles to such an extent that they were unable to bear the direct load imposed upon them, and were also unable to withstand the transverse

strain put upon them by the sudden application of the airbrakes to the heavy load on the span. This sudden application of the brakes, even though the train was moving at a slow speed, caused the slack between the drawheads to run up and created an impact which forced the truss in the direction in which the train was moving, namely, to the north. This movement threw a transverse strain upon the piles, broke them off and caused the failure of the pier and the collapse of the span.

If the officers of the railroad are responsible for this accident, it is because the bridge was not examined thoroughly enough to disclose its true condition; and that if its true condition was known, that an order restricting the loads which were to be imposed upon the bridge was not issued when it was found that the pier was defective enough to require replacement. However, it is only fair to the railroad officials to state that the movement of gravel over this bridge is unusual and is much heavier than their usual trains. The cars in the accident were loaded in the neighborhood of Oroville, and were brought by the S.P.Co. to Sacramento for delivery to the Oakland, Antioch & Eastern R.R.Co. It is usual to deliver this material on the interchange track of the Central California Traction Co. (This track is also used for the same purpose by the Northern Electric Ry.Co.), located on Front and X streets, where the Northern Electric Ry.Co. secure the cars and take them across the Sacramento River and deliver them to the Oakland, Antioch & Eastern Railway.

On Monday, the day of the accident, due to the heavy traffic for the State Fair, this track was filled with cars and the S.P. Co. was unable to place the gravel cars as customary. The cars were taken about 2½ miles from this point to a connecting track between the Northern Electric Railway Co. and the S.P.Co., near the American River, and delivered there. It was while switching these cars to take them back over the track of the Northern Electric Railway Company that the accident occurred.

In August of this year a general inspection of the bridges on the Northern Electric Ry.Co.'s lines was made by Assistant Engineer Brown, accompanied by General Bridge Foreman McGregor. This particular bridge was inspected by Mr. Brown, McGregor and Bridge Foreman Brewster about August 10th, and a report of its condition and recommendation was made by Mr. Brown in his general report of bridges rendered to the General Manager on August 15, 1913. His report of this bridge is as follows:

"1. 2A - American River Bridge.

Description: 6 Pile Piers, 19 to 30 piles each 5 - 150 ft. spans. One panel trestle approach south end; 2 panel trestle approach north end.

Condition: Approaches good for at least one year. Pier 1, south bank, 10 of the 19 piles need renewal. Piers 2, 3, 4, 5, river piers; the piling in good condition. Pier 6, north bank pier, needs 9 of the 19 piles renewed. Floors of piers are just now being renewed, and the trusses are in good condition.

Recommendation: Reinforce piers 1 and 6 by bolting short timbers to the bad piling. Piles are only affected for a distance of 2 feet below to 2 or 3 feet above ground. The short timbers would, by being bolted to good sound timbers below and above, extend the life of the bank piers to such time as the stream piers would have to be renewed."

Shortly after receiving this report Mr. Schindler, the General Manager, accompanied by Mr. Rowray, the Superintendent of the Company, and also the Superintendent of a large bridge contracting firm of San Francisco (Thompson Bridge Company), inspected this bridge and their decision was, in regard to the shore piers, that they were safe until they could be conveniently renewed. However, Mr. Schindler decided that these shore piers should be replaced by concrete instead of following the recommendations of Mr. Brown, and cement had been ordered, and piling for false work was on the ground at the time of the accident.

Mr. Schindler is a civil engineer, and has had considerable bridge experience, and inasmuch as temporary bents, at a cost of less than $100.00 could have been placed which would have made this span safe until the permanent concrete pier was erected, I am satisfied that the true condition of the piling was not known, and that all persons who inspected the bridge were not aware or had forgotten the fact that a fill 2 ft. or 3 ft. around the south end of the bridge and the south pier had been made, and thus they failed to examine the piles at the critical point, namely, the original ground line, which is the place where the piles failed. Mr. Brown says that he did not know of this filling, which is undoubtedly the case for the piles fractured at a point from two to three feet lower than the lowest point reached by Mr. Brown in his examination.

The cause of this bridge failure was the decayed condition of the piling in the south piers, which were unable to withstand the stress placed upon them by the heavily loaded gravel train and engine being brought to a sudden stop on the span by the application of the air brakes.

Attached to this report and made a part thereof are four photographs showing the wreck of the collapsed span and train, two plans of the truss over the American River, two plans of pile piers, two strain sheets and a plan showing the track layout at the American River bridge.

Respectfully submitted,

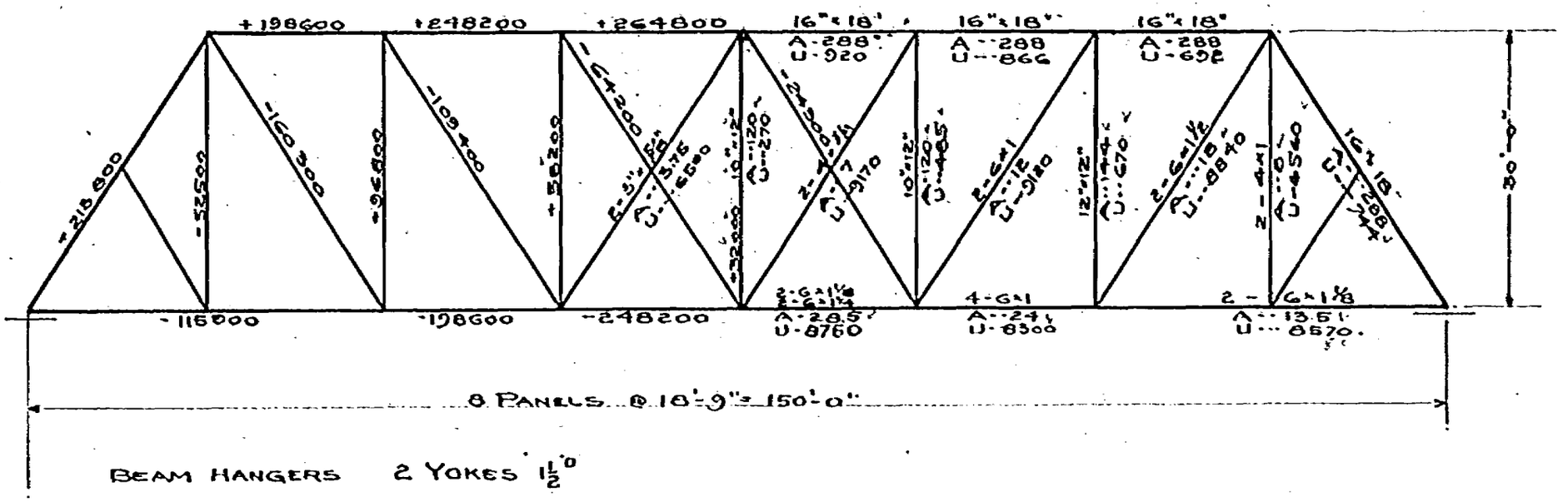
W. C. Eaves

Chief Engineer.

WCE:L

STRESS SHEET
150 FT. COMB. SPAN.

L.L. 4000* LIN FT
D. L. 1600* " "



BEAM HANGERS 2 YOKES $1\frac{1}{2}^{0}$

A= ACTUAL AREA OF MEMBER.
U= " STRESS PER SQ.IN. ON SECTION.

Timber Column Formula

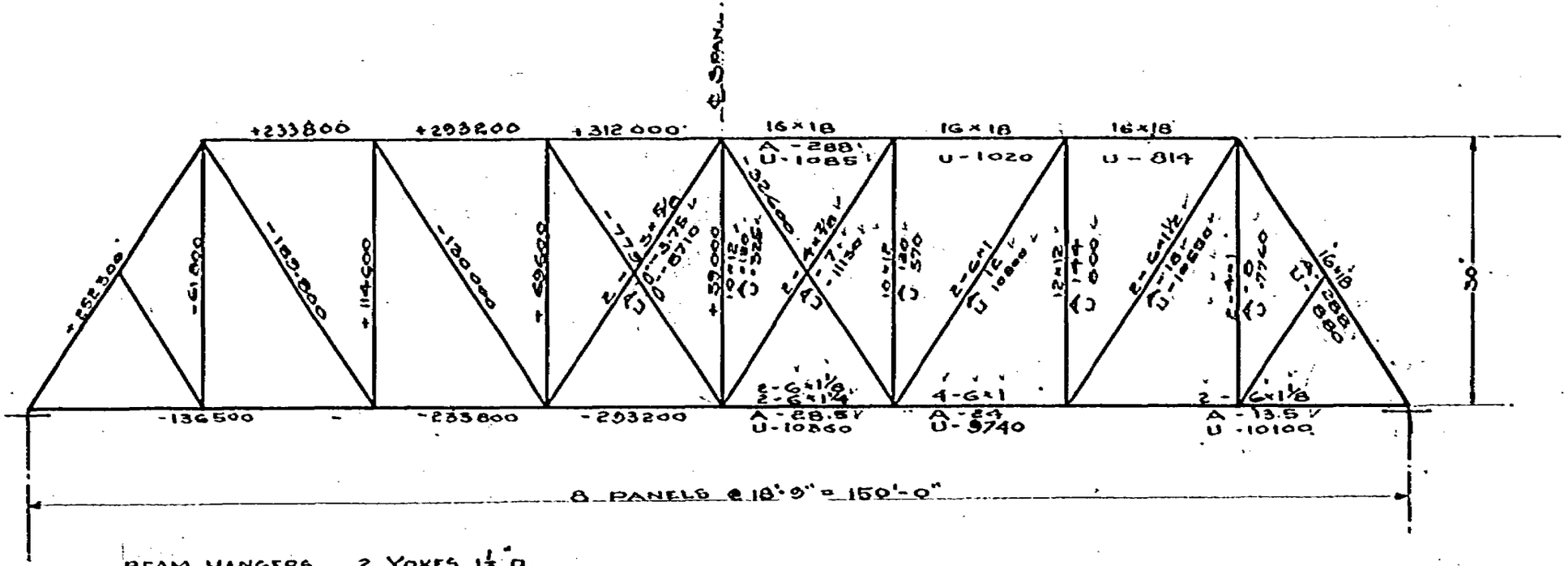
$$U = A\left(1 - \frac{l}{50d}\right)$$

A= allowable unit stress
l= length in feet
d= least side in inches

(S.P. practice)

Stress Sheet.
150' Comb. Span.

L.L. 5000# LIN. FT.
D.L 1600# " "



BEAM HANGERS 2 YOKES 1½" D.

A - ACTUAL AREA OF MEMBER.
U - " STRESS PER SQ.IN. ON SECTION.

"E X H I B I T S."

Accompaning

REPORT ON ACCIDENT

of

NORTHERN ELECTRIC COMPANY.

at

AMERICAN RIVER BRIDGE

SACRAMENTO, CALIFORNIA.

SEPTEMBER 9th - 1913.