IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE LOS ANGELES AND SALT LAKE RAILROAD, UNION PACIFIC SYSTEM, NEAR CLAYTON, CALIF., ON FEBRUARY 15, 1927.

On February 15, 1927, there was a derailment of a passenger train on the Los Angeles and Salt Lake Railroad, Union Pacific System, near Clayton, Calif., which resulted in the death of 1 employee and the injury of 12 employees and 9 passengers. The investigation of this accident was made in conjunction with representatives of the Railroad Commission of California.

Location and method of operation

This accident occurred on the First Sub-division of the Los Angeles Division, which extends between Los Angeles and Yermo, Calif., a distance of 163.8 miles. In the vicinity of the point of accident this is a single-track line over which trains are operated by time table, train orders and an automatic block-signal system. The point of accident was at bridge 13.12, which spans San Jose Creek at a point about one-quarter of a mile west of Clayton. Approaching this point from the west the track is tangent for a distance of nearly 2 miles, while the grade is 0.56 per cent ascending for eastbound trains, this ascending grade ending approximately at the western end of the bridge.

Bridge 13.12, beginning at its western end, consisted of one truss span, 110 feet in length, and two plate-girder spans, each 62 feet in length. These spans were supported by concrete abutments on the banks of the creek and by concrete piers in the bed of the stream.

It was raining at the time of the accident, which occurred at about 6.37 p.m.

Description

Eastbound passenger train No. 8 consisted of one baggage car, one dining car, three Pullman sleeping cars and one observation car, hauled by engine 7850, and was in charge of Conductor White and Engineman Ireland. It left Los Angeles at 6 p.m., passed Pico, the last open office, located 2.75 miles west of bridge 13.12, at 6.32 p.m., and was derailed at bridge 13.12 while traveling at a speed estimated to have been from 35 to 40 miles per hour.

All three spans of the bridge collapsed. The engine came to rest bottom up on the south side of the track nearly opposite the east abutment of the bridge, clear of the water, while the rear end of the baggage car was in the water, with its head end resting on the wreckage of the center span, the eastern end of which in turn rested on the east pier. The dining car sank to the bed of the creek on the 110-foot truss span and was partly submerged while the head end of the first sleeping car dropped to the bed of the creek, leaving the rear end of the car resting on the debris of the west abutment. The head end of the second sleeping car was also derailed. The employee killed was the engineman.

Summary of evidence.

Fireman Frazier, of train No. 8, said that after his train passed Whittier Junction, located a fraction of a mile east of Pico the speed was increased to about 35 miles per hour. Both he and the engineman were looking out of their respective cab windows as the train approached bridge 13.12, and Fireman Frazier said that the rays of the headlight were shining on the rails across the bridge, which apparently was all right and not sagging in any way while there did not appear to be an abnormal amount of water passing under the bridge; the greater portion of the water seemed to be close to the west abutment. As the engine entered on the bridge, working steam, Fireman Frazier glanced at the engineman who was looking at his watch, and at about this time he had a sensation of falling, the rear end of the engine seeming to drop down and then to sway toward the right there was no shock as would have resulted from striking something, but rather a sinking sensation as if some part of the bridge had given away. Fireman Frazier said that as nearly as he could determine the engine was then at the eastern end of the truss span.

When the accident occurred, Conductor White had finished collecting transportation and had started to return to the head end of the train. He estimated the speed at the time of the accident to have been a little more than 33 miles per hour and stated that he did not have any slow orders covering the territory in this immediate vicinity. The statements of Head Brakeman Crawley and Rear Brakeman Smith brought out no additional facts of importance. The statements of all the members of the train crew indicated that they did not feel any application of the air brakes prior to the occurrence of the accident.

The crew of westbound extra 6044, which passed over the bridge about one hour prior to the occurrence of the accident, said they did not notice anything unusual and that the water was no higher than it had been on other occasions. The conductor of this crew, who lived within a short distance of the bridge, said he paid particular attention to the fact that the water was not cutting away the embankment and that the stream appeared to be within its banks at all points.

Section Foreman Adams, stationed at Pico, said that when going on duty on the day of the accident he proceeded with his men to the eastern end of his section, 5 1/2 miles east of Pico, and then returned making an inspection of the various bridges. He reached bridge 13.12 at about 10 a.m., got off the motor car and walked across the bridge, which appeared to be in safe condition at that time. In the afternoon he was instructed to proceed to the Anaheim Branch where work was performed in connection with some washouts, not getting back to Whittier Junction until late in the afternoon. Westbound extra 6044 passed him at this point, followed by a signal maintainer who told him that everything appeared to be all right. At the time of the accident Section Foreman Adams, with his men, was at the station at Pico, and he said it was his intention to keep his men on duty that night but that he had not had an opportunity to send out a track walker before the accident occurred, the men at that time being engaged in protecting the track from washouts in the station grounds.

Signal Maintainer Lyons, who had bean following extra 6044, said the water under bridge 13.12 was not running any higher than usual at this time of the year, that there was no

accumulation of drift wood and that the banks were not being cut away by the water. He said he remembered paying particular attention to the west abutment, trying to determine the height of the water, but he did not notice any unusual condition at that point and on reaching Whittier Junction he told Section Foreman Adams that everything was all right. Similar statements were made by Lineman Jones, who had preceded extra 6044. Lineman Jones also stated that the greater portion of the water was running in a channel between the west abutment and a point a short distance east of the west pier, while east of the latter point there was no water at all.

F. M. Bigelow, supervisor of bridges and buildings, was a passenger on train No. 26 which was closely following train No. 8 and stopped a short distance behind it after the occurrence of the accident. Mr. Bigelow said he proceeded to the scene immediately and expressed the opinion that the water was not any higher than it had been the preceding year. It was not cutting away the west bank but after the cars had settled to the bed of the stream it caused the water to be diverted and resulted in considerable damage to the west bank. Mr. Bigelow was unable to make a detailed examination of the bridge that night but said that as nearly as he could determine the west abutment was the first part of the bridge to have failed. At this time the conditions were such that water could not possibly have gotten in behind the abutment although he said it might have worked up underneath. Mr. Bigelow further stated that an annual inspection had been made of bridge 13.12 in August, 1926, and at that time it was found to have been in good condition. It was customary in these inspections to note the extent of the erosion of the stream bed and if there was any appreciable amount of erosion, for example 2 or more feet, attention would be given to the matter. In this particular case, however, then the results of the inspection were checked with those of the previous annual inspection it was found that the distance from the tops of the rails to the bed of the stream had not varied.

Bridge Engineer Drew said he examined the bridge shortly after the occurrence of the accident and at that time he did not notice any cutting away of the west bank. Such a condition, however, developed during the night immediately following the accident. From his examination of the west abutment he was of the opinion that the water had been cutting underneath the abutment, undermining it and allowing the central portion of the abutment to break away and to fall forward to the bed of the stream. Mr. Drew further stated that bridge 13.12 was built at the time of the original construction of the line in 1901 and 1902, and that at the time of the accident it was the same as when built with the exception of the fact that a curtain wall had been added to the west abutment in 1917, and he said he understood that at the same time the south or upstream wing of the west abutment was rebuilt and carried deeper into the ground. The records did not indicate clearly the reason for the work which was done in 1917 but apparently the curtain wall was added for the purpose of avoiding the scouring effect of the stream. This curtain wall had been placed from 6 to 7 feet below the bed of the stream; no rip rap, however, such as is ordinarily used to prevent scouring, had been put in place. Mr. Drew also said that according to records made prior to the accident there had been little change in the bed of the stream since the bridge was constructed, and that according to the plans the west abutment must have extended 5 or 6 feet below the bed of the stream, and apparently this 5 or 6 feet of earth had been cut away by the flood waters at the time of the accident.

Mr. Drew further stated that on the night of the accident he also made an examination of the west pier, which had supported the eastern end of the truss span and the western end of the first girder span. The bottom section of this pier apparently had not been disturbed but the two upper sections had been forced off the bottom section and were found lying on the bed of the stream immediately east of the foundation. The breaks between the sections had occurred at the construction joints but the only possible defect indicated was that when the pier was built the surfaces of the concrete were not as thoroughly cleaned as should have been the case before the upper sections, or courses, were added. Mr. Drew did not notice any erosion or scouring around this pier at the time and said he did not think any settling of this pier which might have taken place could have had anything to do with the occurrence of the accident. It also appeared from Mr. Drew' s statements that he had inspected the bridge in company with Mr. Bigelow in 1926 and that at that time there was nothing about its condition to arouse any apprehension. Mr. Drew also said that there was a crack in the north or downstream wing of the west abutment but apparently this had not weakened the abutment in any way. In a memorandum made in connection with the investigation of this accident Mr. Drew said the record of the 1926 annual inspection showed that this crack ex tended from the top to the bottom of the wing. This crack had existed for several years and no change had been noted during the past three years.

Assistant Chief Engineer Adamson, who was division engineer of this division between March, 1925, and February, 1927, said he inspected bridge 13.12 in September, 1926, and according to the records there had been practically no erosion or washing away of the bed of the stream, the stream bed being only from 1 to 2 1/2 feet lower than it was in 1901. Measurements made after the accident, however, showed that the bed of the stream had been scoured out to the extent of about 5 feet in the territory between the west abutment and the west pier; there had also been scouring between the two piers, probably due to the damming of the stream by the derailed equipment. Mr. Adamson's opinion as to the cause of the accident was similar to that advanced by others; that is, that the water had undermined the west abutment, thus causing it to fail.

The records indicated that for the three days of the storm which had existed in this territory up until 6 p.m., February 15, the rainfall in the territory adjacent to San Jose Creek varied from 5.30 to 7.58 inches. Measurements made on February 17, which covered practically the full period of the storm and which were made after the flow of the stream had been altered by the derailed equipment, showed that the bed of the stream between the east and west piers had been washed out to a maximum depth of about 12 1/2 feet. Between the west pier and the west abutment, where the greater portion of the water had been running prior to the occurrence of the accident, the maximum was about the same, while the minimum was only 1 1/2 feet, this latter amount being sufficient to reach the curtain wall or apron which had been built at the west abutment. It further appeared that bridge 13.12 was designed for a Cooper's loading of E-50 and that with the type of engine in use on train No. 8 at the time of the accident the bridge was being subjected to a 5 per cent overload.

Conclusions

This accident was caused by the failure of the west abutment of bridge 13.12.

From the evidence presented, it is believed that the southern or upstream corner of the abutment was undermined by the flow of water in the creek and that it failed under the combined weight of the 110-foot truss which it supported and the engine of train No. 8. The middle part of the abutment tipped forward and over, having been broken from each of the wings by vertical cracks. The southern or upstream wing was also tipped forward to a considerable extent and it settled obliquely in a downstream direction. The northern or downstream wing remained in place substantially undisturbed.

The middle part of the abutment, when it pitched forward under the weight of the train, carried with it the 110-foot truss, crowding the middle span of the bridge in an easterly direction, which in turn detached two concrete blocks from the west pier. The concrete separated at joints between different days' work in its original construction. The middle span, itself forced easterly over its east pier, in turn forced the eastern span to overlap the east abutment; in fact, the entire bridge was carried forward in an easterly direction, all resulting from the failure of the west abutment. The speed of the train enabled all this to happen before the collapse of the bridge was complete.

Concerning what premonitory signs of failure existed before train No. 8 came upon the bridge can only be a matter of conjecture. Very likely, however, evidence of approaching failure was not lacking in the condition of the west abutment. There were probably cracks in the concrete, of pronounced degree, indicative of weakness. There was no reinforcing steel or iron bars in the construction of the abutment. The comparative weakness of concrete in tension is well known. It should lead to great care in the inspection of concrete structures which are not adequately reinforced. The separation of the west pier at joints, however, is not so grave a matter when compression loads only are to be sustained.

The eroded banks of the river, immediately upstream, should have been a sufficient warning of the probable danger of undermining and have led to the taking of corrective measures. It does not appear from the evidence that proper engineering care and maintenance was exercised in respect to the west abutment which was so obviously exposed to erosive conditions.