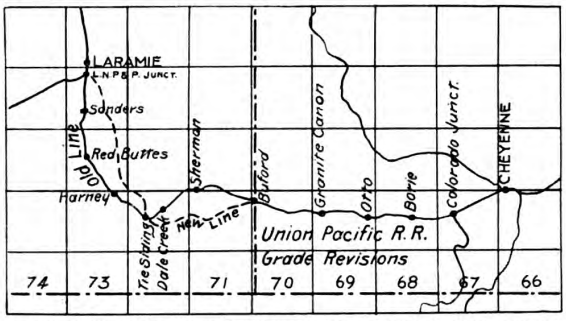
HEAVY FILLING ON THE UNION PACIFIC.

One of the heaviest pieces of railroad grading which has ever been undertaken in the West, and for which the progress attained in doing the work has been equally remarkable, is the reduction of important grades on the Union Pacific Railroad during the past three years; and of the great work of improvement undertaken by this company, perhaps nothing in the West can compare in magnitude with the work completed the past season on the Wyoming division in the reduction of the heavy mountain grades between Buford and Laramie, Wyoming. A general account of the rebuilding was given in The Railway Age of November 2, 1900.



OLD AND NEW LINES BUFORD TO LARAMIE, UNION PACIFIC RAILWAY.

Starting at Omaha, at an elevation of 1,031 feet above sea level, the Union Pacific road reaches Cheyenne, Wyo., on easy grades, in an almost direct westerly line, 519 miles distant, at an elevation of 6,050 feet.

From Cheyenne west to Laramie, a distance of 57 miles, crossing the summit of the Rocky Mountains at Sherman, the problem of railroad construction and railroad operation is difficult.

The present summit of the Rocky Mountains on the line of the Union Pacific is at Sherman, at an elevation of 8,247 feet above sea level; the summit of the new line is about 3 miles south of Sherman, at an elevation of 8,001 feet above sea level, thus effecting a saving in elevation of grade 246 feet, in a distance of about 7 miles, and at the same time eliminating the Dale Creek bridge, just west of Sherman—a steel trestle over which the road has been operated for a number of years.

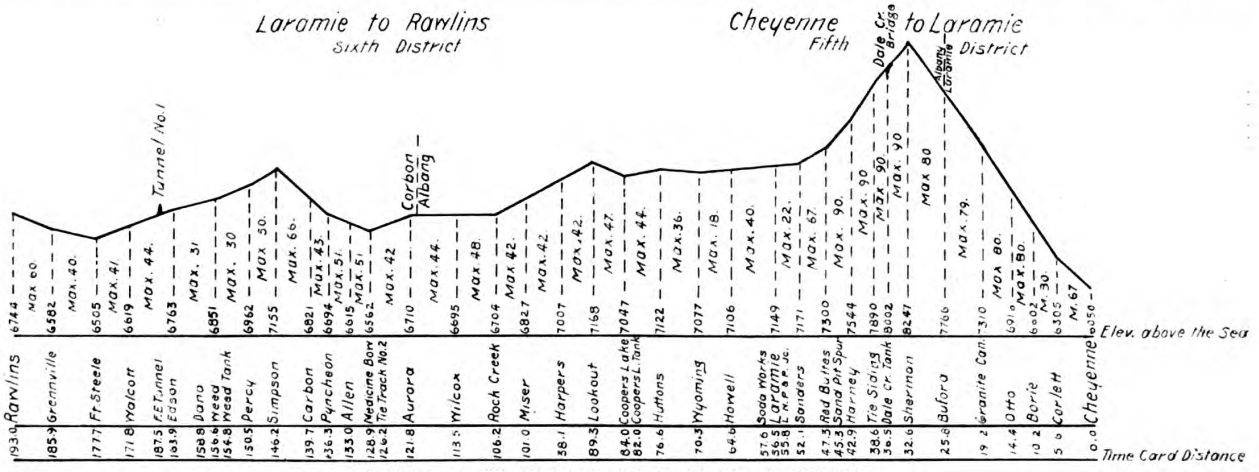
In the construction of the new line all bridges have been eliminated, and the tremendously deep canyons, over which the road must traverse, have been filled with solid embankments. The immense drainage area is taken care of by large substantial concrete and iron pipe culverts.

From a constructive standpoint, the line is chiefly remarkable for the amount of material required in the construction of the immense embankments and the building of a 3,000-foot tunnel just east of Tie Siding.

The construction of this new line has involved the excavation of five million cubic yards of material, one-third of which has been solid rock, exclusive of the tunnel excavations, or something over 160,000 cubic yards per mile for the single track roadbed.

Proposals for the construction of this line were asked for on the 15th of March last, and the contract for same was awarded on the 19th day of April following.

Work of construction was begun immediately with a big force of men, teams, steam shovels, etc.; no less than 20 steam shovels, with their full equipment of cars and locomotives, in addition to several thousand men, and teams, being employed on the work. So rapid has been the progress that the work from Buford to Dale Creek was entirely completed on December 1 last, and the whole line will be completed the present month, the contractors, however, having in their contracts until September 1 next to complete the work. All outside work has been practically completed, there only remaining at present some work in taking up the benches in the tunnel, in order to complete the whole line.



PROFILE OF WYOMING DIVISION, UNION PACIFIC RAILWAY.

A profile of the Wyoming division as heretofore operated is given in one of the accompanying engravings. After many careful studies and surveys of the problem presented, it was decided to construct an entirely new line from Buford to Laramie, a distance of 31 miles.

The new line branches off from Buford, a station 26 miles west of Cheyenne, and traverses the country south of the present line for a distance of 14 miles, where it crosses at Tie Siding the present constructed line at grade. From this point northwest to Laramie, for a distance of 17 miles, the new line practically parallels the present constructed line at a distance of about 3 miles to the northeast. The old and new lines are also shown herewith.

While the construction of the new line does not materially shorten the alignment between Buford and Laramie, it does, nevertheless, make a reduction in the grades of about 50 per cent from the grades on the present line, and very materially improves the alignment of the present road.

Some of the embankments of the new roadbed have been remarkable for their height and large quantities of material required for their construction over seemingly short distances, while there are many short embankments on the line which require from 100,000 to 300,000 cubic yards to make the fills the height of the same, varying from 50 to 100 feet.

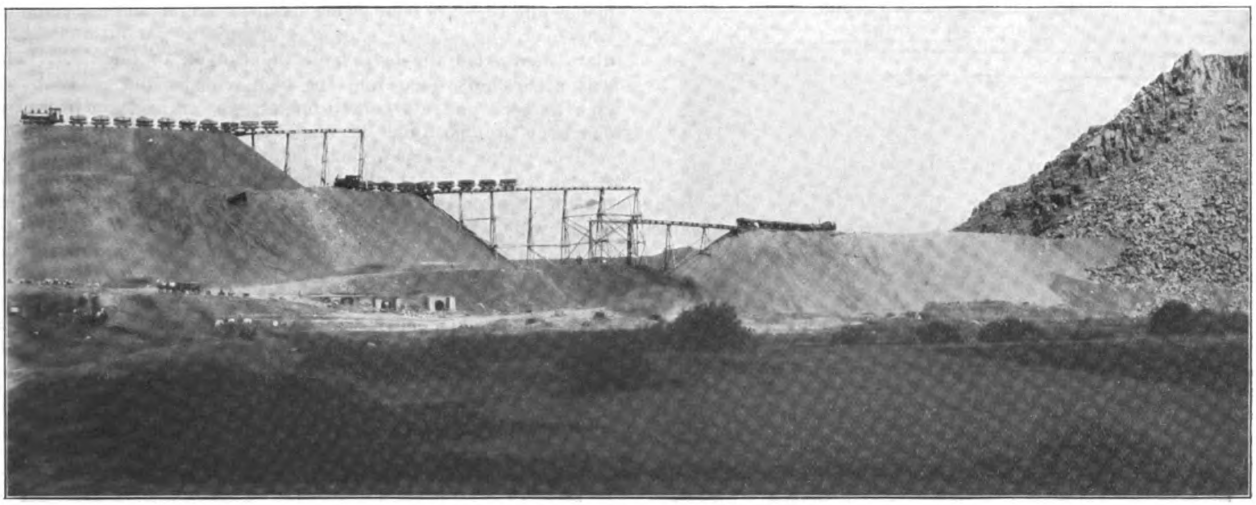
The two most difficult embankments constructed were at the crossing at Dale Creek, southwest of Sherman, and the Sherman branch of Lone Tree Creek, southeast of Sherman. These embankments are remarkable for their height and the inaccessibility of material for making them. The embankment at the crossing of Dale Creek is 120 feet high, 900 feet long, and involved the handling of over 500,000 cubic yards of material to complete it. The two embankments adjacent to the Dale Creek fill required the handling of 250,000 cubic yards, or, all told,

something in excess of 750,000 cubic yards, within a distance of 1 mile. At the crossing of the Sherman branch of Lone Tree Creek, the embankment is 130 feet high at its deepest point, and involved the handling of over 350,000 cubic yards.

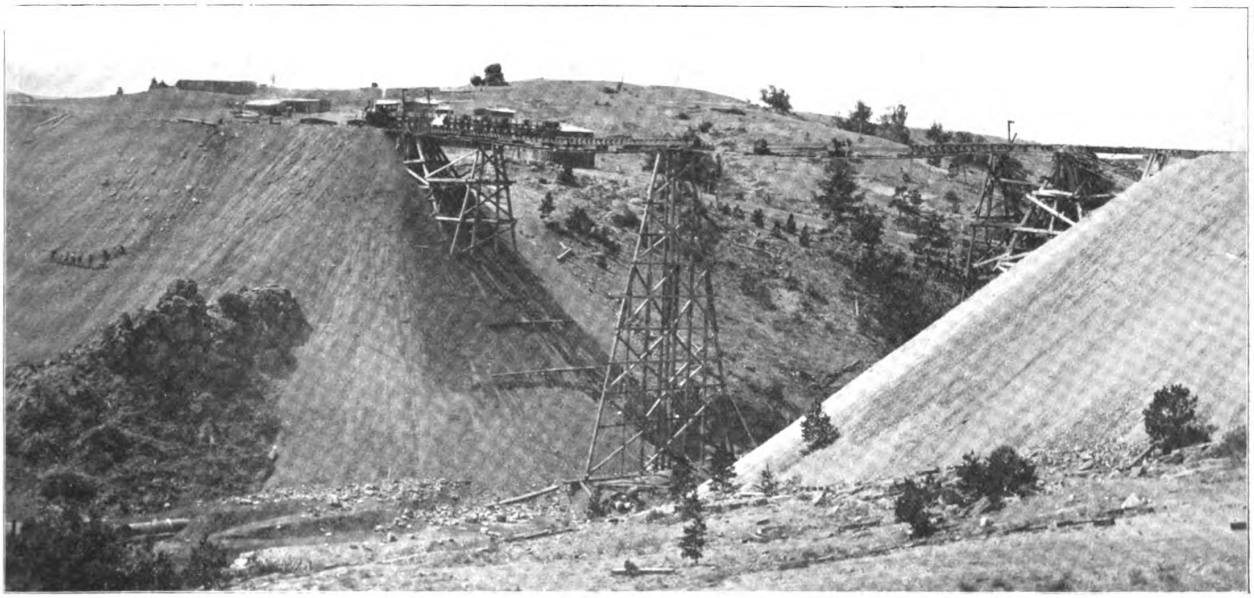
The building of these heavy embankments all along the line presented no unusual features of difficulty, with the possible exception of the embankments at Dale Creek and at the Sherman branch of the Lone Tree Creek. The methods usually employed and well known to engineers and contractors, of putting in the heavy bases of the embankments by means of wheeled scrapers and graders, up to economical working heights, was generally employed. For completion of the embankments to grade, the material was generally obtained at high elevations, from selected borrow pits in which steam shovels were operated, and the material transported by cars and locomotives to the various fills, in most cases over considerable distances, the method of steam shovel work being the usual one in filling the embankments from temporary trestles constructed for the purpose; but at Dale Creek, on account of the absence of material sufficient for the base, most of the material was brought from a distance, and the embankment put in from trestles in a succession of four lifts, an illustration of which work in progress is herewith shown.

At the Sherman branch of Lone Tree Creek, the rocky sides of the canyon presented no opportunity for obtaining material with which to put in the base of the fill by ordinary methods, and it was decided by the contractors to attempt to make the fill complete from grade, obtaining the material from borrow pits—the only ones which presented themselves as feasible for working—at a considerable elevation above grade, and some distance from the line. Accordingly, the canyon was trestled to a height of 94 feet, when operations were begun for filling.

A very substantial trestle of standard type was constructed, but it soon became apparent that it would be impossible to fill a trestle of greater height, and maintain it during construction. It was, therefore, determined to make the remaining part of the fill, some 300 feet in distance, and at a height of 130 feet, by the employment of some form of span bridge.



DALE CREEK FILL, UNION PACIFIC RAILWAY.

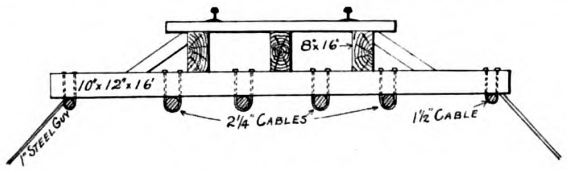


A CABLE RAILWAY FOR MAKING A FILL, UNION PACIFIC RAILWAY.

On account of ability to secure firm anchorage, a suspension bridge naturally presented itself for favorable consideration, but on account of the location made necessary for the towers, their great height, and the cost of the usual form of suspension bridge, the idea was abandoned; but in a modified form, a somewhat novel, and at first glance an unscientific, method, of a suspension bridge was used.

The method referred to consisted in the construction of two

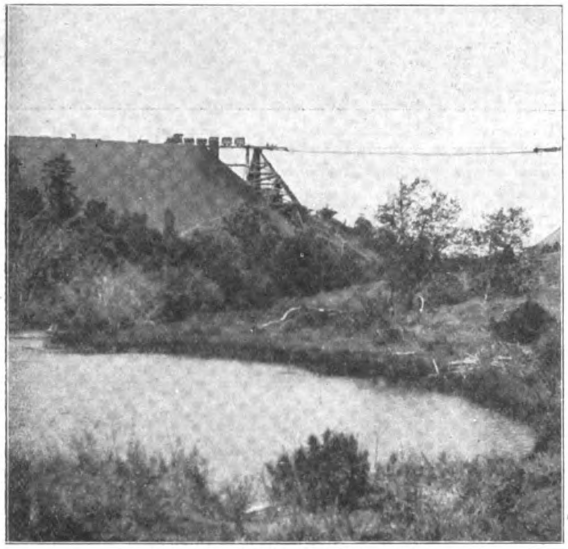
heavy timber towers, securely braced in all directions, being built on each side of the canyon to a height of 80 feet each to grade. Across the top of these towers were stretched six crucible steel cables; the four principal cables being 2¼ inches in diameter, upon which the floor system of the bridge immediately rested. In addition to these, there was an outrigger cable 1½



SECTION OF CABLE RRIDGE.

inches in diameter, on each side, the four principal cables being spaced 2 feet centers, the distance between the outrigger cables being 15 feet centers.

The cables were securely anchored on the west side in a heavy timber crib at the back of the tower, 25 feet below grade. On the east side the cables were anchored by means of 12 heavy eyebars, held in place by a shaft of steel 6 inches in diameter, framed in the heavy timber crib 20 feet below grade. Four 3⅞-inch turnbuckles, with 6-foot take-up, and two 2-inch turnbuckles, with 6-foot take-up, were employed in taking up the final adjustment of the cables after they had been stretched into proper position. Before putting on the floor system, these cables were tightened so that there remained only 31 inches' deflection in the span of 300 feet. With the floor system and load, the deflection became 44 inches. This probable deflection was calculated as closely as could be, and allowances made therefor in putting on the floor system.

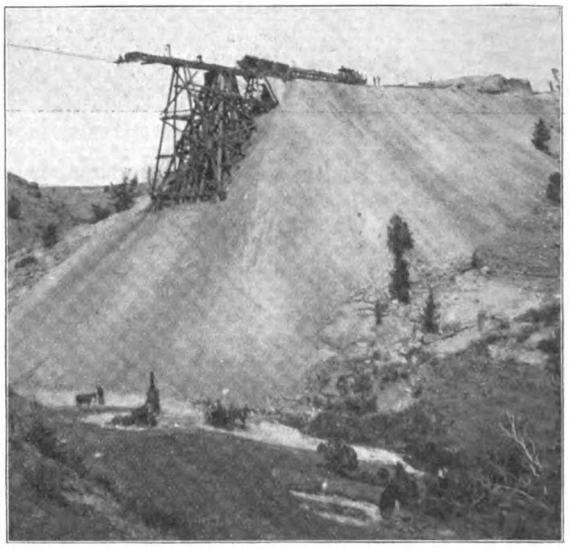


LONE TREE CREEK CABLE BRIDGE.

This floor system consisted first of 10 by 12 inch timbers, each 16 feet long, spaced 15-feet centers, and laid transversely across the six cables, and securely held in place by "U" bolts; and upon these were placed three 8 by 16 inch stringers, 30 feet long, for the entire length of the span. The stringers were blocked up to sufficient elevation to give the deck about 12 inches of camber in the center of the span. Upon the stringers cross-ties were placed, upon which the 3-foot-gauge track was laid. A 6 by 8 inch guard rail was likewise placed between the rails and securely fastened. The stringers, guard rails and "T" rails were cut accurately to 30-foot lengths, so that all joints in the deck came directly over each other, thus producing practically a rigid panel, each 30 feet, and permitting the cable to assume more or less deflection intermediate between each panel of 30 feet without disturbing the track. At intervals of each 30 feet, and attached to the 10 by 12 inch cross timbers, and securely fastened to them, were placed, on each side, steel guy lines, one inch in diameter, extending downward to just outside the slope stakes of the fill; a very necessary precaution in order to overcome the lateral motion of the bridge when under load, or subjected to the usual high winds, which were very prevalent.

With the bridge thus completed, the first trainload of rock was successfully dumped; but an apprehension having arisen, whether well founded or not, that the whole structure, under load while the cars were being dumped, might make a complete "flop-over," up side down, it was decided to put in an intermediate bent from the bottom of the canyon to the floor. This was accordingly done, and the bent, constructed of 12 by 12 inch timbers, and 126 feet in height, was framed and raised as one bent into position. It unquestionably served the purpose well of giving the span some additional stability; but, as was feared from the start, the difficulties experienced in maintaining this bent in position against the great pressure of rock and earth, which was dumped against it at the rate of 5,000 cubic yards each 24 hours, partially neutralized its apparent value in other directions.

The bridge was constructed within one week from the time work was begun upon it, and trains were successfully running and depositing their loads from it within three hours after the last cable was stretched and properly adjusted.



LONE TREE CREEK CABLE BRIDGE.

During the entire time occupied in making the fill, only one derailment to the trains occurred. This was due to the fact that, coming down the heavy grade from the borrow pit to the bridge, a train became uncoupled from the engine, and, crossing the bridge at a high rate of speed, one of the guard rails became displaced, precipitating the whole train to the canyon below. Fortunately the men on the bridge saw the train coming, and the only serious accident was to 15 dump cars, which were promptly charged to profit and loss.

Some comparisons as to the cost of this structure may be interesting. Had the timber trestles been extended across this 300 feet, the cost, at the contract price for which they were being built, would have been nearly $8,000. This structure cost, completed, $4,300, and all of the material, with the exception of the timber in the towers and a few feet of cable buried in the anchorages, was saved.

The work of construction of the line between Buford and Laramie was carried on by Messrs. Kilpatrick Brothers & Collins, contractors, Beatrice, Neb., and McArthur Brothers Company of Chicago; Kilpatrick Brothers & Collins handling the work from Laramie east to and including the big Dale Creek fill; McArthur Brothers Company handling the work from this point east to Buford. We are indebted to the latter company for the foregoing description and the photographs from which the engravings are reproduced.