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The location, construction, and maintenance of the Rabbit Ears Pass Forest Highway

Julian Greenway Huckins

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THE LOCATION, CONSTRUCTION, AND MAINTENANCE
OF THE
RABBIT EARS PASS FOREST HIGHWAY

by

Julian Greenway Hukins

THESIS

submitted to the faculty of the
SCHOOL OF MINES AND METALLURGY OF THE UNIVERSITY OF MISSOURI
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Approved by

Joe B. Butler
Professor of Civil Engineering
Foreword

The Bureau Public Roads, Department of Agriculture, has jurisdiction over the construction of, and Federal Aid funds expended on, the Federal Aid Highways throughout the United States, Alaska, and Hawaii. It may not be generally known that the Bureau is also in direct charge of the location, construction, and maintenance of all National Forest Highways under the Department of Agriculture and all National Park Highways under the Department of the Interior. District No. 3 of the Bureau Public Roads, with headquarters in Denver, is composed of the States of Wyoming, Colorado, New Mexico, and the Black Hills Region of South Dakota. The district includes several important National Parks, of which Yellowstone, Rocky Mountain, and Mesa Verde are probably the most famous, and many more National Forests which are too numerous to mention here.

The vast areas of the Public Lands of the Rocky Mountain section of this country may be likened to a chain stretching almost continuously from the Canadian Line to the Mexican Border whose links are the many individual National Forests and Parks that lie along the crest of and adjacent to the Continental Divide. Since most of these reservations are located at the higher altitudes and on some of the most rugged terrain to be found in the world, any proposed improvements within their borders must necessarily involve certain peculiar problems which are not encountered elsewhere. In this report, the writer has endeavored to present a comprehensive account of the many circumstances contributing to one of the major problems, together with the solution thereof.
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Introduction

Transcontinental Highway U.S. #40 traverses the United States from East to West and its termini are located at Annapolis, Md. and San Francisco, Calif. This route crosses the State of Colorado in an easterly and westerly direction and passes thru Denver the metropolis and capital of that state. West of Denver, it crosses the Continental Divide three times, at Berthoud, Muddy, and Rabbit Ears Passes, and follows the beautiful Colorado and Yampa River Valleys for long distances. These valleys, with their rapidly flowing streams which supply great quantities of irrigation water, are the centers of much agricultural activity, and some of the finest scenery and playgrounds to be found in America are to be enjoyed in the mountain sections; thus, the route is of great economic value and also serves as a medium by which many thousands of people may yearly avail themselves of vacation opportunities.

This route, with some variations, was traveled by prospector, stage coach, and covered wagon long before a railroad was thought of in the region and is still the shortest and most direct thoroughfare from Denver to northwestern Colorado. Kremmling, 120 miles northwest of Denver, is situated where the Blue River and Muddy Creek empty into the Colorado River and is an important trading center for the ranch country surrounding. In addition to being located on U.S. #40, it is the junction of that route with State Highways #9 and #11, the former of which serves a large territory to the south including the smelter towns of Climax and Leadville, and the latter is a direct connection with South 40 at Wolcott.
Steamboat Springs, west of Kremmling and famous for its hot springs and winter sports, is a junction of U.S. 40 with State Route #131 which leads from the well-known Moffatt County coal fields to the south, and is also the southern terminus of State Route #129 which begins at the Wyoming line and serves the placer mining and varied agricultural interests of the Elk River Valley. Kremmling and S Steamboat Springs are directly connected by U.S. 40, a distance of 58 miles, and indirectly by the Denver & Salt Lake R.R. (Moffatt Road) and the Gore Pass Highway, either of which route is over 25 miles longer.

The Rabbit Ears Range, a section of the Continental Divide, enters Colorado from the north and continues almost due South to a point 65 miles from the Wyoming line where it turns almost at right angles to the east and eventually joins the Medicine Bow Range. At the point of turning mentioned, U.S. #40 crosses the Divide twice, at Muddy and Rabbit Ears Passes, within a distance of 4 miles. This is explained by the fact that it was, and is, impossible to build any sort of road up the steep and treacherous Muddy Creek Canyon to the west of the Range's point of turning. Muddy Pass, 4 miles east of Rabbit Ears Pass and 30 miles west of Kremmling on U.S. #40, is a comparatively flat opening in the Range. It has an elevation of 8700 feet, is located on the eastern boundary of the Routt National Forest, and is also the southern terminus of State Route #14 which extends northerly and parallel to the Range up into Wyoming and thru what is known as the North Park country, an extensive cattle and sheep raising area.

The Routt National Forest, a vast area comprising over
950,000 acres, one-third larger than the State of Rhode Island, extends down along the crest of the Rabbit Ears Range for a distance of about 70 miles. Its lakes and springs are the source of all of the important rivers of northwestern Colorado and its upper slopes are covered with heavy stands of pine and spruce. The timber growths act as reservoirs in retaining the snow waters that later on in the growing season filter down on to the lowlands below and transform many a section of what once was desert into a fertile farm. The Forest was practically denuded by a great fire which raged its full length in 1867, but has since reseeded itself in most sections.

To the sportsman, the nature-lover, and the mountain climber, a visit to the Forest proves a real delight. Charming camp-sites, winding trails, splendid mountains, and many brooks and lakes await the summer visitor, especially the one who is prepared to leave the main highways available and explore the region in true "ruff-it" fashion on foot or horseback. The lake country is to be found at an elevation of about 10,000 feet on a broad plateau from 2 to 7 miles wide that forms the backbone of the Range. This plateau is studded with rugged mountains, several of which look down upon and shelter lakes of purest Alpine blue wherein the lively trout bids defiance to the angler.

Many of the peaks are approached by easy stages and can be climbed to their crests. Many forms of wild life are to be found, including deer and elk who make their summer homes high among the crags. The wild flowers are legion and some hardy varieties, including the famous Columbine which grows in great profusion, cannot wait for full summer but come up thru the snows as they melt away in the month of June. The mountains vary in height from Mt. Zirkel at 12,280 feet to Rabbit Ears Peak at 10,785 feet and, because of their position in
respect to the surrounding territory, stand out distinctly on the skyline, and also provide marvelous views from their summits. Rabbit Ears Peak is all that remains of a long extinct volcano and its unique form can be distinguished for many miles on a clear day. The mountain is located in the southern part of the Forest and 2 ½ miles north of the Pass and Highway bearing its name.

The Rabbit Ears Pass Forest Highway, #19 of the Colorado Forest Highway System, is located in Grand, Jackson, and Routt Counties of the State of Colorado and traverses the Routt National Forest at its narrowest width. It crosses the Continental Divide at an elevation of 9680 feet above sea level and extends down the western slope into the Yampa Valley and to within 7 miles of Steamboat Springs, Colo. The highway is an integral part of U.S. #40 and is that section of the arterial highway with which this report is chiefly concerned.

History

With the settlement of the Colorado River and Muddy Creek Valleys adjacent to what is now the town of "Rampart, Colo. about 1870, people began migrating farther to the westward over the Rabbit Ears Range and down into the Yampa Valley. A wagon road was developed up to and over the Range from the east and for years was used for coach travel and freight haul. Refer to Sketch Map in Appendix. Beginning at Muddy Pass, this road followed up the Grizzly Creek Valley to Rabbit Ears Pass, a distance of about 4 miles; thence, northwesterly along Middle Walton Creek Valley and up over the rolling top of the Divide for a distance of 8 miles; thence, northerly along the west ridge of the Divide for about 2 miles; thence, and finally,
down the steep western slope of the Divide for about 6 miles to the floor of the Yampa Valley - a total distance of 20 miles. The road dodged many a stump, was very narrow and tortuous in many places with its sharp turns and almost impassable grades, and hardly deserved the name of trail. Poor as it was, it provided an inlet and outlet to the Yampa Valley and afforded a means of transporting settlers and their goods to a promised land until the coming of the railroad to the Valley in 1906. Even after the railroad was built and train service established, an appreciable amount of freight was transported and much stock was driven over this route.

As the surrounding country, and particularly the Yampa River Basin, became more thickly settled, it also became increasingly evident that a better road, an auto road, was necessary. Automobiles were becoming more numerous, and forest development and preservation was reaching an important stage in the eyes of the general public; therefore, in 1914, the U.S. Forest Service became interested in the route, money was appropriated, surveys made, and new construction started at that time. This construction was carried on until 1919 when the new road was completed. Its location closely followed that of the previous trail with the major deviations near the top of the western slope, and will not be dwelt upon here. The road was 12 feet wide, grades up to 9% and curves with 25 feet radius being used in many cases, and no materials other than the natural soil used for surfacing. Lack of funds prevented the grade line being raised above the adjacent ground and side ditches were not wide enough to properly take care of surface and drainage water. Despite these conditions, and tho the road was closed by snow from six to eight months of the year, it provided better facilities for one of the most fertile valleys in Colorado, re-
moved a barrier to trans-state traffic, and certainly was a decided improvement over the old trail.

Following the completion of the Forest Service road, and for a period of ten years thereafter, the region adjacent to it saw a marked industrial and agricultural development. The road was subjected to heavier and heavier traffic which led to an ever-increasing demand for a safer and better thoroughfare across the Pass. The State had improved, or were contemplating the improvement of, the approaches on both sides of the Pass, and U.S.40 was fast coming into more general use as an arterial highway for transcontinental travel.

A description of the Forest Service road and the conditions leading up to its construction was given above for obvious reasons, but it might well be mentioned here that after a lapse of ten years its standards fell far short of present-day requirements. Its grade, alignment, and other features had been governed by a lack of funds and the topography of the country traversed rather than suitability for traffic needs. Maintenance by a small State Highway crew was curtailed by lack of funds and no betterments had been attempted. A combination of erosion by surface water and abrasion by traffic had worn the surface of roadway down until the rocky subgrade below was exposed in all too many places. Ditches, very narrow to begin with, had become almost obliterated on side-hill sections and drainage structures were sadly in need of repair. But more than all of this, the road, because of its general bad alignment, heavy grades, and slippery surfaces in wet weather, was very unsafe for modern high-speed traffic, and its low grade line prevented the efficient use of modern snow-removal machinery. In 1930, the average daily traffic was 400 cars during the height of the tourist season and 125 cars for about three
months in early Summer and early Fall.

In 1930, the program approved by the Secretary of Agriculture for the fiscal year 1931 included an appropriation of $110,000.00, of which $3,000.00 was designated for a location survey, for the beginning of construction on the Rabbit Ear Pass Forest Highway.

Reconnaissance

The proposed location and construction of the new highway involved several difficult problems each one of which must be given serious consideration if a satisfactory solution for all was to be found. In a country subject to very heavy snows with consequent high run-off, and at a high altitude where both men and machines work with reduced efficiency, the question of location is paramount since it affects all subsequent operations of construction and maintenance.

In this case, the problem resolved itself into the proposition of bringing a road up over 900 feet within a limited area of development, taking it over a high plateau exposed to the worst elements, and dropping it down 2500 feet in one slope series; all to good standards of grade and alignment which would allow maximum efficiency by automobile units under the circumstances imposed; all with a reduced snow hazard, the idea being that the road would eventually be kept open the year around, and that in a section where the yearly fall of snow varies from 350 to 450 inches; and all within a tentative estimate which was thought by several of the well-informed to be too small.

A gasoline engine loses from 15% to 30% of its sea-level efficiency when between 9,000 and 11,000 feet elevation, and a motorist traveling mountain roads in the winter season must, in addition, contend with icy and snow-packed surfaces; therefore, it
becomes imperative that grades on such roads be held down to the
lowest possible minimum, and that all sharp curves be compensated.
A 6% maximum grade together with minimum 150 feet radius of curva-
ture were decided on as the limits for the new work, tho it was
doubtful that they could be adhered to in all cases.

A preliminary investigation of that section traversed by the
Rabbit Ears Pass Highway by the writer, accompanied by P.V. Wooghead,
representative of the Forest Service, and beginning on August 4, 1930,
disclosed the fact that the old route would have to be followed
generally from Muddy Pass to Rabbit Ears Pass. From the latter west-
ward, across the more or less rolling plateau which was cut up by
many drainage systems, and down the steep western slope, there were
two possible alternates to the existing general route in the
Harrison Creek and Walton Creek watersheds respectively. Refer to
Sketch Map. Accordingly, reconnaissance was made in the Harrison
Creek Valley and Canyon, beginning at the Pass and crossing over Muddy
Creek and a low ridge into its headwaters. This trip occupied one and
one-half days and revealed, among other things, that drainage con-
ditions were very bad at the point where the deep valley merged into
a canyon, and that correct exposure to sun and light could not be se-
cured. The creek lay in a V-shaped canyon, very steep-sloped, and com-
posed of solid rock for much of its distance, and proper grade could
only be secured at prohibitive cost. Probable slides would raise
maintenance costs to a high figure and good alignment would be im-
possible to obtain. The route would be 2½ miles longer than the old,
and this fact, together with reasons cited above, caused its rejection.

The other possibility was the region embracing the Middle
Walton Creek to the north of and below where the stream was crossed
by the old road 4 miles west of the Pass. Reconnaissance was made in this territory, beginning at the crossing just mentioned; thence, northerly down the valley for about 2 miles to where it merged into a canyon; thence, down this canyon northwesterly for another 2 miles to where the creek flows out of canyon and over an escarpment, and falls almost vertically 1400 feet; thence, northerly and westerly along an almost vertical cliff for about 1 ½ miles to where the more rounded and typical western slopes were reached; thence and finally, down and along these rugged slopes to the end, a point on the floor of the valley about 4 miles south of Steamboat Springs. Reference being made to above investigation, the first 2 miles offered a fine water grade, good exposure, and fairly light construction. The second 2 miles were about the same with exception of costs which would be higher because of the rock encountered and steeper slopes. The 1 ½ mile piece below the Walton Creek Falls was the heaviest section encountered on the mountain since road would have to be benched in for its full width on the side of a vertical, solid-rock cliff. Costs were estimated to run $40,000 per mile for the stretch, but exposure was excellent, snow-removal conditions ideal, and the view left little to be desired. The remaining part below was situated on the disintegrated granite slopes which generally compose the western side of the Divide in this vicinity, and would entail heavy construction; however, it coincided with the almost identical terrain further to the south traversed by old road where the new construction would have to be of same type. This proposed line would shorten the route about 4 miles and materially lower in elevation a critical section which would otherwise be left up on top of the Divide and consequently exposed to heavier snows and much stronger winds. Good grades and
alignment could be obtained and maintenance costs would naturally be reduced by reason of the shorter distance traveled. The traveling public would be greatly benefited thru this reduction in mileage, and the line, as part of the proposed survey, was recommended to the Bureau. After inspection by S. A. Wallace, Assoc. Highway Engineer, it was rejected, however, because of what was considered too high first costs. Mr. Wallace thought that the general route of the old road was satisfactory and should be followed. This procedure was carried out by the writer on the first relocation, the new line deviating from the old as much as 1,000 feet for the purpose of improving grade, alignment, and snow conditions.

Location

Starting at Muddy Pass, a connection was made with a State Highway survey which had been run to that point, and the stationing was begun with O+ 00. Proceeding westerly up the Grizzly Creek Valley, with its fairly steep slopes and thick aspen growths, two sets of switchbacks were inserted into the line for the purpose of securing additional distance on the climb to the top of the Divide at Rabbit Ears Pass. This gave a 4.3 % ruling grade for the first 3 3/4 miles with 5.5 % the maximum except for one short stretch of 6 % near the top. Curves varied from 4 to 20 degrees with the exception of two of 150 feet radius on the switchbacks. Most of this section was located on the south side of valley, giving a poor exposure, but could not be avoided because of topographical conditions. This disadvantage was partially offset by designing wide outs and raising the grade line as much as possible. Several springs in marshy ground were encountered and were taken care of by recommending rubble-lined drains from their sources.
to the cross-road culverts.

Westerly from Rabbit Ears Pass, the line was run down a gradual slope, crossed over Muddy Creek, and up over a series of low ridges to the head of the Middle Walton Creek Valley. This valley, wide and flat in its upper reaches, was followed to where the creek was eventually crossed at Station 430, about 4 miles west of the Pass. This section of line traversed a rolling, loose rock, post glacial territory interspersed with some swampy tundra spots, and cut up sparingly by small drainages. This particular section of Divide is almost devoid of timber and the southwest winter winds thus allowed free rein to blow the drifting snows up and over any ordinary obstacle placed in their path. The section offered no particular location difficulties, grades and curves were easy, and the grade line was raised well above the ground to aid the winds in clearing the roadway of snow.

The last 4 miles on top of the plateau was crossed transversely by many streams whose valleys were negotiated at or near their heads to avoid high construction costs. This necessitated some sharp curves, all of which were below 16 degrees, however, except one of 150 feet radius at Station 601. There was considerable side-hill location here and excavation was classified as 50% rock, including both loose and solid; also, two stretches of 7% grade had to be used to avoid very poor alignment.

The foregoing description brings us to Station 615, 3 miles west of the Pass, and a point on top of the western slope of the Divide only 140 feet lower than the Pass itself. It was also the top of the Harrison-Walton Creek Divide, and previous levels had informed us that it was 2476 feet down to the floor of the valley below. As
mentioned before, the western slope of the divide is a series of rugged, rocky mountainsides cut up with many sharply defined drainages, covered with many large boulders left by erosive action above them, and also covered by thick growths of aspen, pine, and spruce. The old road was closely followed here, flattening sharp curves and eliminating some others in an attempt to secure suitable alignment. We had only progressed a short distance when it became increasingly apparent that we were on the wrong track. The elimination of curvature was tending to decrease distance and increase rate of grade at an alarming rate and despite all efforts to gain distance at every opportunity; however, it was decided to follow recommenda-
dations and run the line on down in the hope that information gained might prove of some value in later considerations. When the end was reached at Station IO69, a distance of 8.2 miles below the top, it was found that the average grade for the first five miles below this was 6.2%. Curves were still sharp and two sets of switchbacks, despite treatment, could not possibly be used. The last 3.2 miles had better alignment, an average grade of 4.6%, and might be considered satisfactory if it could possibly be joined to any future relocation of the 5 mile section immediately above it. This latter relocation was made in 1931 and will be treated later.

As a means of alleviating the unemployment situation in 1930, the Bureau was anxious to put some of the project under construction. Since plans for 5 miles of the east end had been worked up in the Denver Office soon after the notes were sent in from the field, bids were received on Section I9-R on October 16, 1930, and a contract for its construction was awarded to the Utah Construction Company of Ogden, Utah on Nov. 3, 1930. On June 16, 1931, a contract
for the construction of Sections I9-AI & O was awarded to the Book &
Ransom Construction Company of Ottawa, Kansas. These sections in-
cluded 8 miles from Station 264 (End of I9-B) to Station 687, a
point 1 ½ miles below the top of the western slope, and 2.7 miles
from Stations 932 to 1069 at the western end of project. The writer
had charge of this construction and did not return to the relocation
of that 5 mile section between Stations 687 and 932 until June, 1931.

Some additional investigation having been made of the lower
end of Harrison Creek Canyon before the time mentioned above, it was
believed that there was a possibility of backing up to about Station
676 on the construction section, turning the line farther to the
south, and using a narrow shelf, together with a short stub ridge,
which was found near the top of the north canyon wall as a means of
gaining distance and getting down into a more passable section of
the canyon. A stadia line was run over this route for about 1 mile;
then, westerly along the canyon wall for 1 ½ miles; thence, north-
westerly for another 1 ½ miles along the less rugged upper slopes of
the lower canyon; thence, and leaving canyon, over a steep point with
almost vertical sides and across a very deep gulch for a very short
distance to a point on a steep hill-side just below the old line and
about 90 feet lower in elevation; thence, northerly and parallel to
the first location for 1 ½ miles to the end at Station 932. This stadia
survey, when plotted up, gave information that led us to believe we
had at least approached the solution of a difficult problem, and in
addition, the very undesirable switchbacks, which, because of their
location, would never respond entirely to treatment, were eliminated
entirely. The new centerline was based on the previous stadia, and,
using the utmost care to stay within the limits prescribed by it, was
run out with very satisfactory results. The average grade on the section
was now 5.3% and all curves compensated for. Good exposure was ob-
tained, snow hazard reduced, better alignment secured; but the cost
had been increased 41% over the estimate for the section. The
Bureau accepted the new location, however, and a contract for Section
I9-A2 was awarded on October 16, 1931 to the S.J. Groves & Company of
Minneapolis, Minn. It may be mentioned that the first surveyed center-
line did not produce balanced quantities in some sections. Paper pro-
jections were made on these parts, and the projections later rerun in
the field. Section I9-A2 averaged over 60,000 cubic yards excavation
to the mile and was the heaviest single piece of work of its kind
ever placed under contract by District No. 3 of the Bureau.

In taking up further details, the complete survey, 20.7 miles,
will again be treated as a unit. Standard instruments were used for
running centerline and base line levels. Cross-sections were secured
by slope-board method, distances by chaining except for triangulation
in some instances, and determination of direction by solar observation.
Abney Level and stadia control were resorted to for preliminary line
and reconnaissance. The engineer’s camp for original survey was lo-
cated at Walton Creek Campground opposite Station 420, and all supplies
were trucked in from Steamboat Springs, a distance of 22 miles. Con-
tractor’s camp facilities were used during the later relocation. The
line from Station 0+00 to Station 925+35 was located within the
Forest boundaries and did not require that Rights of Way be secured.
That section from Stations 925+35 to 1089+00 crossed over private
lands, and the Rights of Way were acquired by purchase and condemnation.
Design & Estimate

The roadway was designed for 24 feet shoulder to shoulder width with widening on all curves above 6 degrees according to the latest approved standards, and widening for guard rail in dangerous and other appropriate places. This guard rail will be built under maintenance or separate contract later on when fills have thoroughly settled. Ditch widths varied from 5 to 20 feet according to topography, drainage conditions, etc. Earth and rock excavation was given up to 20% shrinkage on the former and up to 30% swell on the latter, according to conditions of haul, fill base, and classification. There were no major stream crossings on the survey. The larger streams were taken care of by reinforced concrete culverts, ranging in size from 4' by 4' to 10' by 8' and up to 166 feet in length. Corrugated, galvanized, metal pipe culverts were recommended for the smaller drainages and their diameters varied from 24" to 42", and their lengths from 32 to 226 feet. As good masonry rock was found at one location on the project, Cement Rubble Masonry was recommended for headwalls and inlets, and Dry Rubble Masonry for retaining and diversion walls. As mentioned several times, the grade line was at all times held as high as possible with respect to the adjacent ground to obviate the snow hazard, and this procedure necessitated the use of much borrow material in many sections. The borrow was provided for and staked in the field since lack of time prevented the inclusion of its design on the plans. Clearing varied from sagebrush, willows, and light aspen, alder, scrub oak, and juniper to heavy aspen, pine, and spruce, and was estimated for an average width of 90 feet.

Costs of the various items were estimated by comparing
materials and working conditions with those found on other isolated Forest Highway projects and State Highway projects nearby. The project was primarily one for the use of power shovels, supplemented by heavy hauling equipment, since a large amount of excavation was solid rock and would have to be moved longitudinally from cuts into fills. Suitable concrete aggregates could only be found in the valleys below each end of project, and consequently must be moved long distances by truck. Good and plentiful water was noted at several places adjacent to the route, and engineer's and contractor's campsites could be located at several strategic points on the line. Since the job was entirely isolated from all rail facilities, transportation to and from would be by cars and trucks. The nearest unloading point for heavy equipment was Sydney, a siding on the Denver & Salt Lake R.R. and 3 miles west across the Yampa Valley from the west end of project. Most of the local supplies were secured from Steamboat Springs, 7 miles from west end of project, by the engineer's and contractor's forces during construction. The reader is referred to Appendix for Survey Time Record and Survey and Plan Cost Record.

Construction

The construction season on the Rabbit Ears Pass project varied from about June 1st to November 1st on the east end, from July 1st to October 15th on top of the Divide, and from May 15th to December 15th on the western slope where the exposure to sun and light was best. The above periods were the maximum limits defined by heavy snow-fall and the resultant run-off in the Spring, and it is not to be understood that all of the time in the periods was good working weather. On the contrary, it is generally fair but frosty
during most of June, and snow-storms, accompanied by spells of very cold weather, may be expected at irregular intervals any time after October 15th. The so-called summer months of July, August, and September are generally clear and ideal for work, however, and the Colorado sun is noted for its penetration. For this reason, the contractors were advised to concentrate men, materials, and equipment on the work during the favorable season; and, as a whole, they deserve a great deal of credit for the splendid results obtained despite the short working season, together with many other handicaps.

The Utah Construction Company, principal member of the "Six Companies" now building Hoover Dam, moved on to Section 19-8 November 9, 1930, established camp opposite Station 102, and began clearing with a force of 25 men. No other operations were attempted because of the lateness of the season. The clearing was carried on until December 19th when a bad blizzard suspended work for the year. On June 2, 1931, the company moved in considerable equipment and resumed construction operations with a force of 55 men divided among clearing, culvert, grading ranges, etc. The company's equipment was in very bad shape and the general organization very inefficient with the result that the work was poorly done and progress retarded during the first two months of the season. After considerable remonstrance by the resident engineer, the equipment was repaired, two more shovels brought in, a change of superintendents made, and 50 men added to the force. This, together with a period of very fine weather, had the desired effect, and the progress was considered very satisfactory during the latter part of season. The company had started its reorganization too late, however, and was forced to suspend operations on October 27th with the contract about 92% complete. Due to the extremely heavy fall of snow that
winter, the run-off was late the next summer and the company was not able to resume operations until June 20, 1932. This company had had but little experience with highway work and their progress was very slow again in their third season. The work was finally completed and accepted on Sept. 1, 1932, however, and it may be said that the finished product left little to be desired. It should be noted here that it is the Bureau's policy to not place permanent surfacing on a highway until it has become well stabilized in all parts. For that reason, and because there were quite extensive parts of I9-B inclined to be soft and slippery in wet weather, the engineer had ordered the Utah Company to haul and place a considerable amount of selected surfacing materials on the sections that would inconvenience traffic, especially during wet weather.

On July 9, 1931, the Cook & Ransom Const. Co., who had been awarded the contract for Sections I9-AI & C, began operations on those sections. This company quickly established camp opposite Station 535, brought in two shovels, and went to work with a force of 100 men. The shovels were put on two shifts almost at once and this arrangement continued until October 1st when, because of cold weather, the night shifts were discontinued. At that time, the 8 miles of road on top of Divide had all been roughed in and part of it finished. The equipment was moved down the slope to Station 952 and started in on the lower section. This section was also roughed in by December 3rd when operations were suspended by reason of too much 30 degrees below weather. The contractor resumed work on May 28, 1932 and his work in the main consisted of building Cement Rubble Masonry headwalls, removing slides, dressing up banks and ditches, and putting the final finish on the roadway surface. The road was completed on August 11th.
and accepted for final payment on August 15, 1932. An idea of this company's progress, as compared to that of the contractor on Section 19-B who only moved 128,000 yards of excavation in 286 working days, may be gathered from the fact that with two shovels they built 8 miles of road with 160,000 cubic yards of excavation, much of it 35% solid rock, in 2½ months; and 2.7 miles of road with 75,000 cubic yards of excavation, most of it 60% solid rock, in 2 1/3 months, the latter during the latter part of season when conditions were very unfavorable at times. Reference is made to final inspection report on Sections 19-AI & C in Appendix. A considerable amount of selected surfacing materials were also placed by contractor on this section of the project.

On November 4, 1931, the S.J. Groves Company began clearing operations with 40 men on Section 19-AE. Considerable heavy equipment was moved to the location at that time, but other than drilling and shooting some cuts to be in readiness for the shovels in the following season, no excavation work was attempted that year. The work was closed down on December 15, 1931 and resumed on May 15, 1932. On the latter date, in addition to starting the clearing, culvert, and drilling work, the contractor began pioneering the line back up the mountainside from Station 935. As described under "Location", this part of project was located over a very rough terrain, and the cuts and fills being so sharply defined in profile, it was necessary to pioneer practically all of road before drilling equipment and shovels could be shunted to the sections they would work. See example - Plan and Profile from Station 910 to Station 842 - in Appendix. The company wished to finish the project during 1932, if possible, so as to avoid expensive finishing operations in the following year, but, like many
others who had worked on the Pass, they were doomed to disappointment, being forced to suspend work on December 1, 1932 with 96% of the work completed. The concern will have about one month's work in 1933, consisting for the most part of cleaning up slides and boulders, trimming slopes and ditches, and a final thorough blading and scarification of roadway. This company's work was very satisfactory and their progress excellent.

Engineering

With the beginning of construction operations on Section 19-2 in November, 1930, the writer established headquarters at Columbine Lodge, an Inn situated opposite Station 92 on the road, where arrangements were made to secure meals and lodging for a small crew. A party of three men rechecked the line and levels, making some necessary changes in alignment, and staked out some of the excavation before December 1st when the party was dismissed because of weather conditions. The writer stayed on with the contractor and made some necessary reconnaissance trips over on the west side before December 19th when all operations ceased for the year.

On June 1, 1931, the writer moved in two portable houses and established engineering headquarters opposite Station 96. A force of from 5 to 8 men were stationed here and arrangements made for them to take their meals with the contractor. On July 17th, another camp was established at Station 535, contiguous to the contractor's, and quarters were provided for from 3 to 6 men. Later on in the season, this camp was moved down into Tampa Valley when the contractor's efforts were concentrated on the lower section. During the month of
June and part of July, an additional force of 10 men was engaged in making the Relocation Survey hereinbefore described between Stations 676 and 932. These men and their equipment were also stationed at the east camp on Section 19-3. Upon the completion of the resurvey, these men, with exception of two, were sent to other survey projects in the District.

The size of the construction engineering force and their duties varied considerably, depending on the amount and diversity of construction work under way. The average force engaged during the peak of construction consisted of three instrumentmen, four rodman, three chainmen, and one truck-driver. Their duties, among others, included the running of line and levels, cross-sectioning, staking earth-work and culverts, setting blue-tops, tying in points, and making up estimates, etc. The resident engineer, with the part time aid of a Junior Highway Engineer, had practically all of the inspection duties, including that on concrete and masonry structures, excavation, and final finishing. All borrow was designed in the field, also, all of the quantities were rebalanced in the field office.

During one period in 1932, there were 5 shovels working two shifts each, 3 concrete structures being poured, 3 masons were engaged on masonry work, 3 large finishing crews engaged at widely separated points, - all in addition to drilling and firing crews, and clearing and clean-up gangs, and all in a mad rush to get some place before the first snows warned that the evening of the construction season was drawing nigh. Such procedure produced a lot of employment, and also forced the engineering crew to burn a considerable amount of midnight oil. The highest total force of men engaged at any one time was 493, and the largest total monthly estimate for the
three contractors on the four sections was $93,645.69. It was estimated that the highest total value of equipment on the project at any one time was about $190,000. The reader is referred to the Appendix for the grand total cost of construction items, not including the cost of engineering. The total engineering costs on all sections averaged 8% of the construction total - a very low figure when the isolation, working conditions, and topography of the country are taken into consideration. Of course, this engineering total does not include the cost of surveys and original plans which was charged to Lump Sum Surveys. The engineer's automotive equipment also varied in number at different times, but included one 2-ton Grumm Truck, two 3/4 ton Paige and Oldsmobile trucks, and one Chevrolet coupe with pick-up body attached.

In the early summer of 1932, the resident began the construction of a new engineering and maintenance camp 600 feet to the south of and opposite Station 540 on the new highway. The camp was located in a small park separated from the highway by a low ridge, and out of sight of traffic on the former. Structures include a 24' by 30' garage completely outfitted to take care of all kinds of road equipment, 18' by 24' cook-house with cooks quarters attached, a cold storage warehouse, and three other houses for office and sleeping quarters. Running water was supplied, a light plant purchased, walks and drives built, and the region surrounding policed up in good shape. All of the engineering and maintenance personnel and equipment were consolidated at this permanent camp on July 15th. The camp is considered a model of its kind by many, and it will serve the Bureau forces for a period of five years before being turned over to a State Highway maintenance force. Refer to View #31.
Maintenance

It was previously mentioned that the Rabbit Ears Pass Forest Highway had been maintained by the Colorado State Highway Department prior to the location of the new road. This State crew was small and generally varied in size from two to six men; and their work consisted of blading the road, cleaning ditches and culverts, and making necessary minor repairs. They also hastened the opening of the road in the Spring by removing snow drifts, and kept the Pass open in the Fall as long as their equipment, or lack of same, would let them. The crew generally held the road open until about December 1st of each year, when it was closed until about June 15th of the following year. Due to the contractor's operations, and the Bureau's desire to have him work as long as possible in 1930, the snow-removal crew successfully extended the period to December 19th of that year. The State crew continued to function until September 1, 1931, when the entire maintenance of the project was taken over by the Bureau Public Roads.

At that time, two trucks, one 3 ½ ton, and one 5 ton, with hydraulic dump bodies, and a blade grader, together with a crew of seven men, were sent to the project from Denver. This equipment was used to haul and place selected surfacing materials on bad sections of the new grade in addition to blading and maintaining sections which had been accepted by the engineer for maintenance only. It might be well to state here that the contractors were held responsible for the proper maintenance of all sections subject to traffic until completed and taken over by the Bureau as conditions warranted; however, they were not obligated for snow
removal on any section, whether or not under process of being con-
structed. In October, the smaller truck with part of the crew was
returned to Denver, and the other truck outfitted with a snow plow
of the reversible type. This plow was easily adjustable and removable
and did not interfere with the further use of blade grader for
blading surfaces and removing light snows. The described unit pa-
trolled the road in a satisfactory manner until Nov. 15th, when a
75 H.P. Monarch Tractor, equipped with a push plow was added, and
the two units kept the highway - a distance of 21 miles - open until
January 15th, 1932. During the Fall, and particularly during the
period just described, about 16 miles of the new wide grade had been
roughed in and, tho not finished, was so much better adapted to
snow removal conditions than the old road that traffic was turned
on to the new line after the subgrade had frozen to the point where
it could be supported. This left the old 5 mile section of road on
the western slope which must be used until Section 19-A2 was com-
pleted, and which was a difficult problem so far as snow removal was
concerned. The section mentioned was subject to bad slides which
would start as much as one-quarter mile above the road in the draws
and gulches and come tumbling down over the roadway without much
warning. They brought trees, rocks, brush and earth with them, and at
one point a depth of 80 feet of compacted ice and snow was built up
on the roadway. These slides required much hand work and were con-
sequently very expensive to move; besides, the old narrow roadway
did not allow a radius of action that would permit the snow plows
to work to very much advantage, and traffic was being held up at
too-long intervals. Because of the conditions described, together
with an almost unprecedented amount of snow-fall within a short period - 7 feet from January 8th to 15th -, further efforts were not made and the road was allowed to close on the latter date.

A caretaker was left at the east camp and arrangements made for him to record the daily snow-fall, weather conditions, etc. Other duties included that of shoveling off the roofs of the camp buildings towards Spring in order that the heavy melting snows would not cave them in. All buildings in the region are always left well-propped underneath in the winter, but even so, the pressure exerted by the snow and ice to which it turns is often-times enough to buckle and break them down. The fall of snow in the winter of 1931-1932 aggregated 431 inches, of which 187 inches fell in the month of March alone. The total was higher than the average fall over a period of 20 years, and was 110 inches more than for the season preceding which had been considered a mild winter.

Maintenance was resumed on June 1, 1932 with the completion of preparations and collection of equipment for removing the snows that had not previously melted off of the road. The month of May had been very warm and sunny, with the result that almost all of the road on the eastern and western slopes was exposed; and most of the big drifts were more or less concentrated in pockets at the higher altitudes. With a "Snogo" rotary plow, which had been brought over from Berthoud Pass - 60 miles east, and an Oakkosh 5 ton truck equipped with a push plow and pulling a blade when necessary, the road was cleared of snow by June 8th. The road surface was naturally soft, however, and the Pass was not opened up to traffic until June 12th when the surface had become dried out and compacted by the sun and the use of a blade grader.
A maintenance crew of nine men was used on the highway all summer and their equipment included two 5 ton Oshkosh Dump body trucks, a blade grader, a maintainer, and various small tools. Their work included that of maintaining the road surface, cleaning ditches and structures, building Dry Rubble Wall and blind underdrain, installing road signs and maintenance markers, and gathering and burning brush and dead timber which lay back behind the zone already cleared and cleaned up by the contractors. The crew also assisted in the construction of the new camp established in the middle of the project, and continued to place surfacing materials on sections of road that were proving unstable as time and traffic exposed them.

With the coming of snow in the fall, the trucks were again equipped with plows, and either plowed off or bladed off the roadway along with their other duties. The 5 mile section which had proved such a nemesis during the previous snow-removal season was now replaced by a new section of grade that was wide and well located out of the snow pockets that caused so much trouble before. While the road wasn't completely finished by the contractor, ie, the 5 mile section, the road surface was in fine shape and its width and location permitted plenty of room for the operation of modern snow-removal machinery. It was estimated that the two trucks, working both day and night when necessary, could hold the road open in good shape with the half-time help of the rotary plow, and this supposition was well supported by later experiences. The Bureau did not have available but one rotary plow in this section and it was desired that the one should be made to serve both Rabbit Ears and Berthoud Passes which were 60 miles apart. This was thought reasonable, since
the rotary " Snogo " had a road speed of 25 miles per hour and could make the trip between the two Passes in a very few hours in case of an emergency. The push plows throw out and push out the falling snow as far from the road as possible. As this process continues, the ridge is built up on each side of road until it reaches a height that prevents any additional snow being thrown over and beyond it. When this point is reached, the trench begins to fill up, and it is not long until its width is reduced, despite the further use of push plows, to the stage of impassibility for traffic. The rotary plow picks up the snow and ice in the road trench and throws it from 90 to 125 feet away where it can do no further damage. As the trench is cleaned up and widened out, it reaches the stage of a clear road for its full width, and the process described above is repeated. The Snogo rotary's average speed under full load is 4 miles per hour and it will handle from 8,000 to 11,000 yards of material in that length of time, depending, of course, on whether it is traveling up or down grade, density of the snow, and distance and direction that it must be thrown.

In connection with the maintenance operations, tests have been made of the density of snow during variable periods, the costs of removal by the various types of snow removal equipment have been compared, and the actual costs of every operation are accurately tabulated for future use and comparison. The views included with this report were, with the exception of a very few, taken by the writer during the last two years, and are submitted with the hope that they may aid the reader in grasping some conception of the obstacles met and conquered. Those illustrations pertaining to
maintenance operations are particularly descriptive, I think, and really portray the conditions better than they could be told in words.

The Rabbit Ears Pass Forest Highway is now being kept open for traffic by the equipment enumerated above, and costs to date would indicate that it is cheaper to hold the road open all winter than to let it close about the month of December and reopen about the first of June in the following year; and that is not taking into account the fact that in the former case the travelling public have an open thoroughfare which would otherwise be a bottleneck. If the highway is allowed to open itself in the early summer, it has been ascertained that the costs of repairing a road cut to pieces by the melting snows' erosive action mount to a high figure; and there does not seem to be a good substitute for the removal of snow and its consequent run-off from the highway just as soon after it falls as is possible with a good organisation and modern snow-removal machinery. If nothing else, the maintenance operations have proved that, as a whole, our location was correct, in that most of the snow pockets on the old road were eliminated and no new ones added.

Conclusion

In a country of "Magnificent Distances ", and where the highways and railroads are few and far between, any reduction of travelling time is vital to the inhabitants in that it concerns their social and economic welfare. The improvement described in
this thesis has considerably reduced the driving time from Denver
to northwestern Colorado, and has consequently affected all
communications on U.S. #40, of which it is an important link.
The new highway - a dream come true to those who fought their
way over the old road - provides a safe and well-built thoroughfare
thru a rugged and hazardous country, and in some measure, at least,
fulfills the desires of those who had long awaited the improvement.

It is also believed that, in the location, construction, and main-
tenance of the road, the public has been given the full measure of
value for all of the moneys expended thereon.

As the autoist, approaching the Rabbit Ears Pass Forest
Highway on U.S. #40 from the east, drives up the western slope,
over the top, and down the western slope, all in high gear and at
a speed practically governed only by good driving sense, he may
refuse to believe that he traversing a mountain pass and what once
seemed an impassable barrier. Coming from the west, the motorist,
protected by adequate sight distances and compensated grades,
climbs to the top in easy stages and may little realize when the
summit is reached that his own elevation has been raised almost
one-half mile within 30 minutes time. Going in either direction,
the traveller has the pleasurable experience of gliding over the
crest of the Continental Divide at 45 to 55 miles per hour, and
may be prone to forget that he or she is nearly 10,000 feet above
sea level and actually "On Top o the World".
No. 1. (See front Cover).  
"Springtime in the Rockies".  
Rabbit Ears Peak, elevation 10,785 feet, in background; view taken June 12, 1931.

No. 2. Left. Station 67-71 on new survey, indicating the type of old road eliminated.

No. 3. Below. Looking back at new survey - Station 735-720 - from bottom of upper Harrison Creek Canyon.
No. 4. Left. Station 915-935, showing rugged topography on Section 19-A2. Construction operations and Yampa Valley in background. White spots are piles of aspen ashes and not snow.

No. 5. Below. Taken at Station 901, and looking back to about Station 770 on 1931 Relocation. Yampa Valley below and Flat Top Range in background.

No. 8. Left. Looking back and easterly from Station 511. Some of contractor's equipment including 1 1/2 Yd. Thew Gasoline Shovel and 5-ton dump trucks.

No. 9. Below. Looking back and easterly from Station 260. Partially completed highway shown. View indicates type of road and country on top of Divide.
No. II. Stations 378-395. Finished road in upper Walton Creek Canyon. Cement Rubble Masonry inlet in foreground, and old road may be seen on hillside above.
No. 12. Left. Finished road at Station 490. Indicates type of Cement Rubble Masonry headwall and Dry Rubble Masonry diversion wall.

No. 13. Below. Station 430 – Walton Creek crossing. Indicates type of 10' by 8' R.C. Box Culvert on 30 degree skew.
No. 14. Left. Station 921 ahead. Shows contractor building pioneer road. Rock on right and part of fill is above grade. 44 ft. thru cut in background.

No. 15. Below. Taken at Station 113 looking back and easterly on completed road. Diamond Mountain in background. View taken in October, 1932.
No. 16. Left. Stations 615-621. Shows finished road from the high point on top of the western slope of Divide.

No. 17. Below. Bureau Public Roads maintenance equipment removing snow at Station 545. These 5 ton, 4 wheel drive, 110 H.P. trucks proved ideal for all types of maintenance work.
No. 18. Left. Stations 626-629. 60 Caterpillar pulling 8-yd. Caterpillar Wagon, also 60 Caterpillar and Ball-Dozer unit. There were eight of the wagon units on one section.

No. 20. Left. Stations 750-753, looking ahead and westerly. Taken after light snow and shows type of road and country on western slope.

No. 21. Below. Stations 292-300. Indicates about the maximum height that snow can be thrown up and out by push plows. As trench narrows down, rotary is sent for.
No. 22. Left. Stations 501-505. Road just opened after bad slide. There are only three places on the new road subject to these conditions.

No. 23. Below. Stations 765-770. Rotary Plow moving along at 4 M.P.H. and throwing snow from 90 to 130 feet. The ridge was originally shoved over to side of road by push plows.
No. 24. Close-up of "Snoco" rotary snow-plow. Mounted on 4-wheel drive chassis and powered by 175 H.P. Climax motor, this machine is operated by two men and snow can be discharged at any angle. Cost - $14,000.

No. 25. Rotary at work after three-day storm. Very heavy snow being discharged up-hill to avoid breaking off the trees below road.
No. 26. Left. Fish Creek Falls, one of the beautiful scenes to be found near the highway. This view was taken at 7:30 P.M. in September.

No. 27. Below. Taken from Station 920, looking down on the fertile Yampa Valley, 1000 feet below. Snow-capped Flat Top Range in background is 35 miles distant.
No. 28. Left, Harrison Creek Rapids below Station 730.

No. 29. Below, Some of the 1932 construction engineering crew. Five different schools represented here. Also shows type of 2 ton panel body truck used by engineering crew.
No. 30. Left. The writer, left, with G.A. Kennedy, Junior Highway Engineer, on reconnaissance trip in 1930.

No. 31. Left. Bureau Public Roads Engineering and Maintenance Camp established by the writer in 1932. A view of a "summer" camp taken in the early "Fall."

No. 32. Utah Construction Company's camp opposite Station 102 in month of January, 1932. This was taken before the heavy March snows of that year.
TIME DISTRIBUTION REPORT

1930 Location

Station 0+00 to Station 1069+00.

Travel to and from project ...................... 4 Days
Preliminary Reconnaissance ....................... 5 "
Actual Location .................................. 43 "
Moving Camp & Non-weather Working days .............. 14 "
Total time on Survey ............................. 66 "

Length of line surveyed ............................ 20.25 Miles
Time charged to survey ............................ 66 Days
Average length of line per day .................... .307 Miles
Actual time on location ............................ 43 Days
Average length of line per day of actual location .................... .471 Miles.

Party:

Chief of party, two instrumentmen, three rodmen, two chainmen, three axemen, one truck-driver, one cook. Total - 13 Men.
TIME DISTRIBUTION REPORT
1931 Relocation
Station 676+ 32 to Station 932+ 00.

Travel to and from project ......................... 4 Days
Preliminary reconnaissance .......................... 9 "
Actual location ........................................ 15 "
Moving camp & Non-weather working days ................ 6 "
Total time on survey ................................. 34 "

Length of line surveyed ............................. 5.133 Miles
Time charged to survey ............................. 34 Days
Average length of line per day ...................... .151 Miles
Actual time on location ............................. 15 Days
Average length of line per day of actual location ................ 342 Miles

Party:
Chief of Party, two instrumentmen, two rodmen, one chainmen, five examen. Total - 11 men.
SURVEY AND PLANS COST RECORD

Includes both the 1930 Location and 1931 Relocation

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Rabbit Ears Pass Forest Highway

Inspection made by C.E. Learned

Date inspection made: August 15, 1932


Length: 10,595 Miles
Type: No. 100, 24 ft. Standard
Class work: Contract construction
Bids opened: June 1, 1931
Contract awarded: June 16, 1931
Signed by Secretary: July 20, 1931
Count of time started: July 15, 1931
Contractor started work: July 9, 1931
Contractor shut down: Dec. 3, 1931
Contractor resumed work: May 28, 1932
Contractor completed work and contract accepted: Aug. 15, 1932

Time allowance: Total time allowed on this contract .. 300 days.
Total time used to complete contract .................... 207 days.
Per cent allowable time used ............................. 69.

Location: The Rabbit Ears Pass project is located on U.S. 40 between Kremmling and Steamboat Springs and crosses the Divide at Rabbit Ears Pass. The particular sections designated as 19-AI and 19-C, the first extending from Station 264+00, the western end of Section 19-B, to Sta. 687+00, just below the top of the western slope, and the second from Sta. 932+00, just above the Brenton Hill saddle, to Sta. 1069+00 which is the western end of the highway and where a connection is made with a Federal Aid project now under construction.

Type: The section has been constructed to the 24 ft. Standard as an earth graded road. An excellent roadway surface has been obtained by the use of selected surfacing materials during construction.

General: The bulk of the contract was actually completed a few days before this inspection, a crew of 12 men with equipment being held over for contractors camp cleanup and anything connected with the road which might have been overlooked by the Project Engineer. The road and right of way is in excellent shape and the only item that it will be necessary for the engineer to certify to after this inspection will be the final cleanup of the contractor’s camp-sites opposite Stations 540 and 1069.

The contract has been completed according to the plans, special provisions, and specifications for this work and the finished product is an example of the finest workmanship throughout. All shoulder
lines, both inside and outside, are true to line with the result that the road has a uniform appearance. The ditches are well-lined up, banks well-trimmed, and the masonry work on the structures, particularly the cement block, is very artistic and well performed, thereby adding greatly to the appearance of the highway. Drainage structures are all well located and well built and their sturdy and smoothly finished surfaces also add to the general appearance of the road. Both our engineer, Mr. Huckins, and Mr. Sanders, Gen. Supt. for the contractor, deserve considerable credit for the excellent piece of construction which will serve the public well and add to the Bureau's prestige in this state.

During both the survey and construction periods, considerable thought was given to designing a road which would improve snow conditions, and it is felt from my observations during the last year that desired results have been achieved. With the completion of the other sections now under construction, it is thought that it will now be possible to maintain an open road over what previously appeared to be an impassable barrier.

The lower 2.7 miles at the west end of project was taken over by Mr. Huckins on July 20th, and the remainder of project is now hereby accepted.

As soon as the project engineer has certified to the final cleanup of the contractors' campsites, it is recommended that the contract be accepted by the Chief Engineer, it being further recommended that the Secretary of Agriculture make final payment to the contractor.

Time spent on this inspection - 5 hours.

Signed Clyde E. Learned
Senior Highway Engineer.

I recommend that payment of final voucher be made as soon as the same has been certified to by me and submitted.

Signed A.E. Palen,
District Engineer.
MAJOR CONTRACT QUANTITIES ON CONSTRUCTION OF RABBIT EARS PASS FOREST HIGHWAY - 1930 to 1932.

Unclassified Excavation ......................... 710,000 Cu. Yds.
Uncl. Excavation (Structural) ................... 4,900 " "
Class A Concrete ................................. 1,002 " "
Reinforcing Steel ................................. III,987 Lbs.
Overhaul ........................................... 575,110 Sta. Yds.
Cement Rubble Masonry ............................ 593 Cu. Yds.
Hand Laid Rock Embankment ........................ 263 " "
Blind Rubble Underdrain ........................... 1,140 Lm. Feet.
24 Inch Corrugated Metal Pipe .................... 9,544 " "
30 " " " " ........................................ 1,462 " "
36 " " " " ........................................ 86 " "
42 " " " " ........................................ 142 " "
Clearing ........................................... 132 Acres.
Grubbing ........................................... 63 " "

Total Costs for all items (Contract) $435,000. 76.
PLANS FOR PROPOSED
PROJECT 19-A-2
ROUTE 19 RABBIT EAR PASS
STEAMBOAT SPRINGS TO MUDDY PASS
28 MILES CLASS 1
COLORADO FOREST HIGHWAY SYSTEM
ROUVT NATIONAL FOREST
ROUVT, JACKSON & GRAND COUNTIES
COLORADO

INDEX TO SHEETS

INDEX MAP

- LEGEND -
1930 Relocation
1931 Relocation

Note: The 1930 Relocation is actually a new location and is considered such in Report.

Approved:
DISTRICT ENGINEER,
U.S. DEPARTMENT OF AGRICULTURE
Approved:
Regional Forester,
U.S. FOREST SERVICE
Approved:
STATE HIGHWAY ENGINEER,
STATE OF COLORADO