

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
DISTRICT NO. 1

Final Construction Report

on

Transmountain Highway

West Side Project #287

Glacier National Park

Route No. 1-B, 1-C

By W. G. Peters
Associate Hwy. Engineer

Date _____

Approved _____
District Engineer

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APPENDIX:-

Notification of Completion of Construction
Landscape Architect's Acceptance
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Final Inspection Report
Final FR 58
Final Estimate Voucher



#15579

#15580

#15581

View from slope of Heaven's Peak, looking northeast showing general route of highway.
 "G" Granite Park Chalets site; "L" Loop, sta. 410, camp #2 site; "T" Tunnel site, sta. 444,
 "3", camp #3, sta. 308; "4", camp #4, sta. 268; "H" Haystack Butte, elev. 7405;
 "5" camp #5, sta. 98; "W" Garden Wall, Continental Divide; "O" Mt. Oberlin, elev. 8100;
 "C" Mt. Cannon, elev. 6800. Logan Pass between Mt. Oberlin and "Garden Wall". Sept. 12, 1926.

View taken four miles from highway.

Transmountain Highway, West Side Project #287,
Glacier National Park.

This report to supplement construction report of 1925 to form final report.

CONTRACTORS' OPERATIONS

At the close of activities by the contractors on October 31, 1925, preliminary work on the project had been done between stations 379 and 657/47, consisting of clearing, grubbing, grading and laying of some pipe culverts. The work totaled about 5% of the amount of the contract.

One 3/4 yard Osgood gas shovel was in use and at the season's close had worked itself over a "tote" road from station 498 to a point approximately below station 435. Due to the practical impossibility of getting such heavy equipment as a power shovel past the tunnel site at station 444, it was necessary to work the shovel up the valley of McDonald Creek to a point below the "Loop" at station 410 and thence up the mountain side to the right of way..

Headquarters Camp #1 had been established at station 580 and camp #2 at the "Loop." These two camps were to serve as bases for opening up the work quickly in 1926.

On April 1, 1926 the contractors began preliminary operations of opening up camps for the season's work. At this time freighting by auto trucks was possible to a point on the Mt. Cannon Section about 1/2 mile above the cribbing, which is approximately 18.5 miles from Belton, from where the hauling was done by caterpillar tractor and sled or wagon.

The 3/4 yard gas shovel was started immediately to work itself from where it was left in 1925 up to the right of way, this being reached at station 420 early in May. In the meantime a second power shovel, 3/4 yard steam Osgood, was put on the job to work from station 499 to the tunnel at station 444.

TRAILS AND CAMPS

As soon as camp #1 had been opened, crews of men began improving the existing trails toward Granite Park and to Logan Pass. The first crossed right-of-way at station 308 where camp #3 was soon constructed and from where a new trail was then built along the line to station 268, the site of camp #4. From this point the construction trail was continued up along the general route of the road, keeping on the right-of-way as much as possible. Where the cliffs were encountered it was

necessary to diverge from the right-of-way. This trail was built to about station 190 before the close of the year. The Logan Pass trail was used to reach the vicinity of station 96 where camp #5 was established and camp #6 at station 20. This building of "tote" roads and trails was one of the big overhead expenses of construction. By the end of July 1926 camps #1 to #6 had been established and were working to capacity, about 300 men being employed. Near the close of the season, about the middle of October, camp #7 was built at station 450 to accomodate the tunnel crew. Much tedious work was required on the part of the contractor to construct these camps in the excellent manner in which they were built, since all lumber for walls and floors, etc., supplies and camp equipment had to be either packed on horses up the steep mountain trails or dragged by the system of a sled or travois. In this matter of packing, a string of about 60 horses was in use at the peak of the season's work. After the camps were put in operation the packing continued in order to furnish supplies, explosives, culverts, tools, compressors, cars and track, etc. These various camps accomodated from 20 to 60 men each. Regardless of the difficulty and expense involved in the construction and maintenance of these camps, they were of a high order, well kept and the food furnished was always of the best.

Construction work in general ceased for the season of 1926 at the end of October. However, the tunnel crew continued to work until Dec. 15, 1926, when extremely cold weather forced a shut down. At this time 48% of the whole contract had been completed.

On April 1, 1927 the contractors again resumed active operations. Heavy snow fall and resulting slides during the winter made much extra work for the contractors. Steam shovels were used to clear the highway for early resuming of the work.

Since all camps had been previously constructed and established the opening of each was much simplified. Soon all were filled with station crews and day laborers and construction work resumed. The greatest part of the work was done each season in the four months of June to September, inclusive, August always being the peak month. The largest monthly estimate was for August, 1927, amounting to \$131,148.00. Work for 1927 was concluded on November 8th with 82% of the total contract completed.

October 1, 1927 was the date specified for completion of the contract, but due to an extension to include finishing and surfacing of the Mt. Cannon section, 3.2 miles in length, and other unforeseen obstacles, the completion could not be accomplished on scheduled time.

Work was again resumed on May 28, 1928, and carried along from camps 1, 4, and 5 on the same general lines as of previous years. This was the finishing year, with surfacing, wall and rail construction, and general polishing up of the project occupying the contractor's time. Showing the same steady progress as of previous years, the contractors brought the construction to completion on October 20, 1928.

CLEARING

The timber to be cleared from the right-of-way consisted of a fairly heavy stand of fir, hemlock, tamarack, cottonwood, cedar and birch, together with alder and yew brush. With the exception of the cliff and snow slide sections the clearing was medium in character from the end of the project, station 657/47, to station 123. From this latter point to 0/00 at Logan Pass the clearing consisted almost entirely of alder and yew brush with scattered spruce or fir.

The clearing of the right-of-way required no special means or equipment, since none of the trees was of large size. Hand methods alone were used, the usual procedure being followed of falling, bucking the logs into short lengths, piling and burning. A large percentage of the suitable timber was cut into wood for use of the various construction camps along the line.

The following portions of the right-of-way clearing were sub-let to station crews:

0 to 120/35, 242 to 269, 340 to 374, 406 to 416/50, 446/45 to 537, and 641 to 658.

Prices paid for this work varied from \$80.00 per acre for a brush section on the upper end of the project, to \$200.00 per acre for the heaviest work on the lower end. The net hourly wage of the station crews on clearing varied from \$0.64 to \$1.02, and strange to say, the latter was made on the lowest price per acre, \$80.00.

A total of 25.6989 acres of clearing was sub-let at an average price of \$147.00. This constituted 42% of the advance clearing or 36% of the combined advance and completion clearing.

Over the whole project the cleared width averaged 48.7 ft.

In the specifications two classes of clearing were defined:- advance and completion. The former was intended to include that within the roadway excavation area and the area under fills to a point approximately 3 feet below grade. Completion clearing was that to be done after blasting and after likelihood of damage to forest cover was past and included all remaining clearing to be done. The object of this method of clearing was to leave as much timber as possible as a protection against excessive damage from flying rocks in the blasting operations.

The specifications required that between stations 500 and 650 the first quality timber should be cut into merchantable lengths, and decked along the right-of-way. After the work started this procedure was not desired by the Park Service, and hence the contractor was allowed to otherwise dispose of this timber. The greater portion was used as fuel for camps and for the operation of the rock crusher plants at stations 640 and 632.

The estimated clearing was 60 acres of advance, and 30 acres of completion, a total of 90 acres. The final estimate gave 61.037 of advance

and 10.3154 of completion, a total of 71.4024 acres, or 79% of the total estimated.

Great care was exercised in the burning operations to avoid damage to the timber adjoining the right-of-way. During the first two seasons a Park Ranger was detailed to supervise this phase of the work. Only in one instance was there any damage from fire, this happening on June 4, 1926 at station 226+50 where the fire broke from the right-of-way and spread over about 60 acres on the side of Haystack Butte. However, little damage was done, and it is hardly noticeable from the right-of-way. Park officials, assisted by the contractor's forces, handled the situation so that within one day the fire was controlled and put out.

GRUBBING

The grubbing operations required no special methods or equipment. Included with contracts to stationmen, grubbing was sub-let over the following stations: 0 to 123, 216 to 232+50 and 242 to 268+50. at prices ranging from \$100.00 to \$150.00 per acre, and averaging \$110.00 per acre. This totaled 10.7088 acres or 24% of the job total of 44.5995 acres. On the whole project the grubbing averaged 30.8 ft. in width. Since the grubbing was carried on with the grading in a general way it was practically impossible to get reliable unit costs of grubbing.

EXCAVATION, UNCLASSIFIED

The excavation was let on an unclassified basis, and the use of power shovels permitted. With the exception of light work on the lower end of the project it was generally considered as a rock excavation job. Ten percent would be a fair estimate of the material usually classified as common material.

As it was practically impossible for the contractor to get heavy equipment lined up for work simultaneously along the line, even with the beginning of the second season, work on the difficult and most inaccessible portions was sub-let to station crews. The portions thus let were as follows:- 0 to 123, 216-232+50, 242-269 and 360 to 368. The crews varied in numbers from six to twenty. With the exception of the portion at the summit, stas 0 to 38, which was sub-let at prices of .80, .90 and \$1.00 per c.y., all roadway excavation was sub-let at .80 per c.y. As a general thing the station crews made very good wages, varying from .82 to \$2.04 net per hour, the average being \$1.15 per hour. A total of 195,275 c.y. roadway excavation, or about 38% was handled by stationmen.

The balance of the excavation was done directly by the contractor's forces, making good use of power shovels. The first season, July to November 1925, a 3/4 yd. Osgood gas shovel was used, working from sta. 657+47 to 499+50. Hauling was done first with dump wagons, but when the mountain side was reached dinky gas locomotives with cars and track were used. When Sta. 499+50, Granite Creek, was reached, the shovel began making its way along a

"tote" road following up McDonald Creek to a point below "The Loop" where ascent was started to reach the right-of-way. This was necessitated in order to pass cliff sections and especially the tunnel site at Sta. 442 to 444. Prior to this time a crew had been working from "The Loop", sta. 410 toward the summit in order to make a roadway along the cliff sections, stas. 385 to 370, to expedite work of the shovels in the following seasons. Beginning with 1926 another 3/4 yd. Erie steam shovel was started on the excavation, the gas shovel going ahead on the pioneer excavation. In 1927 a third shovel, a 3/4 yd. Osgood, was used in connection with the other two.

Ahead of the shovels went the compressor and drilling units, consisting of

4 single hammer Sullivan Portable Compressors.
1 double " " " "
1 " " Ingersoll Rand "

Jack hammers used were:

10 Waugh clipper drills
4 BCR 430 Ingersolls
1 DCR 23 "

Hauling of material was done both by trucks and dinky gas locomotives with cars and track, the latter being used to the greater extent. The hauling equipment consisted of

12- 2 yd. Western dump cars, 24" gauge
3000 ft. of track 20# rail
3- 3 ton Plymouth gas locomotives
1- 4 " " " "

This equipment was used with the three power shovels as necessary.

Explosives used on the entire project consisted of the following:

20% dynamite	188,500
40% "	170,500
60% "	6,000
Black powder	<u>135,000</u>
	500,000# or 250 tons

The 60% dynamite was used on the tunnel construction. Considering all the excavation, roadway, structure, half tunnel and tunnel totaling 552,822 c.y., and then deducting the 10% estimated as common material, it shows that the excavation required approximately 1 pound of explosive per cubic yard of material removed. The powder used for grubbing and in the quarry for the surfacing plant is included, but that was not of a comparatively large amount. The explosives used for grubbing could only be estimated since a considerable percentage of the grubbing was carried on as a part of the excavation, and the explosive acted to remove the material to be grubbed as well as to loosen the rock. Excavation by the power shovel was done by the contractors for about \$0.70 per cu. yd.



#12764. June 1926. Sta. 255 back showing stationman beginning excavation on steep rock cliff. Rock barred off in first operations. Note safety ropes used by laborers. Natural dump grounds below cliff. North gulch of Haystack Butte.



#15591. September 1926. Sta. 36 back showing fine example of rock slope in heavy work along cliff section. Slope about 1 to 20, cut being about 90°. Slope made in lifts of 8' to 10' by stationmen sub-contractors. Retaining wall needed at intervals with continuous guard rail. Mt. Clements, elev. 8764, in background, having perpetual snow and glacier.

HALF TUNNEL EXCAVATION

Half tunnel or over hang excavation was done at several of the cliff sections, but generally this was considered not highly satisfactory. The seamed structure of the rock made the work both difficult and dangerous. Prior to completion of the project there were many instances of falling rocks blocking the road. Shortly after completion a huge section of a cliff fell and did considerable damage to the guard rail and retaining wall.

STRUCTURE EXCAVATION

Structure excavation was required to the greatest extent in securing proper foundations for the numerous retaining walls. The character of the rock made it nearly impossible to blast out the roadway without shattering the balance of cliff and thus requiring additional excavation to secure suitable foundations for the necessary walls. In addition, large quantities of slide material had to be removed for wall construction at the various deep gullies crossed.

Of structure excavation there was sub-let a total of 4287.4 cubic yards, at \$1.50 per cu. yd. This was in connection with the construction of culvert headwalls and cement rubble retaining walls. Of the total structure excavation, 12,071.05 c.y., this constitutes about 35%.

OVERHAUL

There was little overhaul on the project. About 521 sta.yds. was necessitated in the construction of the Loop at sta. 412, and the balance, 718 sta.yds., was required on the flat country of the lower end of the project. Hauling in these instances was done by trucks and dump wagons.

SUB-BASE

Sub-base was required to the extent of 879 cu.yds. to fill in soft places on portions of the newly graded Mt. Cannon section, and along the lower end of the project. The sub-base was obtained from natural gravel pits nearest to the place where needed. On the West Side Project 440 cu.yds. was used, and 439 cu.yds. on the Mt. Cannon section. This work was done principally by hand shoveling and dump wagons.

TUNNEL EXCAVATION

The only tunnel on the project is from sta. 442/50 to 444/42, with a length of 192 ft. It was constructed with a width of 20 ft. and a

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Private photos - no number. Sta. 55 ahead showing use of cars and tracks for hauling by station crew. August, 1927.



#16426 - 1-1/2 yd. Ford dump trucks hauling cushion material for rock sections along cliffs. Sta. 70 ahead. September, 1928.



#15586 - Rough graded highway along cliffs, Stas. 100 to 110. Retaining walls, arches, and guard rails later constructed. Center of view site of three 16' span arches built to hold half roadway. Camp #5 upper right. August, 1927.



#16532 - View shows three 16' span cement rubble masonry arches at Sta. 102 constructed in order to avoid excessive structure excavation and resulting high retaining walls. Arch barrels support about half of roadway. Also shows 6' x 4' arch culvert as well as character of rock encountered and depth of cuts required. (Ladder may be used for comparison).

Oct. 1, 1928.



#16531 - View from window of tunnel, Sta. 643/20. Two similar windows, width about 16 ft. wide and 20 ft. high. Heaven's Peak, elevation 8994, in background. Cement rubble guard rail at cliff edge. Oct. 1928.

height of 18 ft., the top portion being a half circle of 10 ft. radius. This makes an average of 11.8 cu. yds. per lineal ft. of tunnel. For light as well as for scenic effect, two windows were driven through the tunnel wall which have proved to be an attractive feature of the road, since from the resulting balconies on the cliff face an excellent view is obtained of McDonald Creek Valley, Heaven's Peak, 9,000 ft. high, and the other surrounding mountains.

These windows extend to the height of the tunnel and each opens onto a wide porch-like shelf of rock on the cliff edge. A masonry railing circles the edge and makes these windows or galleries attractive and entirely safe.

The tunnel excavation was sub-let to a station crew at \$4.00 per cu yd., and was removed by them at approximately \$3.20 per cu. yd. Work was begun on October 18, 1926 at sta. 444/42. An average force of 24 men was employed, working double or triple shifts most of the time.

Two Sullivan air compressors, two water Leyners and one jack hammer were used in the work together with cars and track.

During the early part of December the weather became severe and cold so that the work was slowed up and hindered. Although there remained only a short distance to break through the west portal, the extreme cold weather, -32 degrees, prevented further work so that on December 15th work on the tunnel ceased, ending all work on the project for the season.

The tunnel force was as follows:

2 - Sub-contractors, one as foreman and one as superintendent.	
1 - Powder man	1 - Blacksmith
4 - Drillers	1 - " helper
4 - Chuck tenders	1 - Cook
10 Muckers	1 - Flunkiey
1 - Nipper	1 - Bull cook
1 - Compressor man	
Total	28 men
	1 team

Water from the cliffs above at the west end of the tunnel gave some trouble by leaking through the seams of the rock, and may eventually have to be cared for by some special work at that point.

Early in the season of 1927 the west portal of the tunnel was broken through, and constructed sufficiently wide to allow traffic and equipment to pass through along the highway. For safety, however, timber bracing was left in place until late in the season of 1928 when the west end and portal of the tunnel were completed. No timbering was left in place, nor no lining whatever constructed.

CULVERTS

Corrugated metal culverts were used throughout with the exception of three places where cement rubble masonry ones were built. The costs per ft. of these pipes, f.o.b., Belton, Montana, 21 miles from the near end of the project were:

	F.O.B.	Hauling to Project
18"	- \$1.22	\$0.12
24"	- 1.94	0.19
30"	- 2.45	0.25
36"	- 4.03	0.40

Since the pipe was distributed along the road by various methods such as horse and travois, wagon, carrying, truck and caterpillar tractor, cost of hauling from headquarters to culvert site can not be accurately arrived at. To quote the contractor, "Heaven only knows."

Cement rubble masonry headwalls were constructed on the upper ends of all culverts and on the lower, flat portion of the job at the lower end of the culverts. Headwalls to the extent of 31.03 cu. yds. were constructed on the Mt. Cannon section.

On the large pipes, especially those near the summit and those passing through retaining walls, cement rubble masonry arch headwalls were built to conceal the pipe and give the appearance of arch culverts. Approximately half of the culvert headwalls was done by sub contract at \$10.00 per cu. yd.

Cement rubble masonry culverts were constructed at the following places:

Sta. 153/15	6'x6'x 84'
310/12	4'x4'x 60'
319/70	6'x8'x 36'

The contract price for such work was \$18.00 and was all done by day labor at about \$15.00 per cu. yd.

All sand used in this work was obtained from the sand washing plant at sta. 629, and was of very good quality. The mortar mix was 1:3.

Concrete box culverts 6'x4' were built at stas. 499/10 and 555/65 having lengths of 50 ft. and 30 ft. respectively. Cement rubble masonry arch headwalls were constructed at both ends of each to give the appearance of masonry arch culverts. Both were built by day labor forces of the contractor.

ARCH SPANS

At Stas. 379 and 101/63 cement rubble arches were constructed to span deep crevices, to cross which would have otherwise required high retaining walls at a much increased cost. At Sta. 379 an 18' span 6'9" rise arch with 10' barrel sufficed to carry the roadway. At Sta. 101/63 three 16' span 5' rise arches of 11 ft. barrel length were built. These latter especially add to the appearance of the highway. The construction of these arches was done under sub-contract at \$13.00 and \$18.00 per cu. yd. respectively.



#14960. September, 1927. Showing end wall construction on cement rubble masonry culvert, 6' x 6', sta. 153. Also showing gasoline "dinky" engine and cars for hauling and making fill.



#14928. August 1927
Sta. 211 ahead, showing
size of rocks used,
batter boards set every
ten feet to give true
wall slope and alignment
on 56 degree curve.
Station crew of six men.



#13961 Cement rubble masonry end wall and wings on 6' x 4' concrete box culvert, sta. 499. Oct. 1926

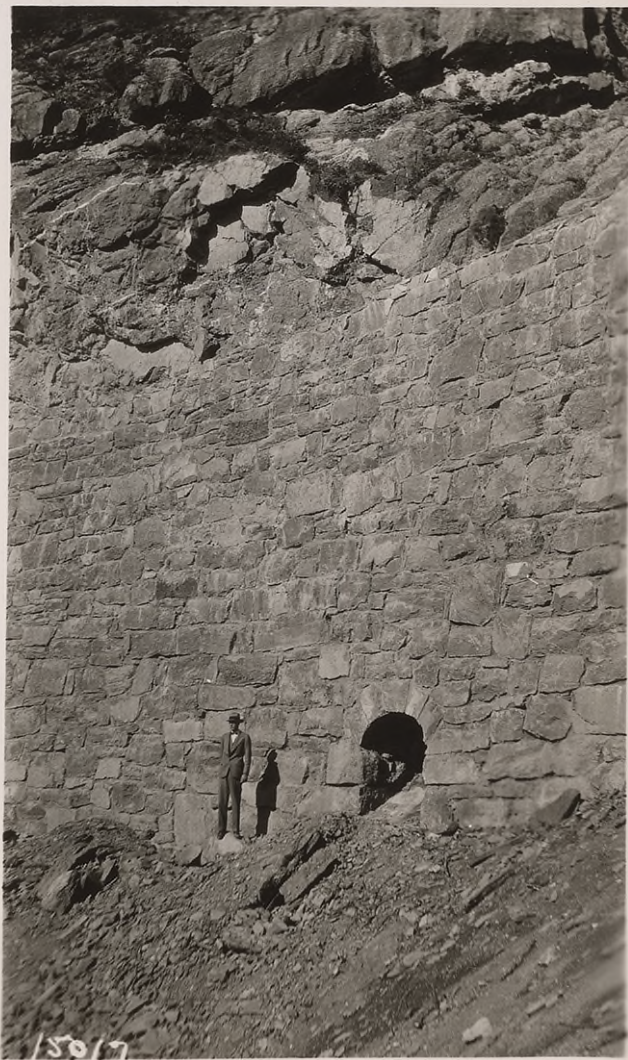


#14885 Cement rubble masonry railing on 16' span, concrete slab bridge, sta. 644. 1'6" thick, 3'3" high, 32' long. September 1927.



#15019 October 1927. Sta. 379 ahead showing 18' span cement rubble masonry culvert opening in wall, general type of retaining wall along cliff section, and type of guard rail to be used on entire project.

#15017. September 1927. Showing wall at sta. 337, size of rocks used, and arch opening for pipe culvert outlet. Greatest height of wall, 31.5 ft.



BRIDGES

Three bridges were constructed. At Sta. 248/25 a 16' span reinforced concrete slab was built on cement rubble masonry abutments. False arches of cement rubble masonry were added to hide the concrete and give the appearance of a masonry arch bridge. This bridge is on a 50 degree curve, and the slab was given super-elevation of 2 feet. After the guard rails were constructed there was a clear width of 24 feet. The railings for this bridge were just the continuation of the standard guard rail, 18" thick and 18" high.

To cross Trapper Creek at Sta. 588, a 20' span 20 ft. clear width, reinforced concrete slab was built on cement rubble masonry abutments with concrete footings. At the request of the Park Service false masonry arches were added which reduced the effective waterway about one-third. On October 16 and 17, 1926, continuous warm rains brought all streams in the vicinity of the project up to extreme flood conditions. The most damage was done at Trapper Creek where the newly constructed bridge was clogged with debris, the road overflowed and the roadway washed out for about 20 ft. at either end of the bridge. While the road would probably have been flooded anyway, the added arch and the reduced waterway hastened and caused the collection of debris. To prevent a recurrence of such damage a similar 20' span was added in 1927. At the upper end of the center pier a rubble masonry nose was built to prevent debris from lodging there. These, combined with the channel excavation and cleaning has prevented further trouble.

The standard cement rubble masonry rails 18" thick, 2'9" high, with 6" felloe guard, give this bridge a good appearance.

At Sta. 644 a 16' span 20' clear width reinforced concrete slab bridge was built on cement rubble masonry abutments with concrete footings. No false arches were thought necessary on this bridge since as a general rule tourists will not stop at this point nor get a view of the side of the bridge. This bridge is on an 8 degree curve. Super-elevation of 1 foot was obtained by adding extra cushion material on the slab prior to surfacing. The height of one railing was increased 1 foot. The standard cement rubble masonry railings were constructed.

All bridges were built by contractors' day labor forces.

MASONRY WALLS AND RAILS

Cement rubble masonry was used entirely for retaining walls, guard rails, arches, bridge abutments, and culvert headwalls. There was 8708 cu. yd. of retaining walls built with a combined length of 7242 ft. Over a distance of 10,873 ft. there was constructed 1178 cu. yd. of guard rail or 1 cu. yd. every 9.25 ft. which, at the contract price of \$14.00 per cu. yd., made an average cost of \$1.51 per lin. ft. This compares most favorably with the customary cost of \$1.50 per lin. ft. for log guard rail, which is far from being as acceptable as is the masonry railing.



#16122 - Sta. 155 ahead showing water conditions along rock cut. Almost continuous sheet of water from Sta. 155 to 162, from snow field above. Wide, deep ditch with frequent culverts provide for run-off. June 23, 1928.



#16716 - Trapper Creek bridge, Sta. 588. Two 16' span cement rubble masonry false arches and rails combined with reinforced concrete slabs. Channel straightened and widened. Oct. 1928.



16710

#16710 - Sta. 248/32. North gulch of Haystack Creek, showing 16' span false arch combined with reinforced concrete slab spanning stream. Retaining walls and guard rail. Oct. 1928.

#12760 - Sta. 248/32. North gulch of Haystack Creek, showing character of country before construction. Line of survey may be seen in brush at center right. June, 1926.



12760

The retaining walls were built with an outer batter of 1/10 to 1 and an inside batter of 1/4 to 1 and a thickness of 1.65 at road grade thus insuring a uniform slope of 1/10:1 of the outer side of the guard rail which was constructed later 1.5 high and 1.5 top thickness. Most of the walls were less than 11 ft. high above which point the base thickness would be less than one-half the height. The higher walls occurred on curves where the arch action might be considered to offset the decrease in thickness. Very little back-fill was ordinarily needed, keeping the thrust comparatively small.

For the masonry work, which was practically all done by station gangs, as large rocks as could be properly handled were secured. The mortar was a 1:3 mix in which all stones were firmly bedded. For better appearance, the face joints were raked to a depth of 1/2 inch or more.

Batter boards were set at close intervals for the outer face, and true lines and grades were provided for the men at all stages of the work. An inspector was kept on the job at all times to look after the masonry work exclusively. From records of the various sub-contracts, totaling 30 in number, results as to ratios of wall, sand and cement have been calculated as follows:

No.	Date	Masonry (cu. yd.)	Sand (cu.yd)	Sand to Wall (%)	Bags Cement Used(100Lbs)	Bags Cement per cu.yd. of wall	Sand should have used (cu.yd)	Sand Wasted (%)
2	1927	1755.	264.	15.	2092.	1.19	232.	14.
4	1927	3906.	490.	12.5	4013.	1.03	446.	10.
2	1928	1467.	259.	18.	2017.	1.38	224.	15.
5	1928	2409.	439.	18.	3517.	1.46	390.	12.
Totals and		9537.	1452.	15.3	11639.	1.22	1293.	12.
Averages								

Analyzing the data on the basis of cement used, it is seen that about 12% of the sand was wasted or misused. Measuring boxes, 18"x18"x16" (3 cu.ft.) were used to proportion the sand and cement, and careful inspection was made. As a general rule, the stationmen were found to be honest and trustworthy, so that it may be assumed that the 12% difference in sand was due to loss in hauling and dumping on the loose-rock grade. However, the second year showed a more uniform and higher ratio of cement and wall which would lead to the belief that experience of the first year had resulted in better inspection and consequent better results.

On three different walls a derrick rig was used to move the stones from the point on the grade to the wall. The better paying sub-contracts were those where the derrick was not used.

The guard railing was built 1.5 ft. thick at the top and 1.5 ft. high, vertical inside and 1/10 to 1 batter on the outside. It was surmounted by battlements 6" high by 5 ft. long spaced 15 ft. on centers. This made a very pleasing guard rail. A short stretch of railing was laid with

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#16542 - Sta 89. Completed cement rubble masonry retaining walls and guard rails. Wall 47' maximum height. outer batter 1 to 10, inner batter 1/4 to 1, top thickness 1.65 ft. on 54° 30' curve. September, 1928.



#16535 - Shows section of completed highway, stas. 252 to 265. type of cliffs encountered by engineers and contractors, cement rubble masonry retaining walls and guard rail, crushed rock surfacing stock pile. September, 1928.



#14784 July 1927. Sta. 456 ahead. Cement rubble masonry guard rail, 1'6" high, 1'6" thick; pilasters 18" square, 10" high, spaced 13' c-c. This type discontinued in favor of type shown below. Background shows road on slope of Haystack Butte, big slide approximately at sta. 219.



#15646. August 1927. Type of cement rubble masonry guard to be used on entire project. Pilasters on railing 0'6" high, 5'0" long, 18" wide and spaced 10' clear between pilasters. Guard rail 186" above grad = elevation. Note rocks incorporated into pilaster and railing. Sta. 384 ahead.

battlements 10 in. high by 24 in. long spaced 13 ft. on centers, but this type was soon discarded.

All of the mortar sand was taken from a bar in McDonald Creek at Sta. 632 where a washing and screening plant was installed. The cost of the sand delivered on the grade to the masons was about \$5.00 per cu. yd., equally divided between production and hauling.

The sub-contract price received by the station men was in nearly all instances \$10.00 per cu. yd. for either walls or railing. Cement which cost \$1.05 at the railroad and \$1.25 at camp one was furnished them at \$1.50 per sack delivered; sand \$3.00 to \$4.00 delivered, depending on the distance to be hauled from the sand washing plant.

The net hourly wage of the stationmen ranged from \$0.50 to \$2.03, with an average of \$1.35.

FINISHING

Finishing of the graded road was carried out in a thorough manner in a variety of ways. On the Mt. Cannon section, 3.2 miles in length, which had been previously graded under a contract by the Park Service, a caterpillar tractor combined with a large blade machine did the preliminary shaping and trenching. Prior to laying of the base gravel, hand raking was done to remove oversize rock.

On the balance of the highway the blade machine was used wherever possible but much hand work was necessary. Although the various station crews and day labor forces left the grade in very good shape, extra finishing was always necessary prior to laying of the crushed rock base. The accompanying photographs show how the work was performed.

SURFACING

Surfacing was specified to be in two courses of crushed rock or gravel, the base size being 1-1/2 inch maximum and the top course 3/4 inch, each course to be 4 inches in depth and 16 ft. in width. Watering was provided for in the contract but this was eliminated when it was decided to be unnecessary. Rolling was accomplished by the trucks hauling the material. No rock crushing or surfacing was done in 1925. In 1926 a crushing plant was installed at Sta. 640 where a drag line was used to bring material to the primary #2 Aurora jaw crusher.

The recrushed material was handled by a 4-1/2" Traylor Gyratory Finishing crusher, and screening was done by a 30"x12' Western revolving screen. Power was furnished by a 90 HP Russell steam tractor.

The pit proved unsatisfactory since the material contained too large a percentage of dirt mixed with boulders too large to be handled conveniently. In wet weather the dirt clogged the machinery and caused delays. Washing



15596

#15596 Aug. 1926 Use of tractor and blade machine in preparation of subgrade before laying of base course rock on Mt. Cannon Section, $\frac{1}{2}$ mile above Avalanche Creek.



14886

#14886. Aug. 1927
Finished surfaced road,
sta. 610 back. Middle
background, north gulch
of Haystack Butte.
"Garden Wall", continen-
tal divide, in back-
ground.

the dirt out was tried with more or less success, but the plant was never on a good paying basis. Double shifting was resorted to in order to speed up production.

During the season of 1926 there was produced here 3903 cu. yds. of base and 2179 cu. yd. of top material, a total of 6082 cu. yds. It was placed on part of the Mt. Cannon section, and from sta. 657⁴/₄₇ to 501 on the West Side project. The average 8 hr. run was 60 yds.

At the beginning of the season of 1927, the same crushing equipment was set up on a gravel bar of McDonald Creek at Sta. 629. Here there was produced 1328 cu. yds. base material, 4306 cu. yds. top and 548 cu. yds. maintenance material, a total of 6182 cu. yds. This season was very little improvement over the preceding one. High water and old machinery were the causes of delay and breakdowns.

In 1928 a set-up was made at Sta. 220 where a gas shovel, dinky gas locomotive and dump cars supplied rock to new crushing equipment. During the first two seasons a total of 12264 cu. yds. of material was produced, with the old equipment, while in 1928 a total of 11,111 cu. yd. of crushed rock was produced. A comparison of these figures shows the relation efficiency of the several plants, old equipment versus new.

The principal equipment used in the last set up was as follows: one 12 in. Traylor gyratory crusher; one 24 in. Symonds cone; one 90-HP Russell steam tractor; one elevator, screen, belt conveyor, etc; one Plymouth dinky gas locomotive with two 2-yd. cars. one 3¹/₄ yd. Osgood gas shovel; one 110 Sullivan compressor and jack hammer outfit.

Crushing operations were carried on for 60 days in 1928 with an average daily output of 200 cu. yds. per 8 hours.

Hauling was done under sub-contract to individual truck drivers who furnished their own trucks. There were used: 1 Standard, 1 International, and 1 Marmon, all of 4 cu. yd. capacity; 1 International and 2 Grahams of 3 cu. yd. capacity. These operated on a \$0.20 per yd. mile rate, the average haul being about 2-1/2 miles. In addition to these principal haul-units, occasional trips were made with 2 yd. Ford trucks and a 3 yd. White truck used elsewhere on the project.

The material was all of limestone and very little binder was required. On the lower portion, when it became necessary to wash the material in order to run the plant, binder was required after the surfacing was placed on the road. This was secured almost entirely along the side ditches without extra cost.

Of the total surfacing laid the following amounts were placed on the Mt. Cannon section; base, 2527. cu. yds.; top 2824. cu. yds. and maintenance material 318.5 cu. yds.

No base material was made in 1928. It was not considered necessary to lay base material from Sta. 470 to 0/00, the summit, due to the base being already of rock.

Prior to laying of the base course the subgrade was trenched, raked and brought to proper grade and alignment. Dragging of the two courses was carried on continually to insure a uniform, compacted surface.

Maintenance material, $3/4$ " crushed rock, was placed at available places along the entire project. A total of 1471 cu. yds. was left on the job for future use by Park Service.

SAND PLANT

For producing sand for concrete and cement rubble masonry work a sand screening and washing plant was built at the gravel bar in McDonald Creek at Sta. 629. The gravel was brought to the bucket line elevator either by horses and slip scrapers or by a drag line which was operated at one time. After being elevated, the material was washed and passed over a grid which removed the extra large rocks and boulders. From here it was carried down an inclined flume with the water and another size of gravel removed. This latter size was graded for concrete use. The sand was finally collected in a settling bin where the dirt and soil were removed. By this process a good grade of clean sand was secured.

A total of about 1800 cu. yds. of sand was produced at an estimated cost of \$5.00 per cu. yd. delivered at the various sites. This cost was divided about equally between producing and delivering. An average of about 16 cu. yds. of sand was produced daily without any crushing, and employing a force of six men and two teams.

A good screen of forest growth hides the opened area from the road which is about 100 ft. distant. At the close of construction the site was leveled off and cleaned up in a manner acceptable to both the Bureau and the Park Service.

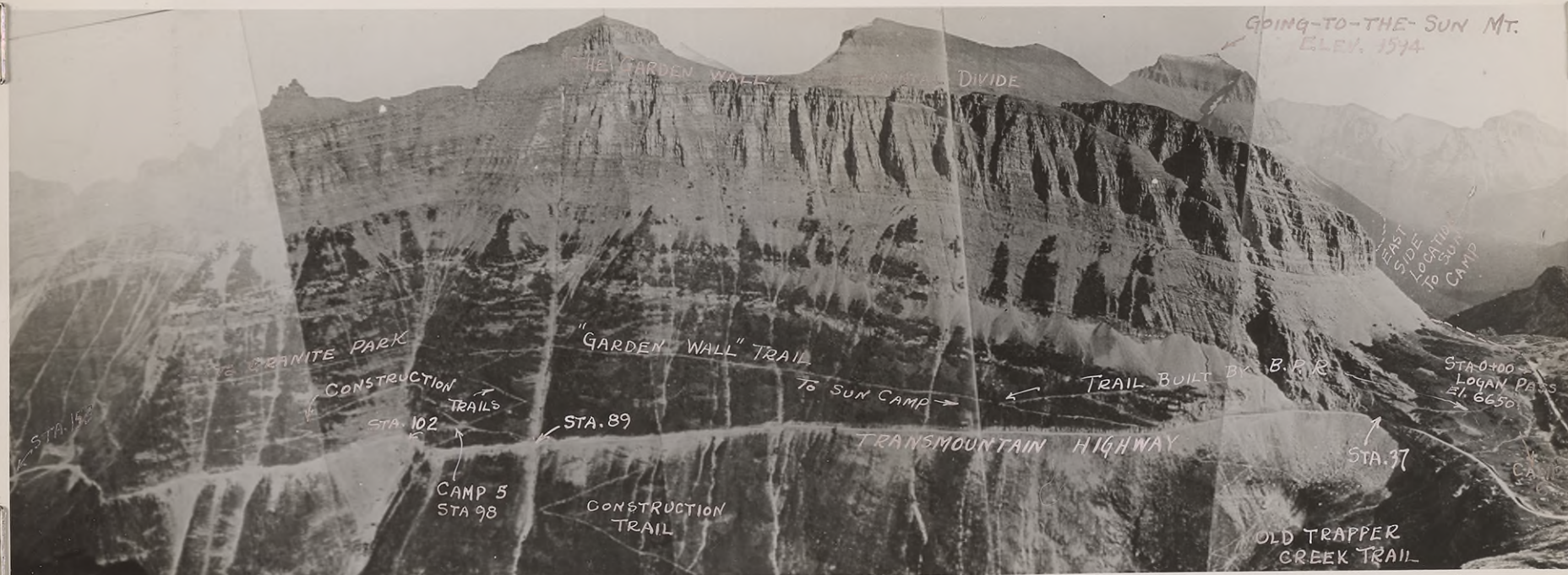
TRAILS AND TOTE ROAD

Throughout the progress of the work it was necessary for the contractors to build many miles of temporary trails in order to reach the various parts of the highway or to route the pack strings around portions where heavy blasting made travel either impossible or too dangerous. There was 15 miles or more of trails which were either built entirely or old trails widened and otherwise improved. This work was done at an outlay of about \$2500.00.

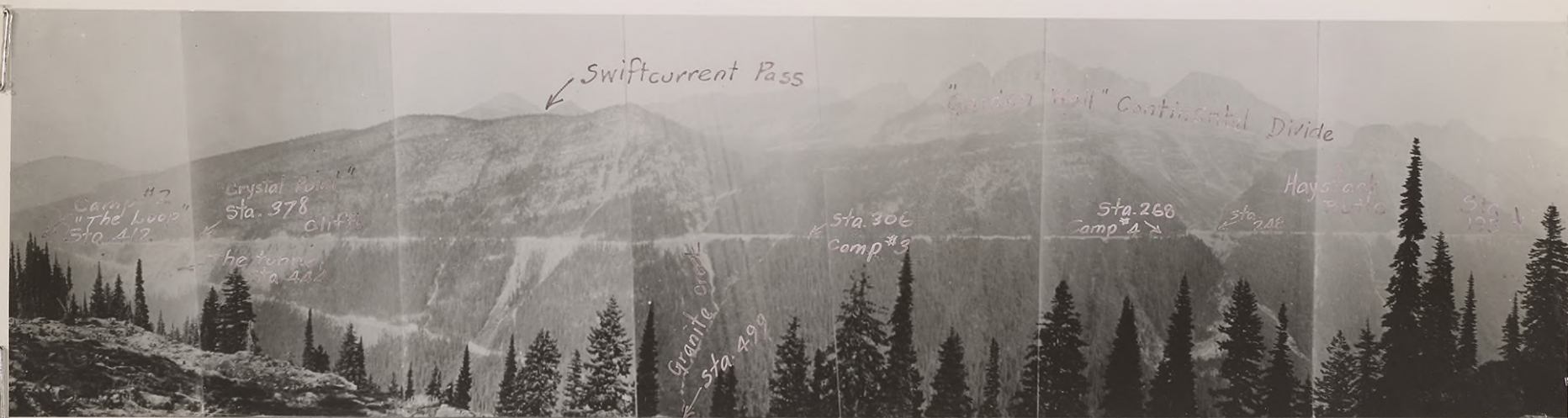
The Tote Road, about two miles in length was built from Sta. 499 along McDonald Creek and then climbed steeply to strike the right of way again at Sta. 420. This served to get the heavy equipment past the tunnel site and as a road to supply camp #2. The work was done by the $3/4$ yd. Osgood gas shovel and a crew of 5 men at an estimated cost of \$2500.00.

TRANSPORTATION

Transportation facilities of all kinds were used by the contractors.



Panorama #2 - Composite of films #16541, 43, 44, 45 & 46, showing general view of country traversed by highway, stas. 0/00 to 153. View taken Sept. 17, 1928 from top of Mt. Oberlin, elevation 8100 ft., and $1\frac{1}{2}$ miles distant from sta. 153 and $\frac{1}{2}$ mile from nearest point of highway. Sta. 37, site of 90 ft. rock cut; sta. 89, high rubble wall; sta. 102, 3 - 16' span rubble arches.



Panorama #1 - Composite of films #16536, 37, 38, 39 & 16713, 14 & 15, showing general view of country traversed by highway, stas. 195 to 499. View taken Sept. 18, 1930 from spur of Heaven's Peak, nearest distance to highway one mile, farthest distance about 2½ miles.

When work was first started, auto traffic could only reach a point about two miles from the project. Pack horses were first used to open the work. Next, teams and horses were resorted to; these were followed by trucks when the condition of the road permitted. A Caterpillar tractor hauling a sled or wagon over the snow was used to good advantage in the early months of 1926 and 1927. Horses hauled "go-devils" with culvert pipes, steel rails, water pipes, or gasoline drums over the mountain trails. Even man-power alone was at times used to move some of the heavy equipment along the trails where horses were not available.

After the work had been well established two trucks were kept busy bringing in supplies and equipment, making two round trips daily from the railroad at Belton, 22 miles from headquarters. Two Ford dump trucks were used to deliver sand, cement, powder, etc. from headquarters camp #1 to the various camps and sites along the line.

At the peak of the packing situation in 1926, 60 horses and 6 men were engaged in this work. The horses were contracted for at \$0.70 per head with feed furnished. The packers were paid \$100.00 and board. The average load per horse was 150 lbs., so that three 50 lb. boxes of dynamite made a well balanced load. Special cans for packing gasoline were made, being of a truncated wedge shape. Any spilled gasoline on a horse's hide soon ruined him for work.

Packing to upper camps from headquarters camp at Sta. 580 was about \$50.00 per ton for one trip daily or \$25.00 when two trips could be made.

Freighting by truck contract in 1927 was at the following rates: Belton to Camp #1, \$4.00 per ton; to Granite Creek, Sta. 499, \$4.50, and to the Loop, Sta. 410, \$5.00 per ton. Prior years with road conditions bad, freighting costs were much higher.

SNOW PROBLEMS

This project, due to its location well up in the Rocky Mountains of northern Montana, is subject to heavy snowfall and resulting deep and wide snow slides. In 1926, as late as June 19, enough snow fell to crush several of the tents at camp #5. The combating of snow slides was just another of the contractor's problems. One large snow slide at the cribbing site of the Mt. Cannon section had to be passed over or through each year before the project could be reached. Both hand and power shoveling were resorted to in order that the work might proceed. Shooting the packed snow assisted materially in letting the air circulate within the drifts or slides and thus hurried the melting process. One of the largest slides occurred each year between Stas. 143 and 153 where the maximum depth was 35 or 40 ft. This always lasted until late in the summer and will always be a source of maintenance expense. Much time and many thousands of dollars were spent each year by the contractor to fight the snow drifts and slides.

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#15588. April 17, 1926. Fordson caterpillar tractor hauling supplies from cribbing on Mt. Cannon Section to camp #1. Prior to use of wagon, sled was necessary. This system of hauling was required for a period of about one month.



July 1926. (Dept. of Agri. Moving Picture Div. film.) Showing pack string at site of high falls on Logan Pass trail. Enroute to camps # 5 and #6 from camp #1 with dynamite, black powder, supplies, etc. Load of each horse from 150# to 200#. One day required for trip a distance of about five miles, one way, and climb of 3,000. ft. in elevation. Sixty horses used at peak of work. One man needed for each every eight to ten horses.



#15648. View of huge snow slide at cribbing on Mt. Cannon Section, 18.5 miles from Belton, $2\frac{1}{2}$ miles from beginning of #287 project, $3\frac{3}{4}$ miles from camp. #1 of contractors. Slide about 600' long and 20 to 50 ft. deep. April 1927.

#15649. April 1927. Contractors sledding supplies over slide above described. Caterpillar tractor used for power. Slide cover roadway and even extended across McDonald Creek, about 80 feet wide. This slide may be expected each year, and shows one of the problems met by the contractor and problem to be met by maintenance forces in future.



MT. CANNON SECTION

By agreement with the contractor, the project was extended to include the finishing of the Mt. Cannon section from Avalanche Creek to the connection with the West Side Project, a distance of 3.2 miles. This included putting sub-base in soft places of the road, finishing the roadway, making a fill at the cribbing, surfacing with crushed rock, and building cement rubble masonry headwalls on the existing pipe culverts. This extra work was made possible by the fact that a large saving of funds was brought about by the furnishing of explosives to the contractor by the government and the consequent deductions from the payments to him. The accompanying estimates show the powder deductions.

FOREST FIRES

Only one small forest fire resulted from clearing operations of the contractor. On June 4, 1926, fire from the right of way at Station 226 spread up the mountain side and an area of about 60 acres on Haystack Butte was burned over before the blaze was put under control by the contractor's forces under the direction of Park Rangers. The damage is hardly noticeable from the highway.

During July, 1926, a very bad forest fire broke out on the west side of Lake McDonald. To combat this fire all the available men of the contractor's forces were taken away by the Park Service. This caused a shut down of construction for about ten days. The engineering force also served as fire fighters.

HAZARDS OF CONSTRUCTION

Due to the steepness of the country traversed, and the nearness of the upper line of the road to the road below, the workmen on the lower line were almost constantly in great danger from slides or rolling rocks. There were numerous narrow escapes from very serious injury. A number of the men wore "tin hats," surplus war material, for protection against falling rocks. With all the precautions followed there was still a number of minor accidents. Although a large amount of explosives was handled and used, there were no accidents from this source of serious consequence.

One fatal accident occurred in 1926, when a foreman fell from a cliff and was almost instantly killed. The accident was due to his inability to retain his hold on a rope by which he was attempting to descend from an overhanging cliff to the roadway 60 ft. below.

THE GARDEN WALL TRAIL

In order that saddle horse parties traveling between Granite Park and Sun Camp might not be forced to use the highway and face the dangers of automobile traffic, a trail was built along the cliff above the road between



#15901. View of site of saddle horse trail above road, stas. 35 to 45. One hundred feet in elevation above roadway. Six feet wide. To be safe guarded with cement rubble masonry railing. October 1927.



#15643. View showing close-up of saddle horse trail along face of cliff, 100 feet above road, stas. 35 to 45. Six feet wide. To be made safe by cement rubble masonry guard rail. October 1927.

#15585-A. Aug. 1926
Showing pack horse string leaving
"Jones" Flat, below
Logan Pass, enroute
to camp #5, sta.
96. Loads of 3/8"
x 5'0" lumber
for construction
camp. All camp lumber
for #5 and #6 hauled
thus.



Stas. 35 and 50. It was made with a clear width of six feet and was about 3300 ft. long. The greater part was done late in 1927 and was finished late in 1928 when a dry rubble rail was constructed along the cliff section. This was all done at a cost of \$5360.62.

Bears

One feature or problem not ordinarily encountered by highway contractors was that of how to get along with bears - black, brown, and grizzly. The black and brown bears were not so bad after it was found that they could be best handled by being plentifully fed; Since the harming of animals within the park is prohibited, many schemes were devised to prevent depredations by the bears. Meat houses and kitchens had doors and side walls studded with nail points. One meat house on top of piles was fitted with a lifting walk like the bridges spanning the moats of the Middle Ages. Clearing forces hung cross-cut saws along the trunks of small trees in which their lunches were hung. This proved a most effective device. Finally the cooks and flunkies found that systematic feeding of the refuse to bears kept them from pillaging. At the tunnel camp it was usual to see 10 or 12 large bears hanging around the cook-house at meal times, waiting to receive their share. One bear's special place was against the jamb of the back door of the kitchen where he sat perfectly at ease, and more afraid of the other bears than of the men. However, in the case of the grizzly bears an entirely different animal had to be dealt with. When, in the late fall of 1927 they began to invade the camp of the Russian stationmen at Logan Pass, the Park ranger was required as a guard to keep the bears away and to quell the fear of the workmen.

MOTION PICTURES

During the period July 18 to 27, 1926, F. W. Perkins and Geo. R. Georgens, Department of Agriculture motion picture men, were on the project taking construction and engineering scenes which have since been incorporated into two reels of the department, "Men Who Build the Roads," 301 E 1 and "A Road Out of Rock," 304 G 1. During this work all assistance possible was given them in order to get the data and views desired. Due to the smoky condition of the atmosphere resulting from the prevailing forest fires, the highest class pictures possible were not obtained.

WEATHER CONDITIONS

As a general thing the weather was very favorable for construction in 1926. The winter snow fall was comparatively light and left early in the year. Work was commenced in a general way on April 1st. The summer was dry and the inability on this account to burn cleared and grubbed material was practically the only drawback to the contractors. The dry weather, however, did inconvenience them somewhat in the matter of supplying water to the camps and the power shovels. Work in general was closed on October 31st, but the tunnel work continued until December 15th. At this time 48% of the contract had been completed.

The winter of 1926 and 1927 brought a heavy snow fall. To overcome this difficulty the contractor early in the season of 1927 began the use of steam shovels to clear the roadway of snow drifts and slides. General construction work was commenced on April 1 and continued until November 8th at which time 82% of the project was finished.

In 1928 work was resumed on May 28 and carried on continuously until the final completion on October 20, 1928.

EQUIPMENT AND PERSONNEL

Major Equipment used by the contractors was as follows:

- 1- Erie 3/4 yd. steam shovel
- 1- Osgood " " "
- 1- " " gas shovel
- 12- 2-yd. Western dump cars. 24" gauge
- 3000' 20# rails
- 3- 3 ton Plymouth gas locomotives
- 1- 4 " " " "
- 4- single hammer Sullivan Portable Compressors
- 1- double " " " "
- 1- " " Ingersoll-Rand "
- 10- Waugh Clipper Drills
- 4- BCR 430 Ingersoll Jackhammers
- 1- BCR " " "
- 2- Ford Trucks with Anthony dump beds
- 1- 3/4 ton White truck
- 1- 2-1/2 " " " dump bed
- 6- 5 ton trucks
- 1- Fordson, full crawler tracks
- 2- 7 ft. Austin team graders
- 1- #2 Aurora jaw crusher
- 1- 4-1/2" Traylor gyrator crusher
- 1- 12" " " "
- 1- Double drum belted hoist
- 1- 30"x12ft. Western revolving screen
- 1- 90 HP Russell steam tractor

At the peak of the construction about 300 men were employed and six camps maintained. Seventy horses were used, 60 of which were pack horses. With the exception of the first season, when only one of the members of the contracting firm was present, the contractors were on the job at all times using their best efforts to complete their contract.

CLEANING UP

At the completion of the work each camp site was cleaned up thoroughly. Garbage was buried; refuse burned; rock crushing sites leveled off, and all conditions left in a satisfactory manner.

PARKING SPACES AND SCENIC POINTS

At various places along the route of the highway sufficient parking places have been provided to enable automobiles to turn out and give the travelers a chance to pause and more fully enjoy the ever changing scenery. After leaving the flat country near Trapper Creek the ascent along the mountain side gives one a sweeping view of McDonald Creek valley with Heaven's Peak and many other snow capped mountains rising above it. At the west portal of the tunnel a stream of water falls over the cliff to spray the tourist.

At the Loop, Sta. 410, considerable development work was done in order to provide a stopping place for automobiles. The curve, one of 75 ft. radius and central angle 215 degrees, is on a $3\frac{1}{4}\%$ grade, roadway widened to 23 ft. and super-elevated 3 ft. The upper portion is necessarily in heavy cut and the lower part on a high fill.

This gave an opportunity to construct a fine parking area within the curve and at an elevation of about 10 ft. above the lower road, which allows a clear view from the upper parking area. In addition there is a lower parking area between the road and the upper area, the two being connected by cement rubble masonry steps. The roadway and the upper area are protected by masonry railing. This spot is destined to become a popular one on the highway.

Continuing from the "Loop" the tourist will have a constantly changing, always wonderful view. Passing the half tunnel sections along the cliff side, at Sta. 379, one comes to "Crystal Point," a wide and beautiful view-point, so named from a ledge of rock studded with iron pyrite crystals, commonly called "fools gold" or cube iron. Next comes the scenic horse-shoe curve at the north gulch of Haystack Butte, where an unexcelled view is had of the "Garden Wall," Mt. Oberlin, Mt. Cannon, Mt. Clements, all rising to about 9000 ft. within a radius of two miles. McDonald Creek valley can be seen for many miles to the south. Rounding Haystack Butte the road follows along the steep side of the "Garden Wall" until finally Logan Pass is reached and the most wonderful panoramic view of the trip is suddenly given the tourist to hold him spell bound. From this high plateau, which during the summer is one huge flower garden, glaciers, waterfalls, towering peaks, and wooded valleys stretch in every direction. To give an additional thrill there are usually wild goats, bear, deer, and mountain sheep to be seen at many places throughout the length of the highway. With the completion of the remainder of the road to the east side of the Park, the Transmountain Highway will be unexcelled for scenic beauty by any highway in America.

ENGINEERING

During the season of 1926, engineers' camps were established as follows: W. G. Peters and three men at headquarters camp at Trapper Creek, Sta. 588, where office work, gravel checking, etc., were looked after; at camp #2, Sta. 410, R. W. Smith and three assistants handled the



#16709 - View ahead from sta. 408 showing upper parking area, 8170 sq. ft. at "The Loop". Automobile on right side of main highway. Beginning of cement rubble masonry toe wall joining guard rail at left of car. Oct. 18, 1928.



#16712 - View back from sta. 411/50 across upper parking area of "The Loop" showing cement rubble toe wall and guard rail. "The Loop" - radius 75 ft., central angle 215 degrees, widened 4 ft. and superelevated 3 ft. 3% grade. Oct. 18, 1928.



#16540 - East portal of tunnel, Sta. 444/42. Length 192 ft., width 20 ft., height 18 ft., ceiling semi-circle of 10 ft. radius. Unlined. On curved alignment, one $15^{\circ} 30'$ curve complete and portions of 44° and 23° . October, 1928.



#16064 - Cut through big snow slide at Sta. 150, July, 1928. Usual slide each year 1000' wide by 10' to 35' deep. Removed by steam shovel.

Transmountain Hwy., West Side Project #287, Glacier National Park.



No number - Pictures from Dept. of Agriculture, Dept. of motion pictures. Showing power shovel handling rock excavation. Sta. 430 Black. July, 1926.



#16067 - Sta. 381 ahead. June 1928. Showing large rocks fallen from half tunnel or under cut section. A source of danger along cliff sections of highway. Very slight damage to wall.



#15645. Sta. 435 ahead. Steam shovel working its way through snow toward tunnel. April 10, 1927. Much shovelling of snow necessary across slides.



#14723. Sta. 45 back toward summit, showing hand methods of handling snow. Preparing trail to move compressor from camp #6, sta. 15 to sta. 50. Trail also used for packing to camp #6 from camp #1, sta. 575. June 22, 1927.



#14792 July 1927. Rock crushing plant 300 ft. left of sta. 639. #2 Aurora Jaw Crusher, 1-4½" Traylor Gyratory finishing crusher, 1-double drum belted hoist for drag line, 30" x 12' revolving screen, 1-90 HP. Russell steam tractor. Background shows road along side of Haystack Butte. Camp #4 at left center.



#14789 July 1927. Sand washing plant at sta. 628, 200' right of road. Rock crushing plant later transferred to this site. First oversize removed; next small gravel; last sand settling bins. Capacity about 20 - 25 C.Y. per day. Sand made and delivered to masons on project at \$3.00 per C.Y.

Transmountain Hwy., West Side Project #287, Glacier National Park.



#16119 - Removing snow from deep gulch, 50 ft. deep 40 ft. wide, June 23, 1928, to begin construction of two retaining walls, sta. 89. Sluicing was attempted but found impractical. Bridge not desired on account of danger of snow slide carrying bridge away. Two walls with back filled road between thought best for conditions. June 23, 1928.



* #15592 Aug. 1926. Sta. 12 back showing car and track method of handling excavation by stationmen. "Garden Wall" and trail on left. Logan Pass in middle background.

#15585 Sept. 1926
Sta. 38 ahead, showing "seam shooting" by stationmen. Advantage taken of natural seams in rock to place dynamite and powder charges. Limestone rock.





#15590. August 1926. Sta. 40 ahead on old Granite Park trail. Elevation 6450. Showing use of "go-devil" or travois for hauling culvert pipes, steel rails, air pipes, etc. over the narrow trail from camp #1, elevation 3500 to camps #5 and #6 at elevation 6600. One day for one trip.



#15597. August 28, 1926. View from top of Mt. Oberlin, elev. 8100, showing general system of construction trails used to serve camp #5, sta. 98, lower center. Upper trail, Garden Wall Trail. Center, wide strip, cleared right of way and partially graded roadway, sta. 110 on left to sta. 70 on right. "Safety" trail from camp #5 around cliffs to serve station men working from sta. 98 to 125. Trail from camp #5 to Garden Wall trail thence to summit at Logan Pass serving camp #6, sta. 15. Retaining walls and culvert to be at deep draw.



#15593. Oct. 1926. Beginning of tunnel at east portal, sta. 444, showing system of construction, character of rock, seams, etc.

#15594. Oct. 1926.
General view of east portal
of tunnel, sta. 444. Note
seam or fault in rock that
necessitated shifting of
center line of tunnel
into cliff to make con-
struction of tunnel poss-
ible. Note rope used by
men in passing over tunnel
line. Tunnel constructed
20' wide, 18' in height at
center. Top of tunnel semi-
circular, 10' radius.
Rock, limestone. Tunnel
2008 in length, with two
windows for light and ven-
tilation.





X #16157 - Showing start of cement rubble masonry retaining wall at Sta. 89, derrick or gin pole with skip for handling rocks for wall. Temporary frame trestle at side for construction purposes. Maximum height of wall 47' outer batter 1 to 10, inner batter 1 to 4, wall on 54 degree curve making arch action in wall. Note large rocks used. July 10, 1928.

Transmountain Hwy., West Side Project #287, Glacier National Park.



X Private photo - One of problems of contractor. Bears foraging around camp #4, sta. 268 at end of season, October, 1927. Eight to twelve bears hovered about each camp.

Transmountain Hwy., West Side Project #287. Glacier National Park.



#16428 - September, 1928. Sta. 60 ahead. Fine grading preparatory to laying crushed rock surfacing. Camp #5, sta. 98 in center background. Also construction trail. Haystack Butte left. "Garden Wall", continental divide, background.



#16425 - Sta. 70. Sept., 1928. Raking subgrade to remove over-size rocks preparatory to laying of crushed rock surfacing. Note trench section to hold surfacing material.



#14769 Moving compressor across snow slide, 50' deep by 1000' wide, sta. 145, south gulch Haystack Butte. July 7, 1927 View toward summit.

X
#14724. June 22, 1927
Sta. 45 ahead. Men hauling compressor from camp #6, sta. 15 to sta. 50. Along old Garden Wall Trail.





(Dept. of Motion Pictures, Dept. of Agri., film)
July, 1926. View showing cross-section party of engineers at work
on difficult cliff sections, stas. 35 to 45. Note safety ropes.
Steepness of cliffs and loose rocks made work extremely dangerous.

X #15647. August 1927. Close-up
of chainman scaling cliff as
part of work in taking sections
and running alignment. Stas.
35 to 45. Falling of rocks
from cliffs 1000' to 2000' above
made work extremely dangerous
for both engineers and construc-
tion laborers. None of the
former were injured in such a
way but several of the contrac-
tors laborers were severely but
not fatally injured by falling
rocks. In some instances steel
helmets, surplus war material,
were used as a precautionary
protection.



15647



#16718 - View back from Sta. 414 showing lower parking area, 5750 sq.ft. at "The Loop". Also cement rubble toe wall, guard rail and steps leading to upper parking area. October 18, 1928.



#16717 - Close up of cement rubble masonry toe wall, guard rail and steps. Inlet of 6" porous tile drain may be seen in center of toe wall left of steps. Steps, tread 12", rise 8", width 6' - 0". Oct. 18, 1928.



#15578

View looking south from station 255 (camp #4) April 1926
 Left to right: Mt. Oberlin, 8100; Mt. Clements, 8764; Mt. Cannon, 8800.
 McDonald Creek valley and spur of Heaven's Peak on extreme right.

#15577

View taken about three miles from mountains. Mt. Oberlin and Mt. Cannon about two miles apart.

Transmountain Highway, West Side Project, #287, Glacier National Park.



#15574

15575

15576

View looking East from top of Mt. Oberlin, Aug. 28, 1926, showing end of road at Logan Pass, elevation 6650. Lower left, saddle horse trail route above highway location. On right, Hanging Gardens which may be easily reached from 0 + 00 probably by auto with very little if any work. Extensive camp and parking area, good water and many flowers during entire summer season. Close proximity to snow fields and glaciers on Mt. Clements on right.

Transmountain Highway, West Side Project, #287, Glacier National Park

work from Sta. 346 to 657; at camp #3, Sta. 308, W. T. Utz and two assistants worked from Sta. 170 to 346; at camp #5, Sta. 96, F. W. Farrar and three assistants handled the work from Sta. 0 to 170. During this season the center line, levels and cross-sections of the entire project were run out. In 1927 the parties were practically the same except that F. W. Farrar was replaced by M. L. Sanders. In 1928 R. M. Smith and his assistants worked from camp #4 at Sta. 270 and V. L. Goodnight handled the upper end of the project from camp #5.

The work of the engineering forces was not only difficult but dangerous at all times. Practically vertical cliffs, many of them several hundred feet high and a thousand feet long had to be surveyed, cross-sectioned and staked. This work was done in all kinds of weather; rain, hot sun, sleet, snow and high winds. The latter even was very dangerous, causing the loosening and tumbling of rocks, and the accompanying great danger to the men. In addition to the risk of a mis-step, which would mean certain death, there was always the possibility of a rock from the high cliffs above becoming dislodged and falling without warning onto the surveyors along the line. All possible precautions were taken. Ropes were used on the cliff sections, but it required lots of skill, strength, courage, ingenuity, and a resolve to "carry on" for the necessary field work to be accomplished. Not only were the engineers continually in danger during their own work but also in their passage along the right of way, due to the shooting of stumps and blasting of rock at many points of the job. From continued contact with the dangers of the work the men learned to avoid them. Although the men had many narrow escapes from serious accident, only one man of the engineering force was injured. He fell from the top of a rock out to the road and as a result had to spend a week in a hospital.

There were no very unusual engineering features. The cliffs only required much slow, hard, dangerous work to secure the cross-sections and to project and stake the line. At the tunnel the cross-sectioning was of a similar nature. Here, however, good judgment had to be exercised in fitting the tunnel to the line of least possible trouble from rock fissures. The Loop required much work, study and designing. Much credit is due the young men who so capably and loyally assisted throughout the work.

In addition to the engineering work on the West Side Project, reconnaissance surveys and reports were made in October 1927 on the following proposed projects within the Park:

North Fork Road to International Boundary	50 miles
Two Medicine Road, Trick Falls to Chalets	3 "
Transmountain Road, St. Mary to Sun Camp	9 "
Cut Bank Spur Road	6 "
Kennedy Creek - International Boundary via Chief Mountain	15 "
Transmountain Highway, Belton - Avalanche Creek	17.3 "
Flathead River Bridge and Great Northern Railway Crossing	1. "
Total	101.3 miles

These reports were submitted in 1927.

In addition, several small surveys were made for the Park Service. The public camp site at Avalanche Creek was surveyed, the data worked up and submitted to their San Francisco office. Surveys were also made for road improvements at Lewis Hotel and at the cribbing site on the Mt. Cannon section.

INSPECTIONS

Throughout the work the special features and landscape effects were under continual inspection by Park Service landscape architects. During the seasons of 1927 and 1928 Mr. E. A. Davidson, Asst. Landscape Architect, resided on the project inspecting the special features and requirements desired by the Park Service.

During the course of construction, the project was visited and inspected by many from both the Bureau of Public Roads and the Park Service.

From Washington, D. C. came:

Mr. Thos. McDonald, Chief of the Bureau
Mr. H. K. Bishop, Chief of Division of Construction
Capt. C. D. Curtis, Asst. to the Chief of the Bureau.

From San Francisco:

Dr. L. I. Hewes, Deputy Chief Engineer, B. P. R.
Mr. F. A. Kittredge, Highway Engineer (now Chief Engr. National Park Service)
Mr. J. W. Ball, Highway Engineer.

From District No. 1, Portland, Oregon:

Mr. C. H. Purcell, District Engineer
Mr. J. A. Elliott, Highway Engineer
Mr. A. C. Clark, Highway Engineer, Missoula, Montana
Mr. F. L. Martin, Bridge Engineer, " "

From the National Park Service:

Mr. Stephen T. Mather, Director of National Parks
Mr. Horace Albright, Asst. Director of Parks
Mr. Chas. J. Kraebel, Supt. Glacier Park
Mr. J. R. Eakin, Supt. Glacier Park
Mr. Thos. C. Vint, Chief Landscape Architect
Mr. E. A. Davidson, Asst. Landscape Architect.

The construction and engineering was directed and supervised from District No. 1 of the Bureau of Public Roads at Portland, Oregon. Mr. J. A. Elliott, having charge of all co-operative park work, made the regular visits of inspection and W. G. Peters was resident engineer on the project for the Bureau of Public Roads.

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

District No. 1

File No.

Transmountain Highway,
West Side Project, 1-C #287
Glacier National Park.

Post Office Building,
Portland, Oregon

October 20, 1928

Mr. W. H. Lynch,
District Engineer,
U. S. Bureau of Public Roads,
Portland, Oregon

Dear Sir:

On the above date the Transmountain Highway, West Side Project, 1-C #287, Glacier National Park, under contract to Williams & Douglas dated June 11, 1925, was completed according to plans and specifications.

Final cleanup was very well done, and according to instructions given by J. A. Elliott, Senior Highway Engineer, on his final inspection of October 4, 1928.

Yours very truly,

W. G. Peters

Associate Highway Engineer.

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

Regional Headquarters

File 485, Glacier
1-C, Gr. & Surf.

San Francisco, Cal.,
December 20, 1928

Mr. F. H. Lynch,
District Engineer,
Bureau of Public Roads,
Portland, Oregon

Dear Sir:

Enclosed is copy of letter of December 19 to this office from Thos. C. Vint, Chief Landscape Architect, approving the landscape features for final acceptance of the contract for constructing Glacier Park Project 1-C, Transmountain Highway, West Side-Logan Pass Section.

Yours very truly,

L. I. Hewes
Deputy Chief Engineer.

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

Glacier National Park
Belton, Montana

December 12, 1928

In reply refer
to File No. 333

District Engineer
Bureau of Public Roads
P. O. Building
Portland, Oregon

Dear Sir:

Referring to your letter of December 7th.

Construction of Project No. 1C, Transmountain
Highway, West Side Project, Glacier National Park, has
been inspected and approved by this office.

Yours very truly,

R. E. Vincent,

Acting Superintendent

RRV:RR

Park

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF PUBLIC ROADS

District No. 1State MontanaProject No. Glacier 1-B, 1-CTransmountain Highway
Mt. Cannon SectionReport on West Side-Logan PassFINALInspection made by J. A. Elliott, Sen. Hwy. Eng. Date inspection made October 4, 1928In company with Mr. Vint of the Park Service, and Mr. Peters, Resident Engineer.

S-4953 U. S. GOVERNMENT PRINTING OFFICE: 1928

About fifteen men were employed in cleaning up along the road camp, dressing up the surfacing, etc. There is a little work yet to be done on the channel excavation at the Trapper Creek Bridge. From Station 0 to 410 the job was 100% complete and the entire contract will be complete in about ten days or two weeks and all camps removed. This completes one of the most difficult pieces of road construction after a four-year operation and considerable credit is due the engineers and contractors in the successful handling of the work. It is recommended that the project be accepted as complete according to plans and specifications upon receipt of advice from the resident engineer that the final cleanup has been completed.

Time spent on inspection: Four hours.

cc to Res. Engr. Peters

U. S. BUREAU OF PUBLIC ROADS

DIST. No. 1

1 PROJECT Transmountain Highway SEC. East Side Project REPORT FOR PERIOD ENDING Feb. 20, 1929, 192

NATIONAL FOREST Glacier Nat'l Park COUNTY Flathead STATE Montana H. G. Peters, Associate Highway Engineer

LENGTH 15.74 miles STANDARD ROADWAY 16' CLASS OF WORK Contract Construction

2 TITLE

ITEM No.	CONSTRUCTION ITEM	WORK DONE		Per Cent Completed	COSTS					QUANTITIES		TOTAL UNIT COST TO DATE	TOTAL PROBABLE		
		Station to Station			Labor	M. & S.	Total this Period	Previous Report	Total Cost to Date Labor + M. & S.	Unit Cost to Date Labor + M. & S.	Since Last Report		Total to Date	Quantity	Amount
1	Advance Clearing	0	657	100	306.		306.	8603.	8909.	145.70	2.101	61.087	196.30	61.087	11,991.38
2	Grubbing	0	657	100	155.		155.	10011.	10166.	228.74	0.66	44.5005	251.	44.5005	11,104.47
3	Excavation, Incl.	0	657	100	4710.	2390.	7060.	446174.	453474.	0.88	8022.2	515278.	2499.819.89	515278.	2499.819.89
4	Structure Excav.	34	657	100	600.	165.	765.	12325	13090.	1.04	639.3	12071.05	1.14	12071.05	13,761.00
7	Completion Clear.	153	657	100	136.		136.	2129.	2265.	200.	0.6424	10.3154	220.	10.3154	2,269.39
8	Overhaul	406	526	100	46		46.	57.	103.	0.06	520.7	1234.7	0.09	1234.7	111.48
9	Sub-base	600	640	100	227.		227.	1521.	1748.	1.99	114.	879.	2.19	879.	1,925.01
10	Finished Road	0	678	100	9.		9.	9304.	9313.	590.	0.0153	15.7432	640.	15.7432	10,216.04
12	Crushed Rock Base	461	678	100	30.	14.	64.	10662.	10726.	2.05	31.	5231.	2.25	5231.	11,769.75
13	" " " "	0	678	100	700.	372.	1072.	38067.	39139.	2.35	456.	16673.	2.58	16673.	43,016.34
14	Binder	557	632	100				68.	68.	0.91	0.	75.	1.00	75.	75.00
15	Water Plant	Eliminated.													
16	Watering	Eliminated.													
19	Crushed Rock Maint.	21	641	100	100.	60.	160.	4032.	4198.	2.85	36.	1471.	3.14	1471.	4,618.94
21	Cushion Material	Eliminated													
22	Tunnel Excavation	442	444	100	30.	13.	43.	14873.	14916.	4.	10.8	3729.2	4.40	3729.2	16,408.48
22	" " " " Overbreak	442	444	100	100.	40.	140.	0.	140.	4.	35.1	35.1	4.40	35.1	154.44
23	Half Tunnel Excav.	135	445	100				28039.	28039.	1.29	-103.6	21708.2	1.42	21708.2	30,825.64
29	Gen. Sub. Mos. in	246	644	100				1824.	1824.	12.30	-1.143	147.07	1352	147.07	1,988.39
	20' Open Bridges														
30	Gen. Sub. Mos. in	17	548	100	309.	79.	379.	6783.	7165.	14.	27.04	511.75	15.40	511.75	7,880.95
	Arch Culverts														
31	Gen. Sub. Mos. in	153		100				270.	270.	12.	0.01	22.5	13.20	22.5	297.00
	Paving Culverts														

3 TOTAL

4 Proratable Factor this Report: 1.10

5 REMARKS: Contract awarded Williams & Douglas 6/11/28. Work began 6/22/28, closed 10/31/28. Resumed 4/1/29, closed 12/15/29. Resumed 4/1/29, closed 11/8/29, resumed 5/28/29 completed 10/20/29. Extension included 3.2 miles repair & surfacing Mt. Cannon section.

6 Weather Record

Contract date of completion Oct. 1, 1929

Days Allowed Days Consumed

GOVERNMENT PRINTING OFFICE

7 LIABILITIES AND EXPENDITURES TO DATE

Charges to be Distributed	
Charges to be Prorated	
Total Cost to Date (Labor + M. & S.)	74,085.87
Construction Engineering	
Survey and Plans	
Total Liabilities	
Agreement Amount	
Apparent Balance	

8 TOTAL PROBABLE LIABILITIES

E. F. S. Survey and Plans	20,957.20
Construction	21,198.40
Construction Engineering	9,967.48
Survey and Plans	2,375.32
Total Probable Liabilities	54,598.40
Agreement Amount	54,598.40
Balance or Deficit	9,892.72

29

WORK DONE DURING MONTH OF _____, 192 (Red) AND PREVIOUSLY (Black)

[illegible]

(10) COMPARISON OF WORK COMPLETED AND COST

10

[illegible]

* Net increase or decrease.

Lumped Items:

11

FUNDS AVAILABLE

ALLOTMENTS

[illegible]

REMARKS:

(12)

TOTAL COST TO DATE

Construction	
Construction Engineering	
Survey and Plans	
Other Liabilities	
Total Liabilities	
Agreement Amount	
Apparent Balance or Deficit	

† If included in same allotment.

DIST. No. _____

PROJECT _____ SEC. _____ REPORT FOR PERIOD ENDING _____, 192

NATIONAL FOREST _____ COUNTY _____ STATE _____

LENGTH	STANDARD ROADWAY	CLASS OF WORK	Signature
--------	------------------	---------------	-----------

2	Contract Construction.	Time.

[illegible]

4 Proratable Factor this Report: _____	7 LIABILITIES AND EXPENDITURES TO DATE 8
---	--

5	REMARKS: _____	Charges to be Distributed _____	_____	_____
	_____	_____	_____	_____

Charges to be Prorated		Construction	
Total Cost to Date (Labor + M. & S.)			

Construction Engineering	Construction Engineering
--------------------------	--------------------------

(6)	Weather Record		Survey and Plans.....	Survey and Plans.....	
			Total Liabilities.....	Total Probable Liabilities.....	

Days Allowed	Days Consumed	Agreement Amount	Agreement Amount
--------------------	---------------------	------------------------	------------------------

GOVERNMENT PRINTING OFFICE	8-4431
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29

192 (Red) AND PREVIOUSLY (Black)

Stations or Miles.

10

TOTAL.

* Net increase or decrease.

Lumped Items:

77

TOTAL COST TO DATE

REMARKS:

† If included in same allotment.

PROGRESS CHART OF February 20, 1929, 192

Sheet 3 of 3 sheets.

9

WORK DONE DURING MONTH OF February 1929, 192 (Red) AND PREVIOUSLY (Black)

Kind of Work	STATION	CLASS OF WORK	STANDARD ROADWAY	WORK DONE	CONSTRUCTION ITEM	ITEM
Clearing		All complete				
Grubbing		All complete				
Excavation		All complete				
Base Surfacing		All complete				
Top Surfacing		All complete				

Stations or Miles.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

10

COMPARISON OF WORK COMPLETED AND COST

Construction Items	43	44	49	50	51	58	59	61	63	64	65	66	67	TOTAL
Quantities of work completed to date	22.	2736.	1262.	246.	24.	184.	3792.7	180.	---	1177.67	---	148.54	12794.	
Unit price (to date)	10.	3.	4.	6.	8.	4.	3.	1.	1.50	14.	15.	35.	0.10	
Cost to date	220.	8208.	5048.	1476.	192.	736.	11378.	180.	---	16487.	---	5199.	1275.	967,771.12
Total probable cost	220.	8208.	5048.	1476.	192.	736.	11378.	180.	---	16487.	---	5199.	1275.	967,771.12
Engineer's estimated cost	5000.	12000.	3800.	2400.	2080.	400.	25300.	100.	3000.	64820.	750.	2800.	2000.	869,145.00
Probable increase			1248.			336.		80.				2399.		98,626.12
Probable decrease	4780.	3792.		924.	1888.		14122.		3000.	48333.	750.		725.	
Total probable quantities	22.	2736.	1262.	246.	24.	184.	3792.7	180.	---	1177.67	---	148.54	12794.	
Engineer's estimated quantities	500.	4000.	950.	400.	260.	100.	8500.	100.	2000.	4530.	50.	80.	20000.	
Difference, + increase - decrease *	-478.	-1264.	+312.	-154.	-236.	+84.	-4707.3	480	-2000.	-32523	-50.	468.54	-7246	
Per cent complete					100%									100%

* Net increase or decrease.

Lumped Items:

11

FUNDS AVAILABLE

ALLOTMENTS

Date	Federal	Local	Total
	Alotted Engineering - - -		\$ 82,365.96
	* Construction - - -		945,806.76
	Total		\$1,028,172.72

REMARKS:

12

TOTAL COST TO DATE

Construction	\$967,771.12
Construction Engineering	60,033.44
Survey and Plans †	* 22,332.52
Other Liabilities	
Powder Reduction Profit. Credit	-21,964.36
Total Liabilities	\$1,028,172.72
Agreement Amount	1,028,172.72
Apparent Balance or Deficit	

† If included in same allotment.

1

130

457

Sheet 3 of 3 sheets

REPORT No. 1333

PROJECT <u>Transmountain Highway</u>	SEC. <u>East Side Project</u>	REPORT FOR PERIOD ENDING <u>Feb. 20, 1929</u>	192
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NATIONAL FOREST Glacier National Park COUNTY Flathead STATE Montana

LENGTH 14.74 miles STANDARD ROADWAY 16' CLASS OF WORK Contract Construction. Signature _____

2

Title _____

ITEM No.	CONSTRUCTION ITEM	WORK DONE		Per Cent Completed	COSTS						QUANTITIES		TOTAL UNIT COST TO DATE	TOTAL PROBABLE	
		Station to Station			Labor	M. & S.	Total this Period	Previous Report	Total Cost to Date Labor + M. & S.	Unit Cost to Date Labor + M. & S.	Since Last Report	Total to Date		Quantity	Amount
63	Guard Rail Type "A"	Eliminated													
64	Con. Sub. Wdg. in Guard Rail Type "B"	32	472	100	490.	153.	603.	1123 ³⁴ .	11837.	10.	60.27	1177.67	11.	1177.67	12.95 ³⁴ .37
65	Con. Sub. Wdg. in Tray Inlets	Eliminated													
66	Glass "X" Concrete in Bridges	248	644	100	60.	29.	89.	2037.	2146.	14.43	6.18	148.94	15.90	148.94	2.161.79
67	Reinforcing Steel in Bridges	248	644	100	4.	3.	7.	886.	893.	0.07	95.	1275 ³⁴ .	0.08	1275 ³⁴ .	1.020.32
TOTAL					8437.	1615.	12052.	723031.	735083.						809,108.67

3)

TOTAL

609.108.67

4

Proratable Factor this Report:

7

LIABILITIES AND EXPENDITURES TO DATE

8

TOTAL PROBABLE LIABILITIES

5

REMARKS:

Cha

Charges to be Distributed

Charges to be Prorated

Total Cost to Date (Labor + M. & S.)

Construction Engineering

Survey and Plans.

Total Liabilities

Agreement Amount

Apparent Balance.

with 100% accuracy.

Construction

Construction Engineering

Survey and Plans.

Total Probable Liabilities

Agreement Amount

Balance or Deficit

6)

Weather Record

Days Allowed

Days Consumed

Public Voucher for Purchases, and Services other than Personal

D. O. Vou. No. _____

No. _____

(Voucher prepared Portland, Oregon, Feb. 14, 1929)
(Give place and date)

U. S. _____
(Department, Bureau, or Establishment)

App. _____
(Signature of Approving Officer)

THE UNITED STATES, Dr., To Williams & Douglas
(Payee)

Address #19 Bradley Road, Tacoma, Washington

Payee's Acct. No. _____

Payee must NOT
use this space

Contract No. _____ Date 6/11/1925 Req. No. _____ Date _____

Activity Transmountain Highway, West Side Project, For Road Construction

Expendi- ture Symbol	No. and Date of Order	Date of Delivery or Service	(Enter description, Item Number of Contract or General Supply Schedule, and other information deemed necessary) Terms _____ % Discount Cash _____ days	QUAN- TITY	UNIT PRICE		AMOUNT		NOTATIONS Payee must NOT use this column
					Cost	Per	Dollars	Cts.	
		Oct. 20, 1928	Estimate No. 23, FINAL For work done and materials in place up to October 20, 1928 for the im- provement of the Transmountain High- way, West Side Project, #237, Glacier National Park under contract entered into June 11, 1925. Total amount earned by contractor as per attached itemized statement \$967,771.12 Total deductions as per attached statement \$947,771.12						

(This certificate not required when a like certificate is made by payee on attached bill or bills)

I certify that the above bill is correct and just, and
that payment therefor has NOT been received.

TOTAL, \$ 20,000.00

Do NOT sign

* Payee

Per _____

Title _____

(Additional statements by Department, Bureau,
or Establishment, if deemed necessary)

(Accounting Classification)

(Payee must NOT use this space)

Differences: _____

Account verified; correct for: \$ _____

(Signature or initials) _____

I certify that the above articles were received in good condition, after due inspection, acceptance, and delivery prior to payment as required by law, or the services performed as stated; that they were procured under the contract numbered above or the unnumbered contract attached hereto, or that they were procured without written contract, in open market, and with or without advertising, under the circumstances stated in No. _____ of "Method of or Absence of Advertising" shown on reverse hereof, and were necessary for the public service; and that the prices charged are just and reasonable and in accordance with the agreement.

† Approved for \$ _____

(Memorandum—Do not sign)

† _____

Title _____

Paid by { Check No. _____, dated _____, for \$ _____
Cash, \$ _____, on _____ } on Treasurer of the United States
in favor of payee named above.

* Payee

(Memorandum—Do not sign)

* When a voucher is signed or receipted in the name of a company or corporation, the name of the person writing the company or corporate name, as well as the capacity in which he signs, must appear. For example: "John Doe Company, per John Smith, Secretary," or "Treasurer," as the case may be.
† If the ability to certify and authority to approve are combined in one person, one signature only is necessary; otherwise the approving officer will sign in the blank space below "Approved for \$ _____" and over his official title.

Per _____

Title _____

(Section 3709 of the Revised Statutes)

use this space

No. and Date of Order	Date of Delivery or Service	Description of Item (Enter description, item number or contract or general supply schedule, and other information deemed necessary)	Quantity	Price	Dollars	Cents	Total

PAID, 25, 1914

10-1751

RECEIVED

MAY 26 1930

REGIONAL HEADQUARTERS
BUREAU OF PUBLIC ROADS
SAN FRANCISCO