MAXIMUM REACH ENTERPRISES
1853 Wellington Court
Henderson, NV 89014
Ph: 702 547 1564
kent.goodman @ cox.net
www.maximumreach.com

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CONSTRUCTION OF I-15 THROUGH THE VIRGIN RIVER GORGE

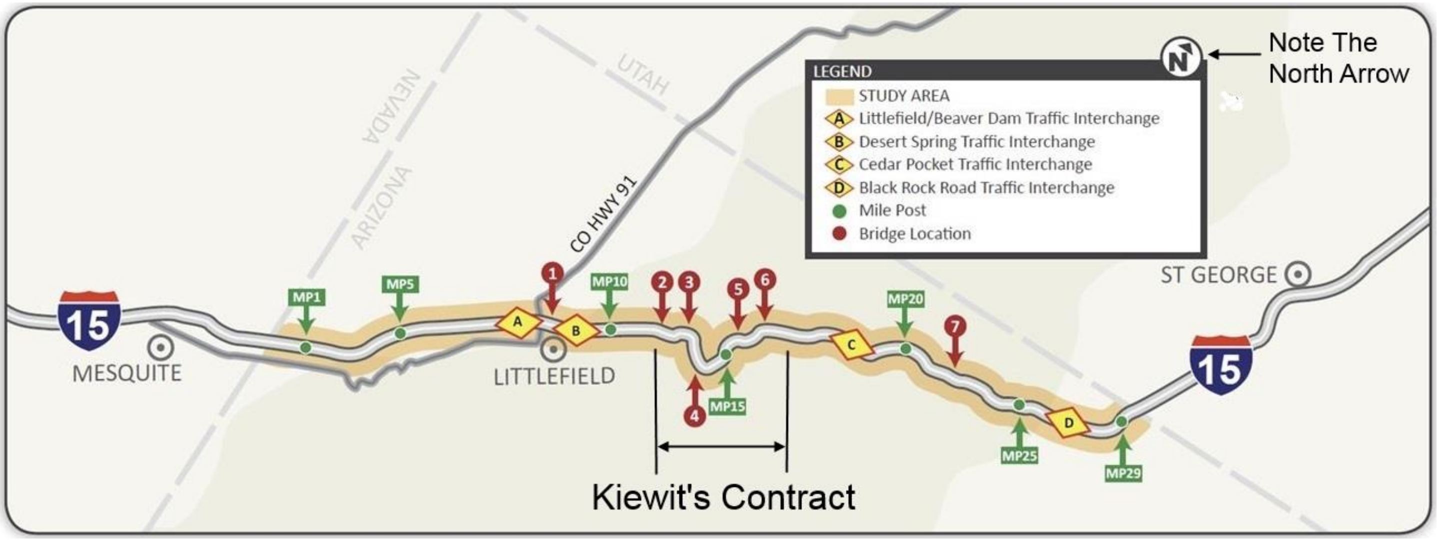
HISTORICAL INFORMATION:

Prior to 1973, motorists traveling I-15 North from Mesquite, Nevada to St. George, Utah had to exit at Littlefield, Arizona and take State Route 91. They would then go past Beaver Dam and on up and over Utah Hill and then down the other side into Santa Clara and on in to St. George.

This detour on Route 91 was quite scenic but the two lane road made for some real challenges, sort of like an E ticket ride at Disneyland. One was because when you were traveling uphill you were behind a line of slow moving 18 wheelers and when you were going downhill, an 18 wheeler was always tailgating you so close that you felt like he was going to push his way into your trunk. This made a lot of motorists very nervous. Another challenge was due to Utah hill being so steep that a large number of cars and trucks were always parked at the side of the road with their hoods up and steam pouring out of their radiators, probably because the cooling systems were not too efficient in those days and also because most people will not turn their AC off going up a steep grade if their lives depend on it. It was so bad, that the State Highway Department placed open topped 55 gallon barrels of water at every pullover or layby.

The saving grace for having to travel over Utah hill, was when you reached Santa Clara you could stop at one of the fruit stands and buy a cool white peach that was about the size of a grapefruit, yum, yum.

When approaching Littlefield, AZ, it was hard to see how I-15 would be routed through the mountainous range called the Virgin River Gorge.



THE CONTRACT:

In early 1969, Peter Kiewit Sons' Company received a contract from the Arizona Highway Department for constructing the **subgrade** for approximately 3.5 miles of I-15 through the heart of the Virgin River Gorge. The usage of the word "subgrade" is used here because the contract called for drilling and shooting the cut areas, moving the shot rock to the fill areas, watering and compacting it up to the top of the subgrade. There was no placing of crushed base material or asphalt paving included in the contract. This would be done later under a separate paving contract after this project was completed. See the drawing at the end of this section.

Depending on who you talk to, the cost of the Virgin River Gorge contract issued to Kiewit was between 10 and 15 million dollars per mile. I seem to remember it being closer to $14 M.

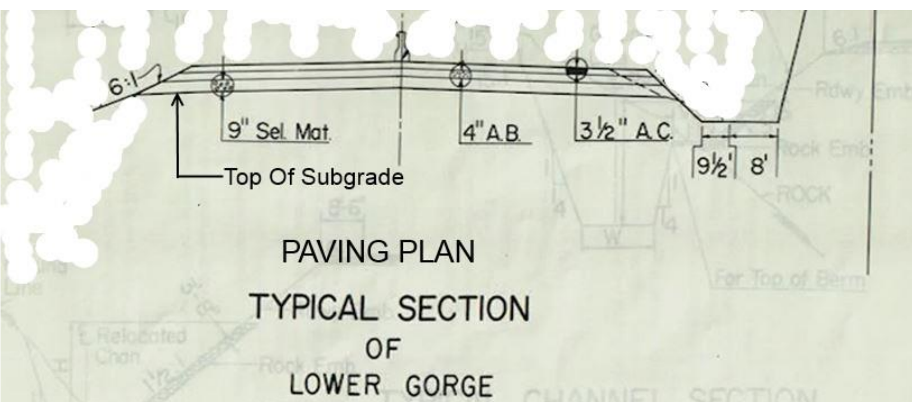
At the time this contract was awarded, I-15 was paved and opened from the Nevada line at Mesquite to Littlefield, Arizona. From Littlefield, the Vinnell Corporation had completed the subgrade to mile post 13 which was just inside the Southwest entrance to the Virgin River Gorge and just below where bridge number 2 would be constructed by Kiewit. They had also completed bridge number 1. Note in the drawing above that the North arrow is shown about 45 degrees out of orientation, so I-15 is actually running from Southwest to Northeast thru the canyon. On the upper end, the subgrade was completed from the Utah line down to mile post 16.5, including the construction of bridge number 7. So, that left the 3.5 miles through the lower gorge for Kiewit to construct, as well as constructing the 5 bridges.

The contract included making the roadway cuts but also making some channel cuts. The channel cuts were required to provide enough cross sectional area through the narrow parts of the canyon for a certain volume of water that could occur during a 100 year flood. In some areas of the canyon, channel cuts were made on one side of the canyon and roadway cuts were made on the opposite side. Riprap slope protection was required along most of the roadway. It was constructed of large boulders laid on the 1:1 H:V (Horizontal to Vertical) roadway slope to a thickness of 10'. The voids between the rocks were then filled with concrete.

Before a contract is awarded, all State Highway Engineering Departments calculate a mass diagram for that project. To construct the diagram, the volume of material in cubic yards (CY's) of each cut and the volume of material required in each fill area are calculated. The resulting data is used to plot the curve on the mass diagram which then shows where each CY of cut material should be transported to the closest fill area and in the shortest route. If there is not enough material in the cut areas to bring all of the fill areas up to the top of the subgrade, then a borrow pit is designated on the plans so that the contractor knows where to get the extra material required. Conversely, if there is too much cut material for the fill areas, then the plans show designated spoil piles or dump areas where the excess material can be transported and disposed of.

This was true of Kiewit's contract as well. The mass diagram showed that there would be excess cut material on the upper part of the project, so a dump area was designated that was located just above bridge 4. A temporary crossing had to be constructed over the river for the material to be disposed of up in a side canyon on the East side of the Virgin River. The mass diagram also showed that there would be excess cut material on the lower part of the project, so a dump area was designated that was located just outside the canyon and on the west side of the roadway that Vinnell had constructed.

The next drawing shows what the typical paving plan looked like for the Lower Gorge. As stated above, this work was not included in Kiewit's contract and is presented here for information only and mainly just to show where the top of the subgrade is located.



RIVER CONDITIONS THROUGH THE GORGE AT THE START OF THE CONTRACT:

In late 1969 when we started pioneering a rough access road through the gorge, we had to cross the river 18 times as it snaked from one side of the canyon to the other. When the project was completed, the river would be crossed over five times using the bridges. Some of the crossings were narrow and deep while others were wide and shallow. We soon learned some valuable lessons. Two lessons learned were 1) Traditionally, the two way radio transmitters/receivers were bolted to the floor of our pickups under the passenger seat. But after several pickups became stuck in deep river crossings and the water came in over the seats and shorted out the units, we decided that we had to bolt the radio units to the underside of the roofs of the cabs of the pickups between the driver and the passenger. 2) We soon found out that the lining on the brakes on the 40 Chevrolet pickups in our fleet were lasting about six weeks. We brought in 5 more pickups and used them to rotate the fleet thru the Chevrolet dealer in St. George to keep up with the brake replacements without disrupting our daily operations. The photo below shows one of the 18 river crossing.

EQUIPMENT AND MAINTENANCE:

We had about 140 major pieces of heavy earth moving equipment on the project. The numbers listed below are approximate due to the span of time and the memory of the author but are close enough for bridge work. The equipment included:

20 ea.	D8 Caterpillar dozers with angle blades
1 ea.	D7 dozer with an angle blade and with a rear mounted winch
2 ea.	992 Cat front end loaders, 10 CY capacity
6 ea.	988 Cat front end loaders, 6 CY capacity
6 ea.	966 Cat front end loaders, 3 CY capacity
6 ea.	#12 Cat blades
4 ea.	Cat water wagons
4 ea.	Sheep’s foot rollers
25 ea.	Rock trucks, 50 ton capacity
2 ea.	Special equipped lubrication trucks
2 ea.	Fuel trucks with disconnects for fast fueling
10 ea.	Mechanic trucks
3 ea.	Robbins rotary rock drills mounted on D8 Cats for drilling 9” diameter vertical burden holes
15 ea.	Air tracks for drilling 3” diameter slope holes
1 ea.	Bucyrus-Erie dragline for laying riprap, 6 CY capacity
10 ea.	Concrete mixer trucks

6 ea.	Gardner-Denver Compressors with two axles,
1 ea.	Bucyrus-Erie truck crane, 60 ton capacity
10 ea.	Hydraulic truck crane, 30 ton capacity
1 ea.	Crushing plant for producing concrete aggregate and sand
1 ea.	Batch plant for making concrete for bridges and slope protection

The above equipment list did not include items like welders, light plants, generator sets, small air compressors, etc. Also, we relied on the Chevrolet dealer to maintain the +40 pickups.

I was the equipment superintendent for this project, not because I was a mechanic but due to my organizational skills and knowledge of maintenance gained while operating heavy equipment and working as a crushing superintendent for three years in charge of a large crusher set up. Crushers require a large amount of maintenance to keep them running.

When a maintenance problem came up on this project, I would review it with one or more of the master mechanics and then I would make the decision on what the solution would be. We had a master mechanic and 20 mechanics on each day shift, swing shift and graveyard shift and we worked 6 days a week and sometimes on Sundays. The operations crews worked 2 shifts, 5 days a week on the roadway grade, so this gave us a little time to catch up on the maintenance on the grave yard shift and on the weekends.

Because this was a rock job, there were several things that we (we meaning the equipment manager from Phoenix and myself) did to cut down or prevent future maintenance. We did this at the start of the project when there was not a lot of equipment requiring maintenance. It was done mainly on the swing and graveyard shifts. 1) We welded 1" thick X 6" wide strips of steel cut from hardened plate to the outsides and undersides of the D8 & D7 dozer arms. The strips were spaced 3" apart so that mud and dirt would build up in the spaces. 2) We welded a 1" plate under the bottom of the buckets on the 992 Cat loaders and on several of the 988 Cat loaders. When the project was completed and we cut the steel strips off the dozer arms and the plate off the bottom of the loaders, these areas were just like new so there was no maintenance necessary before they were shipped off to the next project.

Most of our Cat equipment was bought new for this project from Wheeler Machinery in Salt Lake City. Part of the purchase contract was for Wheeler to furnish a field serviceman for our project and he would be on call 7/24's (note that I did not say 24/7's as most political incorrect people would say). Jay Curtis was the field serviceman and when he was not working on new warranty equipment, he was authorized to work on our used equipment. His knowledge and experience helped us immensely in keeping the equipment running. He went on later to become a manager for Wheeler Machinery.

Kiewit also had a contract with a major tire manufacture to provide a full-time tire man, a truck with a heavy duty hoist, a van and spare tires for every piece of equipment we had on the project. The tire man was on call 7/24's.

Kiewit is a firm believer that it is cheaper to take care of the inside of the equipment by changing oil, etc., than making major repairs. To this end, they use large monthly wall charts that show the amounts of fluids being used each day by each piece of equipment. The lubrication foreman is responsible for keeping these wall charts current.

An example of how these wall charts really paid off was when we rented a Robbins rotary rock drill that was mounted on a D8 Cat. When it arrived at the jobsite, the mechanics started it up and noticed right away that the engine was spitting oil as everybody started noticing little spots of oil on their arms and faces. I asked Jay to give the D8 Cat a thorough inspection and to document everything. I also told the lubrication foreman to be extra careful when keeping up the wall charts so that we could tell exactly what fluids it would be using. The D8 started out using 1.5 gallon of engine oil per shift and increased to 2.5 gallons by the time we sent it back after one years use. 6 weeks later, we received a repair bill for $50,000 for overhauling the engine. I took the wall charts and photo copied the ones that showed the history for the Robbins drill and sent them to the owner. We never heard another word about the bill.

Checking out the equipment on a Saturday afternoon with my family. Note the Cat water wagon at the left of the photo

Note the 50 ton rock truck to the left of the photo

HOW THE SLIVER CUTS WERE MADE:

On most roadway projects, the contractor is able to walk his heavy rock drilling equipment upon the top of the cuts and start drilling with minimal preparation, i.e., the cuts have width at the top with room to move the equipment around. This project was different as none of the heavy rock drilling equipment could be walked up on the top of the cuts. It had to be pulled up. This process will be explained later. Some of the cuts on this project allowed the workmen to carry the jack hammers upon the top of the cut and had room to start drilling. Quite a few of the cuts started about +300' above the Virgin River flow line and were called sliver cuts. This was because there was no width to the top of the cut, only a survey notation that said something like "start cut here". The slope gradient didn't have to be written because the plans showed that all slopes were at a ¼:1 (H:V). H:V is a ratio of the horizontal to the vertical and means that for every vertical foot down the slope from the start of the cut, there has to be a horizontal movement of a ¼ foot toward the inside of the cut. The resulting angle between the slope line and the horizontal is 75.96°. And there was nothing on these cuts to support the rock drilling equipment or the workmen.

Before going on, the survey crews for the Arizona Department of Transportation need to be congratulated on the fine, and many times dangerous work, they performed in calculating and then laying out the survey information on the rock faces. I don't know but I feel sure that they must have employed some rock climbers who took directions from the survey chief located at the bottom of the canyon as to where the cut was to start and then to maybe just paint a 2' long horizontal line and then paint a vertical arrow coming down to it with the words "start cut here". This was probably repeated about every 25' across the cut face.

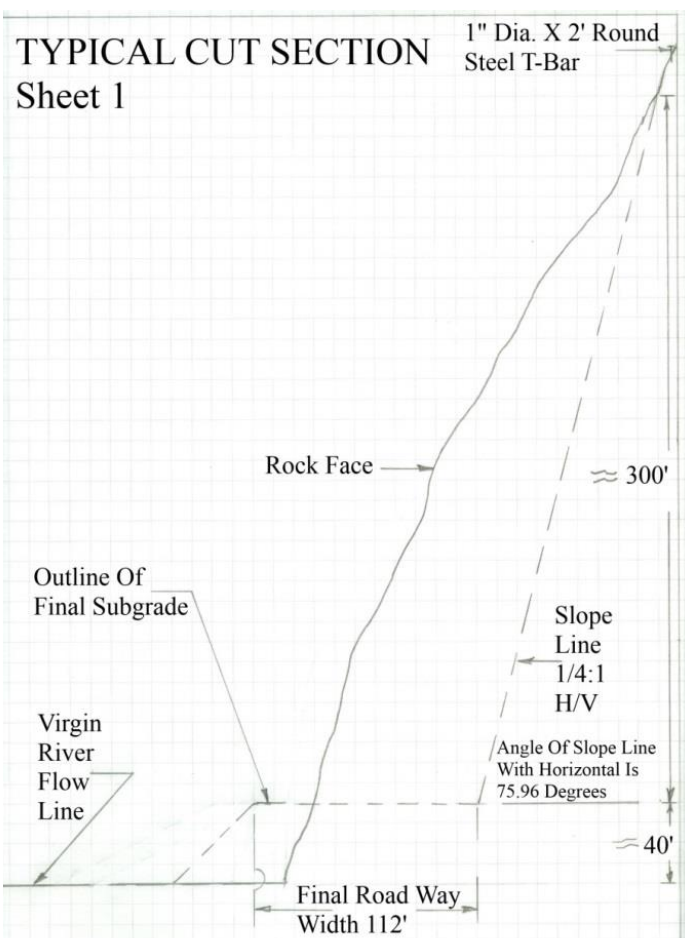
The above required a lot of strength and determination to accomplish, but Kiewit's rock drilling crews required a lot more determination and innovation to go from the paint marks on the rock face to actually starting and making the cuts.

One of the first things needed was a method to tie off drillers, rappellers, light equipment and heavy equipment. A 1" dia. X 2' long, round steel bar was used for tying off the small equipment and workmen. A 2 3/8" dia. X 3' long round steel bar was used to tie off all of the heavy equipment. Each 1" & 2 3/8" round bar had a 6" length of the same diameter steel welded across the top to form a T. They were then called T-bars. The T-bars were placed in holes made by jack hammers so that only about 3" was left above the rock and then high strength epoxy was poured in the holes to cement the T-bar to the rock. Some might be confused by calling them bars, but the American Institute of Steel Construction (AISC) calls out round, square or flat lengths of steel as bars. Remember that jails use round bars. The T-bars for this project were made from high strength steel with a minimum yield stress of 70 ksi (kips per square inch)

The cuts were started with a labor crew laying 6" dia. X 30' long aluminum air pipe sections up a gully next to the cut, but far enough away so that the pipe wouldn't get damaged by fly rock from blasting. If the cut was very long, an air pipe was run up each side of it. The air pipe sections had nozzles on them at different locations so that air could be pulled off at different elevations. When the pipe needed to be supported to keep it from sliding back down hill, it was capped and filled with air from a compressor located at the canyon floor. Workmen then hooked up air hose & drilled holes in the rock and 1” T-bars were cemented to anchor the pipe in place as needed.

As the pipe was being laid up the gully, another crew of laborers carried extra air hose, jack hammers, drill steel or rods, tools, parts, shovels, picks, lunches and water. Another crew carried blasting powder (actually it was ANFO Prills, which are pellets made from an ammonium nitrate and fuel oil mixture), dynamite and detonator caps to the top of the gully and stock piled it there and then returned for another trip. Each laborer carried one 50 lb. bag of powder per trip. This crew made these round trips all day long. In the summer, the temperature was up to 120 degrees in the canyon.

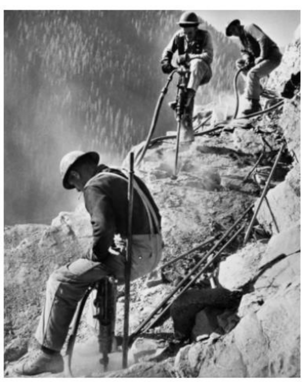
With the air piped to the top of the cut, two rock climbers climbed about 30’ above it carrying small dia. air hose, a small jack hammer, 1” T-bar and epoxy. After drilling the hole and installing the 1” T-bar, they hung two rappelling ropes down from it and moved over to the next location and repeated the operation. This sounds like a pretty simple operation but there was a lot of passing ropes back and forth with grunt buckets filled with tools by laborers on the side of the cut. See the typical cut section, sheet 1 which shows the 1” dia. T-bars about 30’ above the top of the cut.



As soon as the rappelling ropes were hanging down, a pair of drillers equipped with a large jack hammer moved out under a T-bar and started drilling 2.5" dia. slope holes at the start of the cut. It took two drillers to handle the large 80 lb. jack hammer, the drill steel and the air hose while being supported by the rappelling ropes. They used different lengths of drill steel or rods from 2' in length to 12' in length. They screwed lengths of drill steel together to get the drilling depth required. They drilled the slope holes 2' apart along the face of the cut and made as many holes as they could from one tie off location. Meanwhile other pairs of drillers were doing the same thing at other points along the top of the cut.

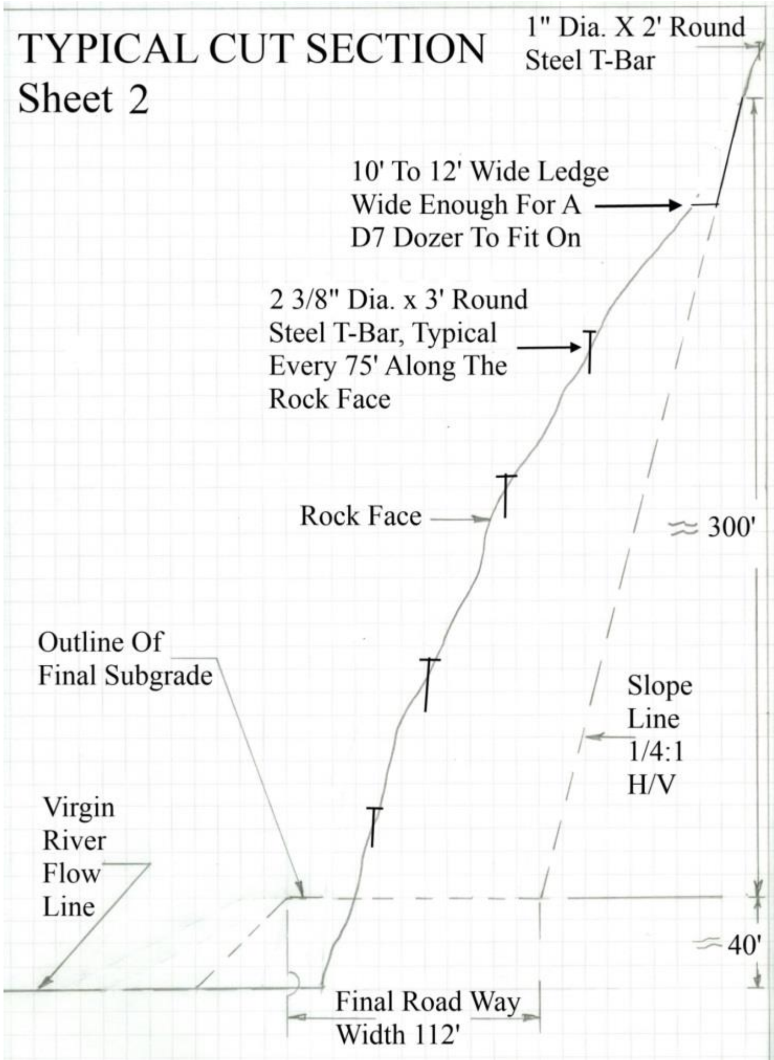
As soon as they finished drilling, they loaded the holes with powder, dynamite and set the detonator caps. Then all of the drilling crew moved to the side of the cut into the gully. The drill foreman radioed the flagmen located on floor of the canyon, one on either side of the cut. As soon as the drill foreman received the all clear signal that all traffic had been stopped below, he set off the blast. The drilling crew then took their shovels and picks to the shot area, and proceeded to shovel all of the shot rock off the slope into the canyon, so the drilling could begin again. Luckily, most of the shot rock fell down into the canyon from the blast.

When the drillers had blasted the rock down so that a ledge was starting to form, then in addition to the slope holes, the drillers started drilling vertical burden holes on a 2' x 2' pattern. See the photo below.



Large Jack Hammers At Work. No rappelling ropes shown as the drillers are working on a ledge. The jack hammers drilled a 2.5" dia. hole.

As soon as the shot rock was shoveled into the canyon, 1" T-bars were installed on the lip of the ledge and rappellers went down and scaled the rock face so there wasn't any loose rock left that could fall and hurt someone below, as it might be dislodged by the blast from another cut. The scaling operation was repeated after every blast. This drilling operation was repeated until the shot ledge was about 10' to 12' wide. At this point drillers rappelled down the rock face and drilled and installed 2 3/8" T-bars about 75' apart. A 2" dia. steel pear link with two large diameter slings, one 15' long and the other 5' long, was hung from each T-bar. See the typical cut section sketch, sheet 2.



D7 Caterpillar Dozer

D7 DOZER WITH A WINCH MOUNTED ON THE REAR. Note the hook on the winch line is attached to the drawbar just below the winch. The drawbar is typical on all dozers.

Now it was time to bring the D7 Caterpillar dozer into action. The operator of the D7 was Jock Carnes. I don't know if the Operators Union sent him out to specifically operate the D7 or if Kiewit supervision asked for volunteers due to the danger involved and Jock was the only volunteer with enough nerve to do it. Jock backed the D7 up to the rock face of the cut. He then started letting out on his winch line and the laborers threaded it around a single sheave block and hooked the dead end to the draw bar on the dozer. This made what is called a two part line and provided twice the pulling power for the winch. Laborers up on the cut throw a rope down and the laborers by the dozer hooked it to the top of the sheave block. Jock then began to let out more winch line and the laborers up on the top of the cut pulled the sheave block up the face of the rock until it could be hooked to the 5' sling on the nearest T-bar by two rappellers. Jock then started backing up the rock face by taking in on his winch line and powering the tracks of the dozer. As soon as the D7 got up to the first T-bar, the rappellers hooked the 15'sling to the draw bar. He then slacked off on his winch line until the draw bar sling was tight. He then let out on his winch line and the rappellers unhook the sheave block from the 5' sling. He continued to let out on his winch line and the laborers at the top of the cut pulled the sheave block up to the next T-bar. This operation was repeated until the D7 was up on the ledge.

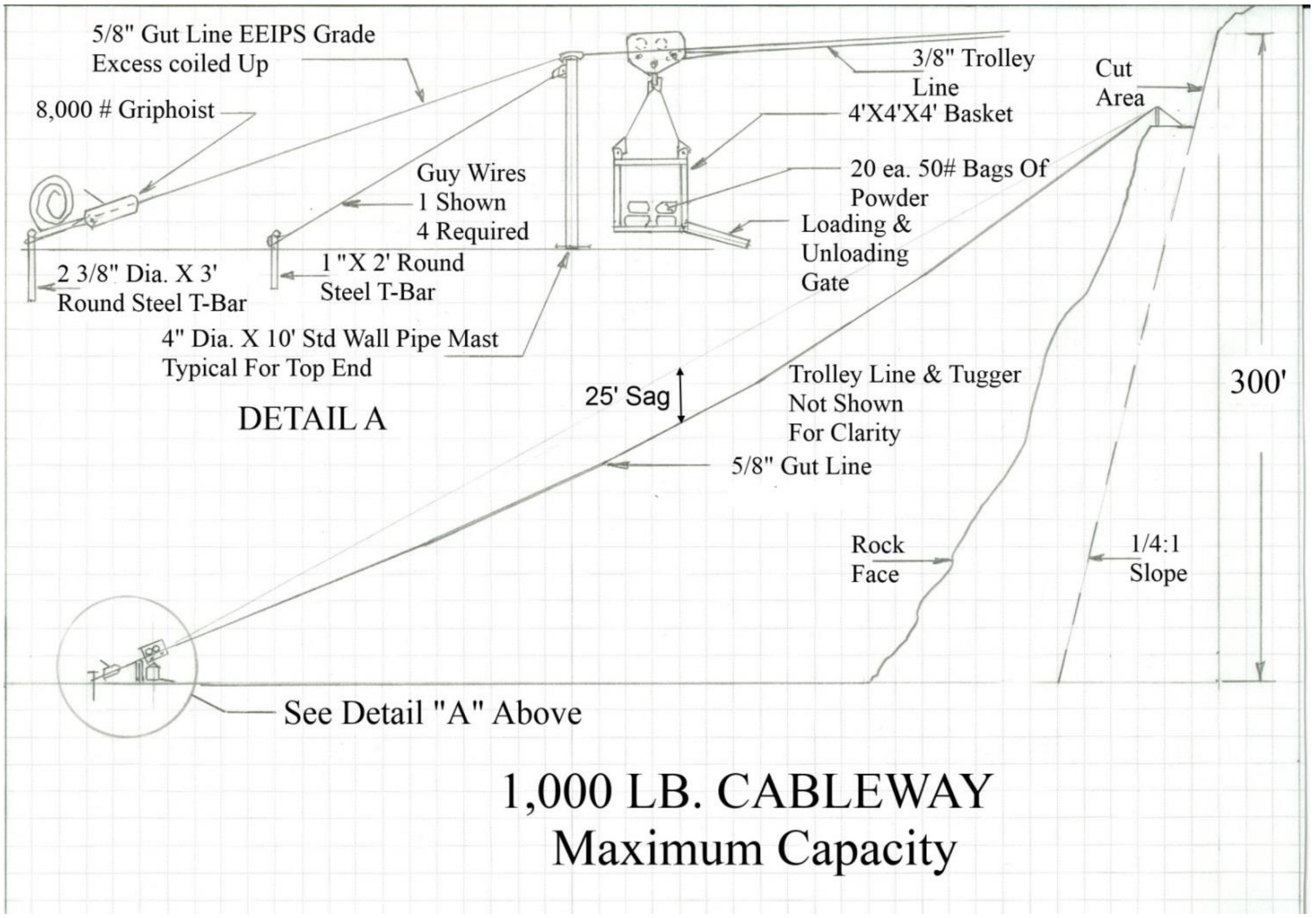
As a side note, this was a very dangerous operation and was not covered under Union rules. So it was up to Jock to determine if he felt the operation was safe and to give a go or no go at any time. One time, the D7 was about 100' off the canyon floor when a damaged tie off sling broke. The D7 went skidding down the near vertical rock face with Jock riding the brakes just enough to make sure that the dozer blade was staying downhill. He also kept the dozer blade as high as he could and when the D7 reached the canyon floor, it rolled out in the sand and gravel until Jock could stop it. He got off and took a little break while the laborers installed a new set of slings and then he started winching himself back up the slope as though nothing had happened.

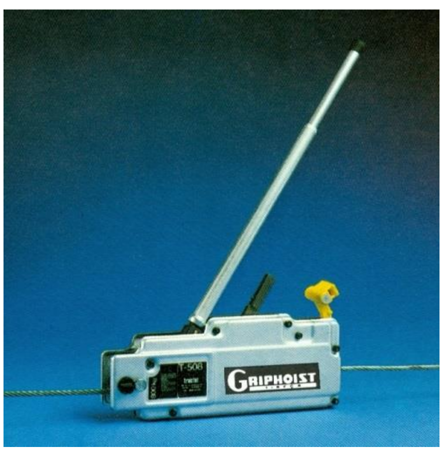
When the D7 was finally up on the ledge, Jock would back it up to the edge of the cut and the drillers would anchor it with 2 each 1" T-bars. He would let out on his winch line as a single part and laborers on the bottom would pull the end down with a rope and hook it on to an air track rock drill. By radio communication, Jock would start to winch the air track up the rock face and the air track operator would also help out by adding air power to its tracks. When it was pulled up on the ledge, Jock pulled another one up. As a side note, there was only one air track operator who had nerve enough to bring an air track up the rock face. He did it for all of the other air tracks. One of the air tracks would start drilling 3" dia. slope holes, 3' apart and 15' deep. The other air track would start drilling 3" dia. vertical burden holes on a 3' square pattern. Jock would then pull up two light plants so the night shift could have good lighting. Jock would then start making a ramp around the corner from the cut area into the gully so that all of the equipment could be moved there before the next blast went off.


Typical Air Track Rock Drill, drilled a 3” dia. hole

It was at about this point on the first cut that it became apparent that using laborers to carry the 50 lbs. bags of powder up on the cut was not going to keep up with the amount required. So we designed a small cableway that had a maximum capacity of 1,000 lbs. This meant that it could carry 20 each 50 lb. bags of powder per trip, or a hundred gallon diesel fuel tank per trip, or all of the ice water, lunches, drilling tools, mechanic tools, parts, etc., that was needed to keep the drilling of the cut going in an efficient manner. See the sketch below showing the cableway. It was light enough that the top mast could be relocated and guyed off on the cut ledge after each shot and re-tensioned using a large grip hoist at the bottom. A Sauerman continuous cable clamp, similar to the one in the photo was installed just above the grip hoist as a safety. The 3/8” dia. trolley line was hooked to the trolley, ran up to the top mast, around a sheave, back over a sheave at the trolley, down & over a sheave at the top of the bottom mast and on down to an air tugger. A high speed air tugger, not shown in the sketch, pulled the trolley line so that a load of powder could be moved from the canyon floor to the top of the cut in under 10 minutes. It was not designed for carrying personnel, so the workmen still had to walk up the gully at the start of their shift and back after the shift. But they could do it without having to carry anything.

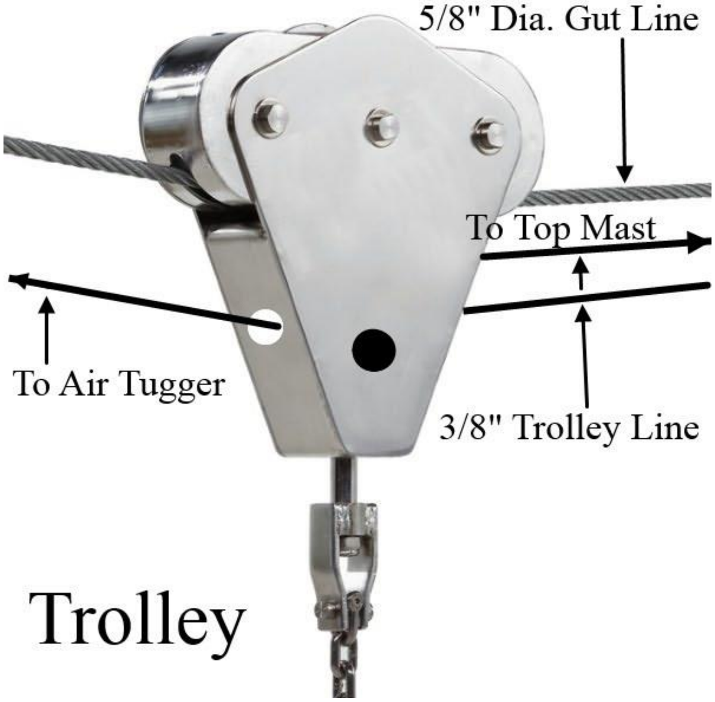
The trolley ran on the 5/8” dia. gut line.

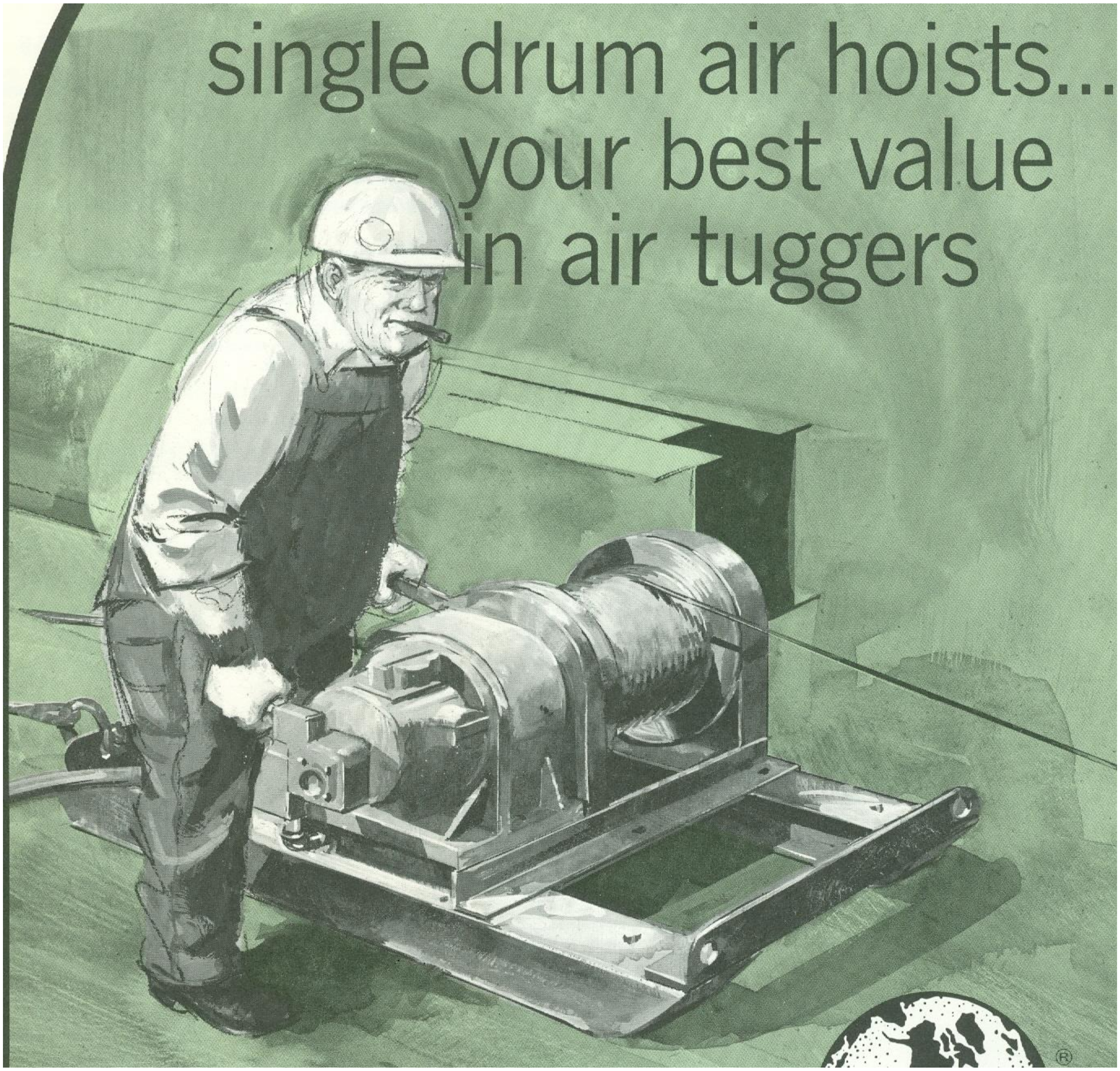




Griphoist, 8,000 lbs. pulling capacity for tensioning the unloaded gut line to about a 25’ sag.

Sauerman Continuous Cable Clamp. Safe Working Load same as the gut line.
Used as a safety with the sling hooked to the T-bar anchor at the canyon bottom.





Air Tugger, 5,000 lbs. pulling capacity, 110 fpm line speed

When the cut was drilled, loaded with powder and was ready to be shot, Jock moved the two light plants around to the side of the cut in the gully. The air tracks were walked back next to them and then he backed the D7 up next to the air tracks to wait for the blast.

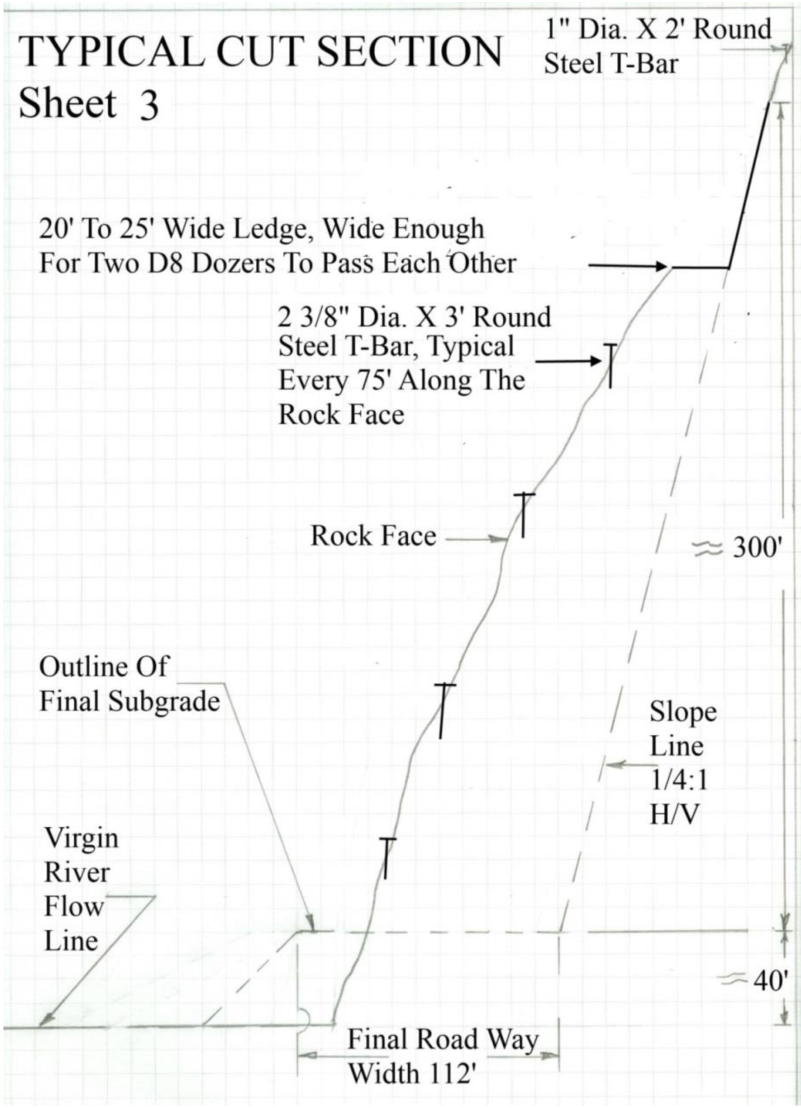
When the blast went off, the powder in the slope holes was set to explode a couple milliseconds before the powder in the vertical burden holes was set off by using delays in the caps. The energy from the powder in the slope holes, seeking the path of least resistance, went from slope hole to slope hole, cracking the rock face in a straight line. Then the vertical burden holes exploded and the shot material rose up in the air. The material around the slope holes then slid down off the slope into the void left by the burden material, leaving pretty much a smooth rock face or slope with only the half round 3” pre-split drill holes showing. The slope required very little scaling. This type of slope drilling is very evident as one drives through the Virgin River

Gorge and looks at the smooth cuts that look like they have been cut with a butter knife. For an example of this, see the photo of the cut just below bridge 6.


PHOTO OF BRIDGE SIX, looking South downstream.

After the blast was over, Jock made a ramp down on to the shot rock and started shoving it over the side of the ledge into the canyon below. As soon as he was down to hard rock on the far side of the ledge, the air tracks moved into that area and started drilling slope and burden holes. After he moved the light plants down the ramp, he started shoving the shot rock from that end of the ledge and cut out the ramp. As soon as Jock was finished shoving the shot rock in that area, the air tracks were free to start working on that end of the ledge as well. Jock then made a place for all of the equipment to hide during the next blast.

This process was repeated until the ledge was about 20’ to 25’ wide, wide enough for two D8 dozers to pass by each other. See Sheet 3 below.



Jock then backed up to the edge of the ledge and the laborers anchored the D7 off with T-bars. He then let out on his winch line until the laborers could thread it thru the sheave block and hook the dead end to his draw bar, making a two part line, the same as before. He then let out more winch line as rappellers pulled the sheave block down the rock face until the winch ran out of line. The rappellers then hooked a series of heavy slings to the sheave block that were long enough to reach the bottom of the canyon floor. The sling at the bottom end was hooked to the draw bar of a D8 Caterpillar equipped with a Robbins rock drill. See the photo below. By radio communication, Jock would start to winch the Robbins Rock Drill up the rock face and the D8 operator would also help out by adding power to its tracks. The same process that was used for pulling the D7 dozer up the rock face was repeated, i.e., the D8 had to be tied off several times to T-bars and a heavy sling removed each time. The actual process was a little more complicated than explained above, but the details have been left off for simplicity. When it was pulled up on the ledge, the D7 would pull a D8 dozer up the same way.

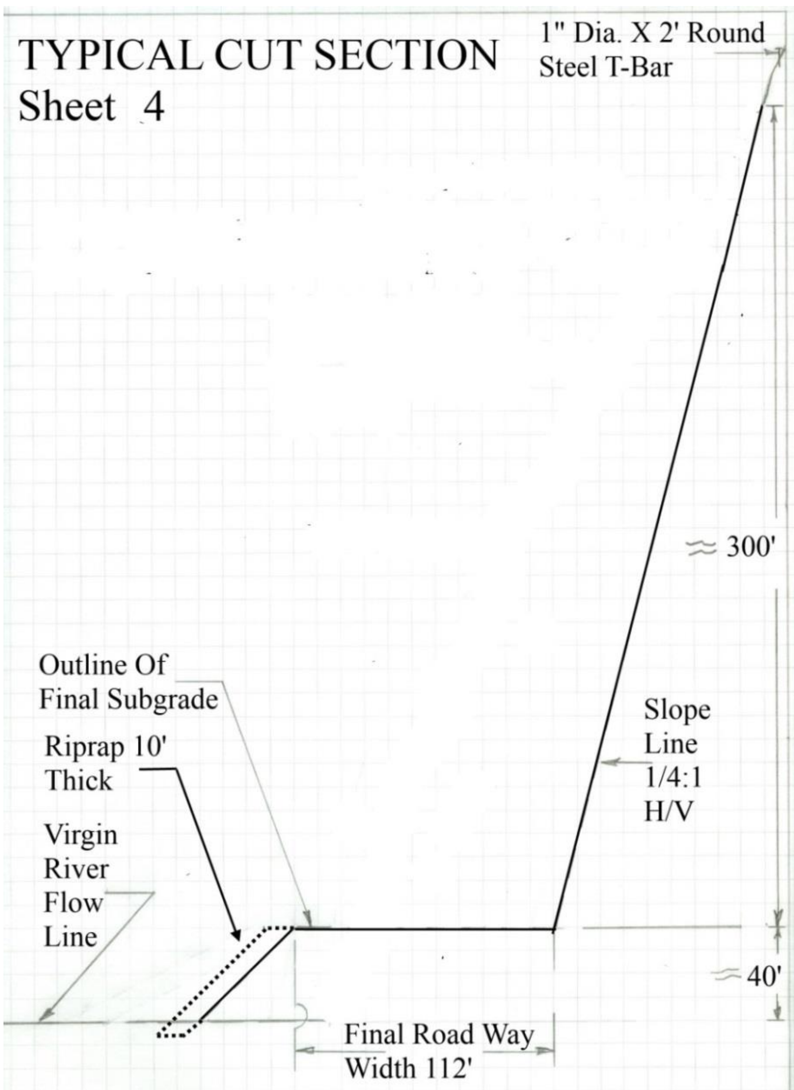
Robbins Rock Drill Mounted On A D8 Caterpillar. Drilled a 9" dia. vertical hole

D8 DOZER WITH HYDRAULIC RIPPER

The air tracks were then used strictly to drill the slope holes and the Robbins Rock Drill was used to drill 9" dia. vertical burden holes on a 7' square pattern. The depth of the drilling holes would now be 30'. While the ledge was being drilled out, the D8 dozer would do what the D7 did before, and that was to make a place for all of the equipment to hide during the next blast. It should be noted that a second Robbins Rock Drill and a second or third D8 dozer would have been pulled up if the ledge had been long enough to warrant needing the additional drilling and dozer power.

At this point, the D7 would let itself down off the ledge and move to start another cut. There were many people who figured that Kiewit should have given Jock the D7 at the completion of the project.

As there was no way to bring up any other equipment with the D7 gone, this equipment would be used to drill and shoot the cut down to the sub-grade level. See Sheet 4.



It should be noted that no matter how the cuts were started, i.e., by using rappelling ropes to support the jack hammers or being able to use the jack hammers without rappelling ropes, the same steps had to be used to bring the cuts down to the subgrade level. The steps were: bringing the D7 up as soon as a ledge was wide enough to accommodate it, then pulling the air tracks up, then the Robbins Rock Drills and then the D8's dozers.

MOVING THE SHOT ROCK:

As soon as the dozers finished shoving the shot rock off the ledge of a cut, a 992 Cat front end loader would move in on the canyon floor and start loading 50 ton rock trucks. If the cut material had to be moved to fill areas both up the canyon and down the canyon, then a second 992 loader and rock trucks would be set up on the opposite side of the rock slide. They would clear the canyon bottom as fast as they could so that it could be opened up to vehicle traffic. The weight of one bucket of shot material ≈ 10 cy * 1.5 ton per cy ≈ 15 tons. Therefore, it normally took 3 heaping buckets of shot material to load a 50 ton rock truck.

A 992 Caterpillar 10 cy front end loader, loading a 50 ton rock truck

SELECTING ROCK FOR THE RIPRAP:

As the 992 loader operators were loading rock trucks, they moved any shot rock aside that was over 4’ in diameter. It was later loaded on 50 ton rock trucks and hauled to areas along the roadway that needed riprap protection. After the rock was in place on the slope, the voids were filled with concrete. See sketch 4 for the location of the riprap on the slope. See the photo below that shows actual riprap in place on the roadway slope.

ACCESS THROUGH THE CANYON:

During construction, trying to travel through the canyon was a nightmare due to the many interferences encountered along the way. Some of the interferences were rock slides from the dozers working one or more cuts, construction of the bridges, heavy equipment constructing the roadway, the route of the access road constantly being changed, etc. Travel was limited to pretty much emergencies only.

A schedule was issued that showed the times of the proposed road closures for the next day so that the supervisors could position their crews to get the most production out of them and not be caught above a rock slide when they should have been below it. The schedule was preliminary and subject to change at any minute.

Many times, it was quicker to go over Utah hill to get to the other end of the canyon than wait for a clear opening between flagmen controlling the traffic at the rock slides, etc. Whenever possible, the cuts were blasted between the day and swing shift so that the dozers could push the rock off during the swing shift. Of course, the road would be blocked the next day until the 992 loader and the rock trucks cleared the canyon floor or at least made a road around the rock slide.

This makes for an interesting question on how Kiewit was able to take all of these unknown interferences into account in putting together their bid for this project. It must have been a very conservative estimate with a lot of contingency.

Before State Highway Transportation Departments let a project out for bids, their engineers make a baseline estimate for the total cost of the project. After the project is let for bids, the baseline estimate is compared with the contractor's bids. Usually, any contractor bid that is 10% higher than the State's baseline estimate is rejected. If all of the bids are higher than 10%, then the State rejects all of the bids and they review their baseline estimate, going over each line item to see if they missed something that the contractors have included in their bids. Then they rebid the project which extends the time of awarding and the start of construction.

In the case of the Virgin River Project, I don't know it for a fact but I feel that Kiewit was the low bidder and was awarded the contract even though they were 25% to 30% higher than the State's baseline estimate. My reasoning is that the State could estimate the hard money items, i.e., the volume of material in the cuts, the volume of material in the fills, the amount of riprap required, the construction of the bridges, etc. But they didn't have a clue about what the interferences were going to be during the construction of the project that would add much time and expense to Kiewit's contract or how the cuts were going to be made. So in order to award the contract and get the construction of the road started, they were pretty much forced to accept Kiewit's bid. Thus the high cost per mile for this section of I-15 through the Virgin River Gorge.

And I think that everyone felt that it was worth every dollar spent to get I-15 finally opened all the way through Arizona, especially California DOT and Utah DOT. These State Departments of Transportation were under the gun to get I-15 open as soon as possible. Arizona DOT really didn't care whether I-15 was completed or not. They were forced into finishing the road and I read that CA & UT funded most of the cost. Another reason why the cost per mile was so high is because it wasn't AZ's nickel, so to speak. Sure they get a little revenue from the trucks, but a lot of that is spent on general maintenance, roadway maintenance & bridge repairs.

THE END