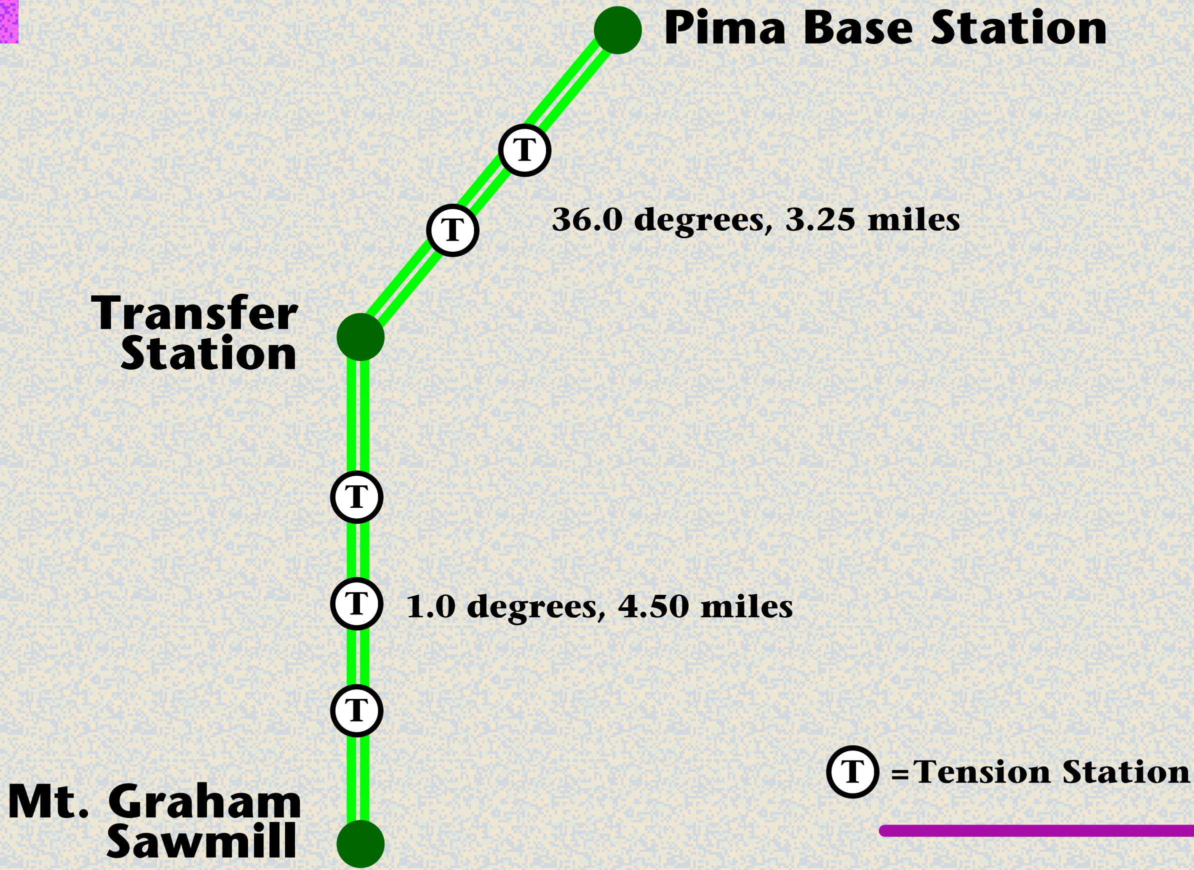
The Mount Graham Aerial Lumber Tramway

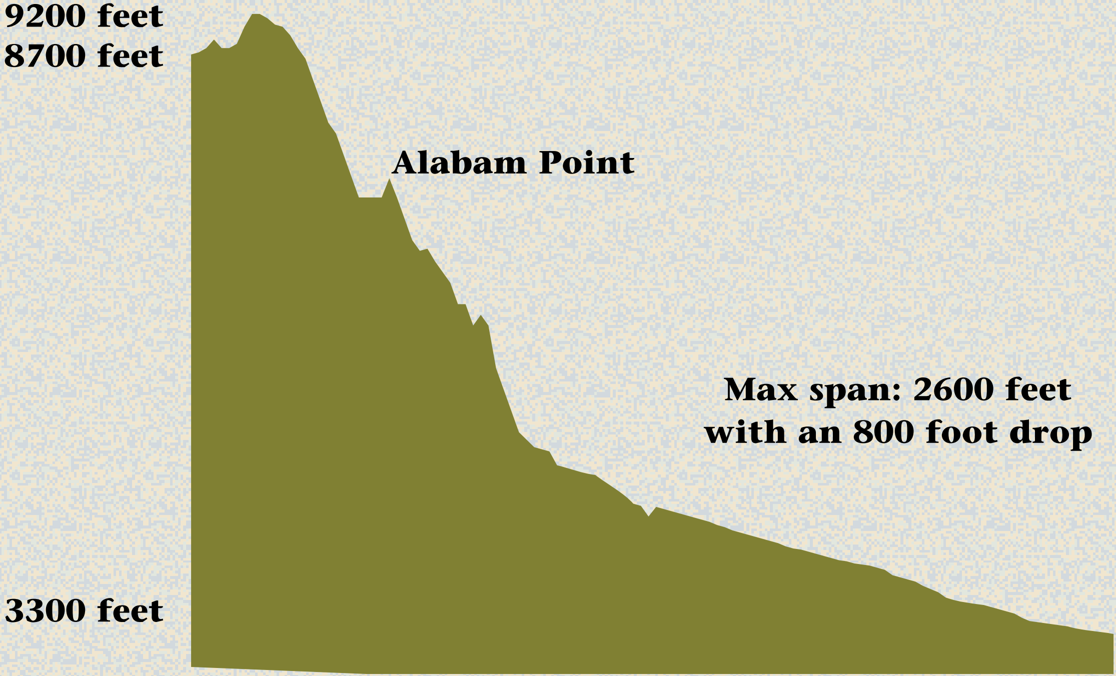
By Don Lancaster
and Synergetics

http://www.tinaja.com

7-3/4 miles, 2 reaches, 14 regions...



UP first, then drops ONE VERTICAL MILE...

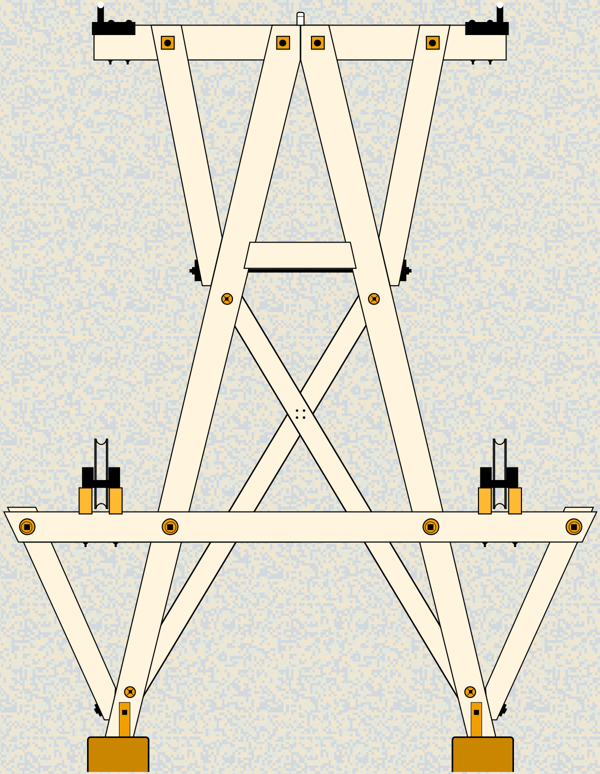


(4X vertical scale)

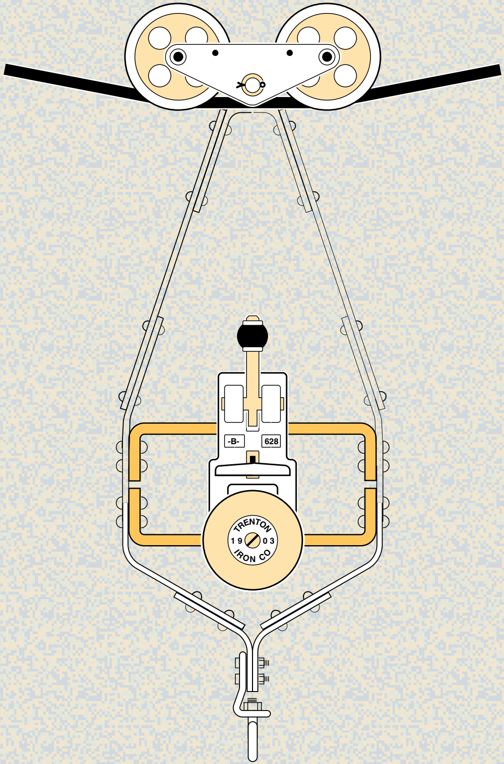
Some Numbers…

- One mile of 1-1/4 inch 100 ton test cable weighs 4 pounds per foot or 22,000 pounds total.
- At least FOURTEEN such cables needed.
- At 0.1 friction, 1100 pounds average needed to yank cables in place.
- Load between 300 foot towers of 1200 pounds of cable, 500 pounds carrier, 1300 pounds lumber.
- Cables under 40,000 pounds of tension from counterweights to minimize sag.
- 40,000 pound counterweights at 200 pounds per cubic foot made from rock and concrete.
- 126 towers, 5 tension stations, 3 transfer stations.

Typical Wood Tower was 18 feet high…



Carriers were used in pairs…



Now What?

- Visit a Tension Station.
- Hike the Tram Route.
- Play the "orienteering" game.
- Scan the Museum photos.
- Enhance and restore the photos.
- Expand the website. Make a CD.
- Research Family Histories.
- Recover a tram carrier car.
- Reconstruct a tram tower.

This has been…

…a presentation by Don Lancaster and **Synergetics**, 3860 West First Street, Box 809, Thatcher, Arizona, 85552. (928) 428-4073.

mailto:don@tinaja.com

A Partial History of the Gila Lumber and Milling Company

transcribed by Don Lancaster
Synergetics, Box 809, Thatcher, AZ 85552

http://www.tinaja.com
don@tinaja.com
(928) 428-4073

This particular **GuruGram** is somewhat different than our usual technical fare.

I have long been fascinated by the **Mount Graham Aerial Tramway**. Which was a spectacular local lumber tramway (circa 1924) that operated over **one vertical mile** of incredibly hostile terrain. And, while uniquely engineered, turned out to have been an economic failure, lasting only a little over one year of operation.

At any rate, one of **the** key historical documents was L.O. Martini's **A Partial History of the Gila Lumber and Milling Company**.

While just about everybody locally can find a shopworn illegible copy-of-a-copy, clean text in machine readable and web friendly form seemed to be conspicuously absent.

A fairly accurate copy of the original historic paper follows...

A Partial History of the Gila Lumber and Milling Company

by L. O. Martini

On Mt. Graham there exists one of the largest stands of Douglas Firs in the southwest part of the United States--Douglas Fir timber being one of the best of the soft woods for structural purposes and one that is extensively used for support timbers in mines. About 90 miles North of Pima in the Globe-Miami area there existed one of the best markets for Douglas Fir timber in the State of Arizona. These facts, coupled with the local need for lumber, caused several people to establish lumber mills on Mt.Graham.

My account will be a partial history of one of the projects--a Mill located in the upper end of Ash Creek Canyon about two miles south of what was then known as Columbine Ranger Station, which was on the top of Mt. Graham. This Mill in 1911 was owned by Moody and Welker families--very prominent families in the Pima-Safford area of the Gila Valley.

Early in 1916 three men, former employees of the Arizona Lumber and Timber Company of Flagstaff, Arizona, became interested in this lumbering project. These three men were by no means new to the lumbering industry having a total number of years experience of exceeding 60 years.

They were Mr. F.C. Fisher, former superintendent of machine shop, railroad, and logging operations, Mr. Ransom Freeman, Machinist, and Mr. George F. Martini (my father) who was superintendent of the Planning Mill and Box Factor of the Flagstaff mill for 23 years.

The three of them with Mr. Freeman's wife, Helen, went to the valley in the spring of 1916 to inspect the Moody and Welker project. They found a flume was used to transport lumber from the mill to the valley floor. This flume was approximately 9 miles long.

There were a number of places where the flume was broken down. The worst of these was a trestle about 75 feet high and 150 feet long that crossed Ash Creek Canyon at the foot of what was known as Trestle Hill. In those days the principles of hydraulics were not as well known as they are today, for if they were, the flume would never have been built, for in the length of the flume there were three hills--Oak Flat Hill, Bellows Hill, and Trestle Hill, the latter stood about 57 degrees above horizontal and the other two approximately 45 degrees above horizontal. For the entire length of the flume there was no stretch where the flow of the water was what is known as uniform. The water flowed in surges or slugs being 6 to 12 inches deep, then tapering back to 1 to 2 inches deep, then to another slug. This made the transportation of lumber very difficult, for on the steep hills the pieces of lumber would travel faster than the water, creating a large fan six feet high in front and leaving a practically dry flume behind. Lumber following would hit the dry flume and gain such speed that it would become airborne and leave the flume and even lodge in some of the trees. This real problem was not appreciated by the three men and they formed a partnership and decided to operate the project.

After this decision was made my mother Annette Martini, my brother George, and my sister Wanda and I joined my father at what was then known as the Flume Camp, which consisted of one large shack and several smaller ones at the lower end of the flume which was at that time about 1/4 mile west of the Cluff Ponds in the lower end of Ash Creek Canyon and adjacent to what was known at that time as the Goodman Ranch. One item of interest about the Flume Camp was that adjacent to the main shack, there was the largest cottonwood tree in the State of Arizona. The main trunk was approximately 10 feet in diameter. Work began on the flume which lasted a good part of the first summer.

We had to rebuild the Ash Creek trail, making it passable for pack animals, consisting of donkeys and small mules. Supplies of all kinds, including bales of hay, grain, crates of eggs, sacks of flour, beans, etc., had to be packed in to the mill. The bushes and trees had to be cleared away so the loaded animals could get through with a bale of hay on each side.

Then we had to rebuild the broken section of the flume. In some cases there was enough lumber at the sites to do this. In other cases new lumber had to be manufactured at the mill and floated down to the areas where it was needed. This meant going into the forest, falling the trees, cutting them into logs, hauling them to the mill and sawing them into the sizes needed, and putting water in the flume and floating the lumber to where it was needed.

To get the logs to the mill we had to build a log chute. For the first year or so the logs were pulled down the chute by horsepower. Later a steam engine, known as a Donkey was brought in and they were pulled by a cable. This chute was approximately 1/4 mile long.

Most of this preparatory work was done by the three owners, myself, and one or two local people. Later as things got organized, my father, mother, and brother George, and sister Wanda stayed at the Flume Camp. My mother drove into Pima, Central, Thatcher, or Safford and bought supplies. Those needed at the mill were packed on the pack animals and taken up the trail 9 miles to the mill by Tony Chavez, the packer, who was very dependable. The trip usually took all day with returning the 2nd day.

My father and brother handled the lumber shipped down the flume, sorted and stacked it and sold it to those who wanted it. Later a Moreland truck was purchased and the lumber was trucked to Central and shipped to Globe by rail.

Mr. Fisher, Mr. Freeman, myself and three or four local people worked the upper end. Under these conditions you learn many things. I learned how to fall trees, trim off the limbs, cut the trunks up into logs for the teams to haul to the chute. I learned the hazards involved when I was working with King Upton cutting off a tree that had fallen across the chute. He was on the lower side. We had to cut off the upper end and were cutting off the lower end, when it started to roll, and he tripped and fell. The log rolled over him, and he was killed instantly. I had been warned, but now I knew what could happen. I, with several others, carried him 14 miles on a stretcher to the valley.

The mill consisted of a wooden shed which housed two steam boilers, a steam engine shafting a pulley to drive a large circular saw 5 feet in diameter, a top circular saw 3 feet in diameter, an edger for trimming off the sides, a carriage that carried the logs back and forth past the circular saw, a trimmer that cut the ends off the board and timbers and bull chain that pulled the logs from the mill pond to the mill deck where they could be rolled on to the carriage.. My job at first was to go to the log pond, get a log, float it over the bull chain, (Needless to say, I fell in the pond sometimes.) which pulled it up to the level of the mill deck. I then helped Mr. Fisher roll the log on to the carriage, and by means of a ratchet lever move the log forward so that a slab could be cut off as the carriage passed the saw. Then the carriage was reversed and brought back to its original position, and Mr. Fisher, whose job was known as the sawyer, would indicate to me by sign language whether he wanted a 1" piece or a 2" piece or a 4" piece or 6" piece. From a dial on the carriage I would have to figure out how much to move the log forward allowing 3/8" for each saw cut. The time to do this was very short as the log would hardly clear the saw on the return trip when it was supposed to go forward again. The days output of lumber was controlled a great deal by the length of time between saw cuts, so I had to think and move very fast.

At first Mr. Freeman fired the boilers. We used sawdust as fuel, and he operated the steam engine. He had trouble keeping the steam pressure high enough to operate the mill. Other people tried it, but they could do no better. Finally someone said if you can get Jimmy Reed to come up and fire the boilers, you won’t have any trouble. We finally got Jimmy Reed, a small man with red hair and beard, and it seemed all he had to do was open the fire box door, shake his beard at the fire, and the safety valves would pop off with a full head of steam. He had a knack of rapidly shoveling in sawdust at the right time and the right place to keep steam up.

In the rear of the mill there was a cut off saw about 2 feet in diameter. This saw was used to cut the slabs and waste pieces into lengths that could go up the waste conveyor and to the open pit burner at its end. One day while I was riding back and forth on the carriage, I saw a red blur in the corner of my eye and I looked to the rear. There I saw one of the employees, as I remembered his last name was Hatch, fall over backward. He had practically cut off his leg.

Then for the second time, I helped carry a man 14 miles on a stretcher to the valley floor. This time the doctor met us part way down and administered pain-relieving medicine to the poor man. Luckily they were able to save his leg, but I never saw him again.

The mill operated turning out 8 to 10 thousand board feet of lumber per day until the snow started falling. Then we shut down for the winter.

Late in the fall of 1916 Mr. Fisher thought I should learn to be a machinist. He arranged for me to start as an apprentice in the Santa Fe shops in Albuquerque, New Mexico. I had to be 16, so shortly after December 1, 1916, I went there and stayed 7 or 8 months when I contracted a slight case of Tuberculosis, so I went back to the mill and recovered shortly thereafter.

The mill operated during the spring, summer, and fall months of 1917, 1918, 1919, and 1920. During this period a small mill was built at the Flume Camp to process some of the lumber coming down the flume.

We also had a man, as I remember his name was Brown, whose job was to walk the flume to prevent jams that were occurring due to water shortages. One night he did not return, and the next day his body was found in the canyon below the 75 foot trestle. He had evidently slipped and fell to his death, and for the third time I helped carry a man to the valley floor.

As time went on financial problems became more severe and additional capital was badly needed. Mr. William Wholley of the Wholley Lumber Company in Globe became interested and was able to get financial help from several in the Globe area. It was also becoming more and more apparent that some other method than the flume was needed to get lumber from the mill to the valley floor. Also during this period I decided to continue my education, so I enrolled at the Gila Academy in Thatcher in January 1919. I rode horseback each day to Thatcher until school was out in the spring. It was there I became better acquainted with Louise Rogers of Pima. We had met several times before when groups of girls had gone to Camp Columbine for an outing, and I had been invited up for a picnic. Also, some of the girls had been riding in the flume and it broke down, and I was sent down to find out where, and she was in that group.

From the fall of 1919 to spring of 1920 my brother George, my sister Wanda, and I attended Gila Academy. I graduated in May 1920 with my sweetheart Louise Rogers.

I worked at the sawmill until the fall of 1920, when I went to Logan a Utah Agricultural College, mainly because Louise Rogers was there. From the fall of 1920 to the Spring of 1921, my brother George and sister Wanda continued at Gila Academy from which my brother graduated in 1921.

As I remember the mill ceased to operate in the fall of 1920, and my family moved to Coolidge, Arizona, where my father, my brother, and I worked during the summer of 1921.

I am not too familiar with the operation of the mill between fall of 1920 to the Spring of 1923. I know that Mr. Fisher, the Freemans, and my father were no longer connected with its operation, as they had gone to California. Mr. Wholley and those associated with him were still interested and had decided to build an aerial tram to move the lumber from the mill to a point on the mesa about two miles north of the old Flume Camp and about six miles more or less west of Pima.

When school at Logan was out in June 1923, I went back to the Flume Camp to work on the design of the aerial tram. The preliminary survey had been made by Hoyht Medler, one of the Medler Brothers Cattle Company who had been a surveyor in the construction of Roosevelt Dam. The preliminary survey had been sent to a cable company in the East and a preliminary layout for the tram made and the plans returned with an estimate of the cost of the final design. Mr. Wholley said their estimate was too high and that he would have it designed, and he gave me the job. From June 1923 to July 1925 I worked on the design, construction, and operation of the aerial tram--a very interesting experience.

The tram started at the mill, went east out of Ash Creek Canyon to the dividing ridge between Ash Creek and the main canyon to the north, the name of which I cannot remember. From the top of the ridge to the next point we had a single span of approximately 1800 feet with a drop of about 800 feet. The tram continued on in a straight line across the old wagon road to an angle point on the mesa along the wagon road about two miles above what was known as the Dugway. from there the tram turned 30 degrees more or less sly of the Ely Course and terminated on the mesa about two miles below the Dugway or about six miles from Pima.

I was furnished a book on the design of aerial trams and with this in hand, I started working. My office was at the old Flume Camp, and on the wall of the largest building I tacked up the profile and calculated tower height and locations, tension station locations, loading transfer and terminal station designs.

The overhead cables called track ropes consisted of 1 1/4 inch lock coil on the load side and 1 1/8 inch lock coil on the return side. Lock coil cable is a specially fabricated cable so that the surface is smooth like a pipe and not uneven like a normal cable. This is done to avoid excess wear on the cable strands and less friction on the carrier wheels that run on the track cable. The moving cable or traction cable was 5/8" normal type construction because greater flexibility was needed. It was necessary to maintain about 30,000 pounds tension on the overhead stationary cables and for this reason several tension stations were needed. At these stations the incoming stationary cables were fastened to a large suspended weight of approximately 30,000 pounds. The outgoing stationary cables were fastened to concrete weights buried in the ground. Transition between the incoming and outgoing cables was by means of small rails. The traction cable or moving cable was continuous through the tension stations. There were four or five of these tension stations. I don’t remember exactly.

A lot of the hardware, such as tower saddles, traction rope sheaves, track cables, carrier frames and grips came from abandoned mining trams in southern Arizona. The carriers all had to be modified from ore bucket use to lumber carriers. Transportation of the material to the construction site was the big problem. Cement, rock, sand, and water had to be packed in on mules to each tower site to pour the foundations.

The timbers for the towers and stations had to be packed in swivel pack saddles so that the mules could make the turns in the trail. This was not easy as a piece of timber 6"x8"x20" feet long had to be placed on two mules, one on each end with a handler with each mule. Also, the track ropes had to be in one piece about 3000 feet long. This was done by making coils and putting two coils on each mule and continuing back to the next mule and the next until the end of the cable. The track cables were pulled into place by power wenches once they were on the side. A smaller diameter cable was strung first to pull the traction or moving cable into place. This cable had to be spliced in a number of places as it was approximately 8 miles long on the upper section and 6 miles long on the lower section.

Mr. Wholley brought in Bert Green from Globe to supervise construction. He also brought in some Mexican construction workers to do the cement work. Some local men worked on the job. I remember Willie Weech was one of the chief carpenters.

After the paper work was done, I checked to be sure the right timbers went to the right location. I also worked on tensioning the track cables. In doing this we would pull up on the track rope by use of an anchored capstone turned by a horse. On one occasion a safety chain broke and I was struck in the mouth by the cable, driving my teeth through my tongue. At first they thought I had been killed.

After the construction was completed of the 7 1/2 mile tram, the operation problems started, and this was my problem. There was located at the upper end a ..."illegible writing"... approximately 8 feet in diameter lock grip sheave. As this sheave turned it moved the traction rope. To start the tram lumber would be stacked in two carriers and pushed along a rail until the carrier grips fastened on to the moving cable, and this load was then pulled out onto the track rope. Single empty carriers or carriers loaded with hay, grain, or supplies for the mill were fastened on at the tower end. Eventually there were enough loads of lumber coming down to pretty well pull the carriers back on the return side. Some power and control had to be exerted at the upper end. On the whole the operation worked fairly well. We had some trouble at times. Varying tensions would lift carriers off the track rope and they would hang up on the towers and stop the tram. then we would have to find out why and correct the problem. This was not always easy. Sometimes it involved sliding out in a rope sling with a hook over the track rope to a carrier several hundred feet above the ground and pry the traction rope out of the grip and then hang on for dear life, as the track rope jumped up into the air and vibrated like a bowstring. Some of the local boys, who helped me a great deal and I thought a great deal of, were Bill Taylor and his brother, and Marcus Allen and his brother.

During the operation of the tram a very sad thing happened. Two young fellows (I remember one's last name was Bond and I think the other was Marcus Allen's brother) were working at the transfer station, which was at the angle point. The traction cable started slipping on one of the big smooth sheaves. The Bond boy picked up a hemp sack and slipped it between the sheave and the cable. As he did this, a hook on the glove he was wearing caught in the hemp and the traction rope started with a jerk and pulled the Bond boy into the framework of the structure, breaking his neck and killing him. This time we were able to bring him out by car, but that was a very sad trip for me.

During the time I was working on the tram, the operation at the mill was changing. They were increasing production and going to high lead cable logging.

Also, the mill at the Flume Camp was moved to a site in Pima along the railroad track and across the road from the Eyring home.

In July of 1925 my wife and I left the valley for the coast, where I had a job waiting for me with the city of Glendale.

Just how long the operation of the mill and the tram continued after that, I do not know. The company was having trouble financially when I left, and I understand they closed down and dismantled the tram within a year.

(end of transcription)

For More Help

Sourcecode for this **GuruGram** can be **found here**.
My paper on the Mount Graham aerial tramway **appears here**.

Additional resources may be gathered as time and funding permit. You can email me at **don@tinaja.com** or call **(928) 428-4073** for the latest info and updates.

by Don Lancaster

The Mount Graham Aerial Tramway

Once upon a time (June of 1923 to be exact), there seemed to be a crying need for sawn lumber in the farming communities of the Gila Valley. There was lots of large Ponderosa Pine and Douglas Fir high up on nearby Mount Graham. Along with an existing steam sawmill. But that was there and this was here.

So close, and yet so far away.

Two earlier attempts at logging flumes lay in shattered ruins. Unworkable because of extreme topography, little water and really bad engineering. A tortuous and deadly wagon toll road priced the boards out of their seemingly nearby markets. Including several "Are we having fun yet?" pleasure spots such as *The Dugway*, *Slick Rock* and *Dead Horse Turn*. Through wild country which *to this day* remains accessible *only* by foot or mule.

So, the decision was made to simply sail the boards up through the air. Frisbee style. An *aerial lumber tramway* was built. Which turned into one of the most astounding engineering feats in all of Southern Arizona.

The Route

The aerial tram began at the Old Columbine mill site at an elevation of 8685 feet. It then headed out straight as an arrow one degree east of true north. First traveling a half mile *up* across a 9045 foot ridge and then dropping to the Shingle Mill Canyon transfer station at 4480 feet and a distance of 4.2 miles.

At the transfer station, the path shifted some 36 degrees easterly. Then traveling another straight-arrow 3.3 miles to the Pima terminal at an elevation of 3241 feet.

A total length of 7.5 miles and an elevation delta of 5804 feet. *Which is well over one vertical mile!*

Wooden Towers

Much of the tram was fairly low tech, cobbed up out of wood and a few key pieces of recycled low grade cast iron. Everything had to be packed in or drug in by mule over wildly inhospitable terrain.

Around ninety towers (the precise number is arguable) were used over the route. The typical tower spacing was around 300 feet. With a maximum single hop span of 1800 feet and an end-to-end drop of 800 feet.

A few of the towers were rather spindly and reached a startling 40 feet in height. But the average tower was just high enough to safely clear the lumber loads.

The typical all-wood tower was a fairly sturdy buttressed A-frame affair which stood a tad under fifteen feet tall. Its sole reinforcement was a pair of iron tie rods. Machine bolts or lag screws and fat washers for the larger timbers; plain old nails for the braces. Most towers rested on small concrete footers which ultimately proved to be too small and way too shallow. A pair of fixed cast iron *track saddles* sat on each end of the tower's top beam.

At shoulder height, one pair of cross-track braces. On these, a pair of along-track wooden rails on each side. The rails supported an off-center sixteen inch *tow wheel idler* spinning inside a cast iron carrier frame. Whose bearings were plain old axle iron on casting iron, helped along with a little grease. Each tower thus had only *two* moving parts.

Fixed "M" shaped guide rods acted as simple pilots for the wheels. A heavier one on the downside; a lighter and longer version on the upside.

You'd see what at first seemed to be five cables at any tower site. One was a simple iron telegraph line that went from tower top center to tower top center along the entire route. And doubling as a broken tower detector.

Track cables went from tower top to tower top, sitting in greased groves in the track saddles. As the name implies, these are more or less stationary cables whose task is to support the hanging tram cars.

Since the heavy traffic all went downhill, the l-1/4 inch "down" track cable on the eastern side was thicker than the western 1-1/8 inch "up" track. A special tram-optimized flat *lock coil* cable weave was used.

What first appears like a pair of *tow cables* went from tower to tower at eye height. In absence of a car, the tow cable sat on and spun the idler wheels. This was thinner wire rope as its only role was to tow the cars along.

In actuality, the tow cable was continuous on either tram leg. This wound around a horizontal drum at the terminal, went down the route on the east tower sides, wound around a second horizontal drum and a tensioner at the transfer station, and then went back up the same route on the west tower sides. This tow cable was field spliced.

As a car or a pair of cars approached a tower, the tow cable would get hoisted up out of the grooved tow wheel idler. After the cars passed, the cable guide rods would realign the tow cable back down into the idler groove.

The Cars

The cars themselves seemed fairly sophisticated. These were recycled from ore bucket mining duty. Each car was basically a four foot diamond shaped iron frame that had a pair of 10 inch track rolling wheels on the top, a swivel mounted and roller-backed automatic gripper in the middle, and a chain sling at the bottom.

Unloaded, each car weighed around 240 pounds.

The cars would roll underslung along the track cables and, when the gripper was closed, got towed by the tow cable. On the down trip, the cars would get used in pairs. One near each end of one dozen boards or half a dozen timbers. The cars would thus typically be six to ten feet apart. Iron guides and channels "squared up" the chain slings to match the load. There was a hidden quick release under each bottom support channel.

On the up trip, the cars usually returned singly. Mostly empty, but sometimes carrying a sack of grain, mail, a bale of hay, or whatever.

The gripper mechanism showed some creative design. There was a rolling ball the size and shape of a trailer hitch which activated an overcenter two-state toggle mechanism. Sort of a mechanical set-reset flip flop. Ball up and the gripper was open; ball down and the gripper grabbed the tow cable. Deflection plates mounted on the stations would automatically release or grab as needed.

These plates would be placed *after* the ends of the track cables but *before* the loop of the tow cable. At activate time, the car would be riding on a set of high rails similar to those in a large meat locker.

The gripper casting seemed to include an obvious bell. Presumably it dinged once on each grab or release.

Tension Stations

Rather than trying to manhandle (and mulehandle) some fifteen miles of cable through country that would make a marine drill sergeant blanch, the track cables were broken up into mile long segments. One end of each cable was secured to a giant eye set in a solid concrete foundation. The cable would then route up and over the top saddles of a dozen or more towers and end at a *tension station*.

Besides allowing shorter cables, the tension stations kept the track lines from sagging under load.

At the tension station, the track cables would go over large pulleys and hang on *floating* concrete weights.

These humongous blocks weighed in from 8000 to 30,000 pounds. Made from iron-reinforced cement poured around groups of locally gathered large rocks. Gneiss, mostly. The weights would ride up and down in massive wood guides reminiscent of a double hung window.

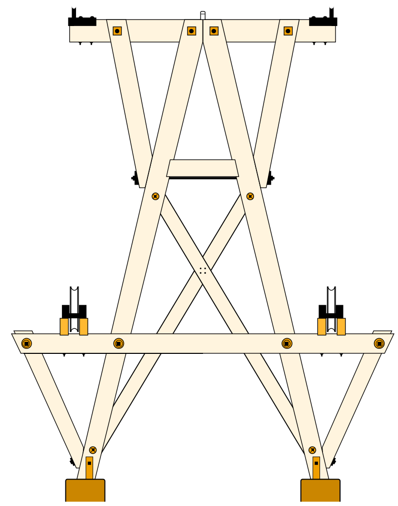
At a tension station, the cars would leave their entry track cable, traverse a short *transition sheave* to a fixed horizontal rail, traverse a second transition sheave, and end up on the exiting track cable. The moving tow cable was oblivious to the bait-and-switch, and simply dragged the cars along. The fixed rail was supported by cast iron "J" skyhooks bolted to upper support timbers.

Three "double" tension stations held two weights and two anchors each. Two "quad" tension stations supported four weights but no anchors. The remaining eight anchors were paired at the upper terminal, the lower terminal, or at either end of the transfer station.

Down track weights were always heavier.

Much of the aerial tram was built from parts recycled from earlier tram and mining ventures. The tension pulleys form a curious mix. Obviously gleaned from a variety of strange sources. In several cases, a rod hoop got welded

A TYPICAL TRAM TOWER



onto a mine car wheel to form a cable guide pulley.

As you might guess, 30,000 pound concrete blocks are somewhat vandal resistant. Many survive intact to this day. Even so, at least one of them has gotten hauled off as a tourist memento. In operation, these tension stations must have been extremely impressive.

It is still a stunning adventure to come upon a station unexpectedly in heavy brush. I'm trying to reconstruct their engineering drawings. But exact details of their upper reaches still remains elusive.

The transfer station and the Pima terminal also were long and rather elaborate wooden structures which allowed for intermediate storage and routing of the loaded cars. At the transfer station, the uncoupled cars would get slid along skyhook rails and recoupled to the second leg of the tram route. Human intervention was apparently required. A few tantalizing photos show how big and how complex these stations really were. But they don't reveal much in the way of precise technical details.

Little remains of most of these sites today.

Gravity Powered?

Local lore has the tram running entirely by gravity. And having enough energy left to run the sawmill as well. There was in fact a steam boiler at the sawmill and an engine at the nearby tram terminal. Motive power apparently was coupled to the lower tram leg at the transfer station by a vertical axle and pair of gripper wheels.

Let's see. Take 400 pounds or so of wood and drop them 5000 feet. That is around 2 million foot pounds of work.

Make the trip in, say, 40 minutes.

This gives you something like *three* horsepower's worth of effort. Per load. Because of loading times, I'd think it unlikely that the average loads could be closer than seven minutes apart. Guessing six loads active at any one time yields you something around 18 horsepower derived from gravity. But two of those loads would cancel each other out going over the ridge.

Leaving you with a net 12 horsepower.

Those 12 horses had to overcome wind resistance, flex a lot of stiff cable, and spin hundreds of idler wheels.

So we can give some credence to historical statements that the tram "pretty much ran by itself." But *no way* did it saw up any boards in its spare time.

Success and Failure

Judging by the few surviving photos, great heaping loads of lumber got delivered on down to Pima Terminal. Sadly, the aerial tram got shut down and was partially dismantled *one year* after it started operation.

Part of the reason might have been underlying economic problems with the sawmill. Or new Forest Service regs.

But the tram apparently needed continuous repairs and seemed to have had woefully excessive downtime. At least, that's what today's on-ground evidence suggests to me. My guess is that the delivered cost-per-board was too high to make much economic sense.

The system design and construction was all done using local help, because an experienced real tram engineering firm was "too expensive".

There were several gruesome fatalities and a number of other gory accidents. The transfer terminal literally ate an operator for lunch one day. At least one track cable failed spectacularly. Giving a profound new depth of meaning to the term *sprooiinnggg*….

In those days, of course, OSHA inspectors were dealt with simply by hooking them onto the next tram car.

One series of repeated tower failures required at least five rebuilds. Done without any attempt at improving the design or fixing the problem. Other towers were hastily rebuilt or added without proper footings.

Scattered piles of fire bricks in strange places suggest impromptu blacksmithing. Collisions between cars and towers apparently occurred. To the obvious detriment of both. Lost loads and shattered towers still litter some of the more remote canyon bottoms along the route.

I guess the final analysis was that the Mt. Graham aerial tram delivered the boards but not the bucks.

Back to the Future

What does this failed and largely forgotten tech venture have to do with any of today's Midnight Engineering?

I see several key points here…

To work hard, you gotta play hard– No matter whether it's hiking, caving, hang gliding, bike, ski, or scuba, you flat out have to get down and dirty.

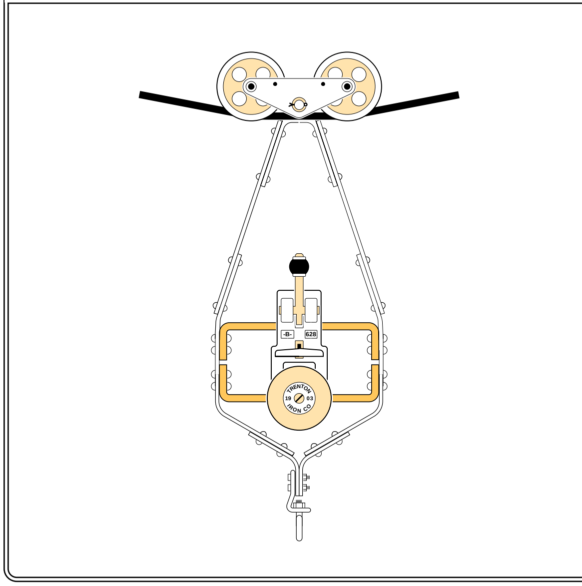
Study the classics– That's where all the fundamentals of appropriate technology, elegant simplicity, and workable real world results first come down.

It ain't creative unless it sells– No matter how wonderful your design, iffen it don't pay for itself in one manner or another, you have a failure.

Cheapest is rarely the most cost effective– Solid footers, steel, and real bearings outperform wood, rocks, and low grade iron. Every time. Guaranteed.

Budget for maintenance– Design your product from the ground up to be fixable and improvable. Always aim for minimum total life cycle costs.

THE TRAM CAR OR "CARRIER"



Much more on these concepts in my *Incredible Secret Money Machine II* and my *Blatant Opportunist* reprints.

For More Info

Your usual starting point on tram research is *Pioneer Town*, the Pima Centennial book published by the *Graham County Historical Society*. Limited but highly useful photo collections exist in the Pima museum or the Safford Ranger District of the Coronado National Forest.

Written family clan histories are a big deal in this area, so there are a lot of private sources. These often can end up a curious mixture of fact and fiction. One or two tramway employees remain in the area and are very much alive.

I could use a little help in relocating two "lost" tension stations. But you'll have to be the type of hiker who brings along your own catclaw. Just in case there is not enough along the route. Naturally, the word *"trail"* is not in your vocabulary. Your 4WD vehicle will, of course, receive a 100% authentic Arizona pinstriping job.

I have uploaded several artsy-craftsy tram sketches as TRAMCAR.PDF and TRAMTOWR.PDF to *www.tinaja.com* Suitable for framing. Along with custom drawing utilities. I'm working on translating the original tram photos to CD ROM. More on this whenever. ✦

Microcomputer pioneer and guru Don Lancaster is the author of 33 books and countless articles. Don maintains a US technical helpline you'll find at (520) 428-4073, besides offering all his own books, reprints and various services.

Don has a free new catalog crammed full of his latest insider secrets waiting for you. Your best calling times are 8-5 weekdays, Mountain Standard Time.

Don is also the webmaster of www.tinaja.com where a special area has been set aside for Midnight Engineering readers. You will also find selected reprints of Don's other columns, the Synergetics Consultant's Network plus lots of extensive annotated web site links here.

You can also reach Don at Synergetics, Box 809, Thatcher, AZ 85552. Or email don@tinaja.com