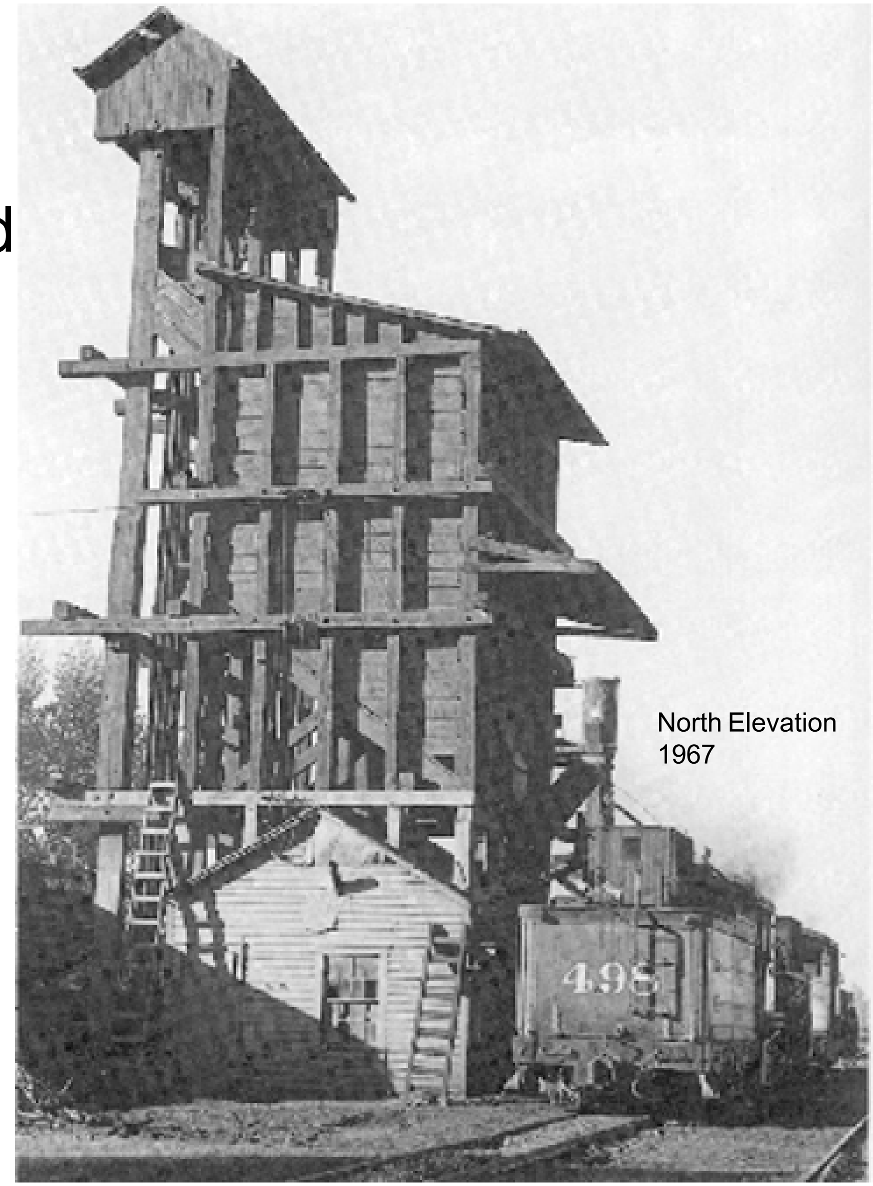
Chama Coal Tipple
Structure Report / Maintenance Plan

Cumbres & Toltec Scenic Railroad



North Elevation
1967

Prepared by Steven Kells and Jim Kreis

for the Friends of the Cumbres & Toltec Scenic Railroad

Winter, 2002

Report Terminology

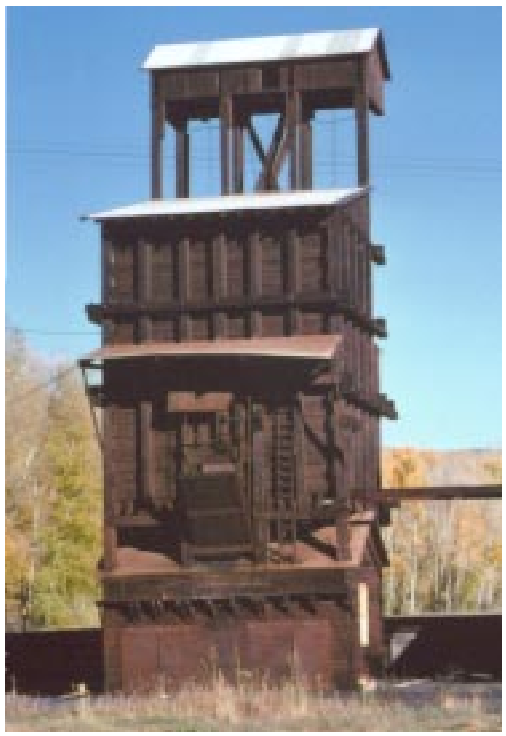
The original construction drawings do not give names to all of the individual portions of the structure. For consistency purposes, the following names are used throughout this report.

Hoist House The enclosed base structure that house the mechanical equipment and controls.

Coal Pocket The roofed intermediate level portion of the tipple that held the coal prior to delivery to the locomotives.

Sheave House The roofed structure at the top that protected the upper hoisting sheaves.

Coal Hoppers The two cast-in-place concrete basins into which the coal was dumped from the elevated delivery track.



1. Maintenance and Repair Background, and Purpose of Study

In 1979, the roofs of the coal pocket, sheave house, and possibly the hoist house were replaced. The cantilevered roof over the coal chute was not replaced. Photographs indicate that this work was accomplished without the use of scaffolding. At this time new windows were also installed.

The Friends of the Cumbres & Toltec Scenic Railroad began working on the Chama coal tipple in 1993. The interior of the hoist house was cleaned and the exterior repaired. These repairs have included the reconstruction of the window sashes, replacement of the exterior siding and painting of the hoist house, and overhauling the hoist engine and lifting mechanism to bring them into operational condition.

In the course of the 1990's repairs, it was noted that the bottom, or mud sill along the structure's west (track) side was failing and thus allowing the structure to develop a noticeable westward lean. In 2000, two vertical posts and a horizontal timber were set in place to provide support to prevent the structure from settling further and possibly collapsing. This investigation has been undertaken to better understand the nature of this structural failure and to develop a long term plan for the solution of the problem. Because the portions of the structure above the hoist house, or from 15 to 60 feet above grade have received no significant repairs since 1979, the investigation and recommendations also include a review of these portions for the purposes of developing a comprehensive preservation and maintenance plan for the entire structure.

Figures 1&2
1979 Repairs
(Note New Roofs)

2. Osmose Inspection

The Railroad Division of Osmose, Inc. made a "cursory" inspection of the tipple on September 26, 2001. The purpose of the inspection was *"to determine the extent of decay deterioration in the exposed larger support timber members"* and to *"recommend what repairs would be necessary to correct the deficiencies."* The examination was based on a visual inspection of the structure, hammer soundings, and borings of suspect areas. The report's summary of findings are:

"Overall, the structure was found to be in fairly good condition from a decay standpoint. The inspection revealed varying degrees of decay deterioration in nearly all of the bottom sills at the foundation. The areas of primary concern are the failing bottom sills, located on the foundation of the powerhouse; this has caused the structure to lean dramatically. On the other hand the supporting beams/upper sills and posts were found to contain no internal decay deterioration. However, Post 1 in Row 3 of Tier 1 does contain surface white rot at the roofline where water has been leaking onto the post. Our inspection did find that the beams/upper sills and posts do contain larger season checks (cracks) than normal, however the checks do not completely separate the members."

The standard method utilized by Osmose categorizes recommended repairs from Priority 1 through Priority 5 in decreasing order of urgency. There were no Priority 1 (emergency) recommendations. The recommendations were:

Priority 2
- Replace all bottom sills in power (hoist) house.
- Install shims between helper bent and sills on tier # 2.

Priority 3
- Through bolt sill #2, tier #2 (broken)
- Fix roof leaks in:
  - Pulley (sheave) house
  - Coal bin
  - Power (hoist) house

Priority 4
- Monitor structure for additional checking and weathering of beams.

Priority 5
- Monitor concrete coal tubs (hoppers) for additional cracking.

The report's primary recommendation relates to the bottom (mud) sills:

"We have recommended that the bottom sills at the foundation be replaced in the very near future before additional failures occur. Also to help prevent additional decay deterioration to the timber members, we recommend to fix the roof leaks and prevent the saturation or moisture buildup at the bottom sills. If the members can be prevented from absorbing moisture they will not decay."

In further communications with Greg Grumke, the inspector who prepared the report, he concurred that only the bottom sills that have actually failed, and are the cause of the lean, need to be replaced at this time, assuming that 1) the source of moisture is eliminated, and 2) there is continued monitoring of the condition.

3. Construction

The tipple was built in 1924 to plans drawn in the Denver and Rio Grande Western Railroad's Denver Engineering Office. The same design was used for the tipples in Durango and Gunnison. The plans, dated June 12, 1924, identify the design as a "75 Ton Mechanical Coaling Station, Balanced Bucket Type - Narrow Ga." The Chama Tipple is the only one to survive.

The entire structure above grade is of timber, which the drawings specified to be Oregon fir. Except for the massive 8x18 bucket guide timbers, all of the major timbers are called out on the drawings as either 10x10s or 8x10s. The foundations are shown as 18" thick by 3'-0" deep continuous concrete stem walls resting on 1'-0" x 2'-0" footings.

Inspection of the tipple reveals that there are several deviations from the design drawings. Primary among these are the addition of diagonal X-brace timbers set between the two inner 8x18 bucket guide timbers.

Figure 3 - East Side

Figure 4 - Second Tier
(Note adzed timber at right)

Five pairs of these braces are set above each other from the hoist house level to the sheave house. They provide substantial north-south stability to the structure. Diagonal braces on the north-south axis, also not shown on the original drawings, are set inside the hoist house. It is not clear whether or not these braces were added at the time of construction or later, but there is reason to suspect that they were added later. The X-brace members set between the guide timbers demonstrate a generally lower level of workmanship than the rest of the structure, and at least one member was trimmed with an adz to fit (see fig. 4). One of the interior timbers has the imprint of a splint ring bolt connector on its side, suggesting that it too may have been a reused timber. Also the concrete footings do not extend under the bearing block for the interior braces, suggesting that they may not have been originally planned. A photograph of the Durango tipple in the 1958 *Narrow Gauge in the Rockies* by Beebe and Clegg shows that structure with only two or possibly three pairs of the braces between its guide timbers, further suggesting that they may also have been an ad hoc later addition.

Another significant deviation from the plans is in the 8x18 bucket guide timbers. The plans show these members as one member 66 feet in length. In actuality, they were constructed from two timbers set end to end, with a third member bolted along side in the center to form a splice. The Durango tipple was also built similarly. A very curious deviation from the drawings is that the north side of the structure has five support posts extending up through the hoist house, whereas the south side has only three. In that the two sides carry the same load, there is no apparent reason for this change.

4. Statement of Significance and Interpretive Plan for the Chama Yard and the Tipple

The Cumbres & Toltec Scenic Railroad was nominated to the National Register of Historic Places in 1977. As an early nomination to the register, the form does not list a specific "period of significance" for the railroad, but states that the railroad is "in all ways unchanged from the way it was in 1925."

The coal tipple was the last major structure to be built in the Chama yard. The tipple thus plays a key role in interpreting the yard in its fully evolved state.[1] Further, because it was built to service the new larger K-36 and K-37 locomotives that had arrived at the same time, and remain to this day, the tipple takes on added significance in interpreting yard and the operation of the railroad as it was at the time of abandonment by the Denver and Rio Grande Western.

The interpretive plan for the Chama Yard is to demonstrate the operations of a working narrow gauge steam railroad through the preservation and explanation of its surviving artifacts, by means of walking tours and demonstrations. The coal tipple is a major element in this plan. The tipple has not been used to fuel locomotives since the ownership of the line by the Cumbres & Toltec. Nevertheless the tipple retains strong potential for demonstrating fueling methods, either by interpretive signage (already in place) and/or by actual demonstration operations at scheduled times. This study does not, however, recommend that the tipple be used on a routine basis, nor that it be loaded with more than the minimal amount of coal required for demonstrations.

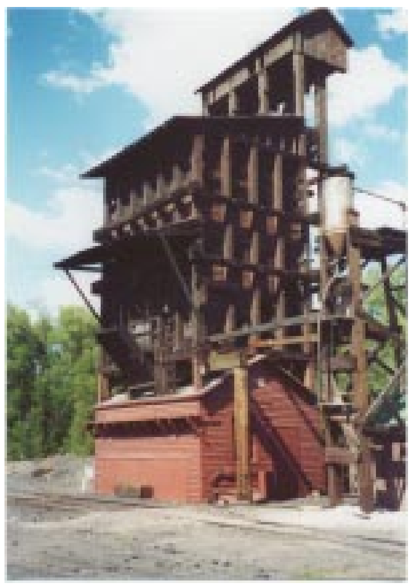


Figure 5
View from southwest, 2001

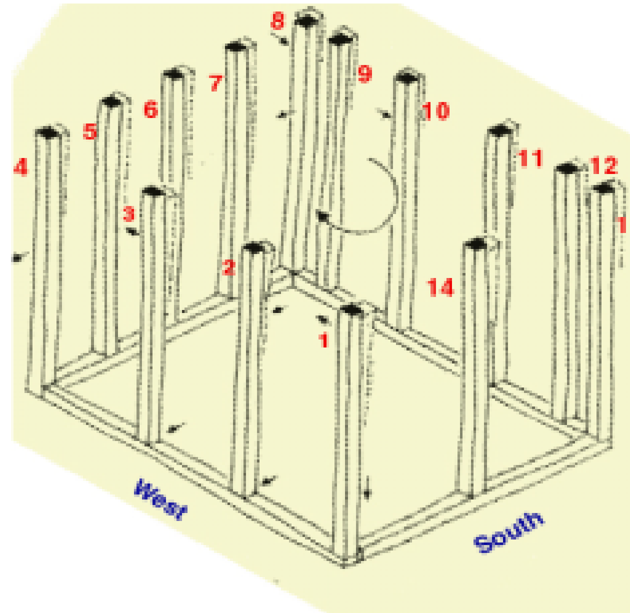


Figure 6

5. Structural Condition and Performance of the Tipple

The tipple's structure functions largely as a post and beam cage with bolted moment connections. Lateral rigidity is provided by a combination of member triangulation, wall sheathing, the coal pocket planking, continuity of the vertical guide posts, and the moment rigidity of member to member connections.

The tipple has a lean to the west of approximately 24 inches from the vertical measured at its highest point above grade. The lean is the result, primarily if not entirely, from the failure of the bottom (mud) sill located along the west side of the structure. At the southwest corner of the structure this member has been crushed downward 2-1/8 inches and along its length it has rotated allowing the base of the post resting on it to be deflected outward by as much as 5". All of the 14 posts that extend up through the hoist house to support the outside perimeter of the coal pocket have been stressed by this combination of downward and outward forces, resulting in the clockwise racking, or twisting of the structure as shown above.

Figure 7 - Failed west bottom sill

Each of the posts extending through the hoist house has been given a number and its lean in each axis measured as listed below.

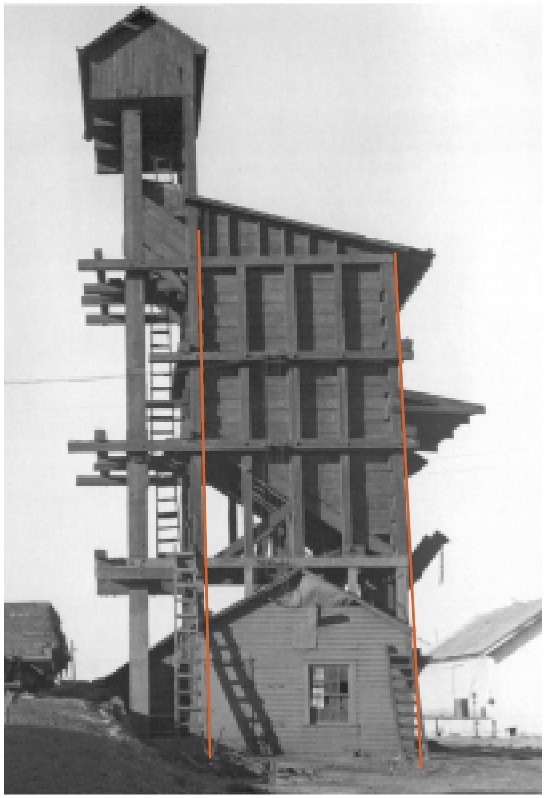
1	W 6.00"	N 1.35"	8	W 4.05"	S 0.68"
2	W 1.68"	N 1.01"	9	W 4.05"	S 0.68"
3	W 2.36"	N 1.01"	10	W 4.72"	S 0.68"
4	W 4.72"	NS - Plumb	11	W 5.73"	NS - Plumb
5	W 4.05"	N 2.03"	12	W 6.41"	NS - Plumb
6	W 4.38"	NS - Plumb	13	W 6.75"	NS - Plumb
7	W 4.38"	NS - Plumb	14	W 6.75"	N 1.61"

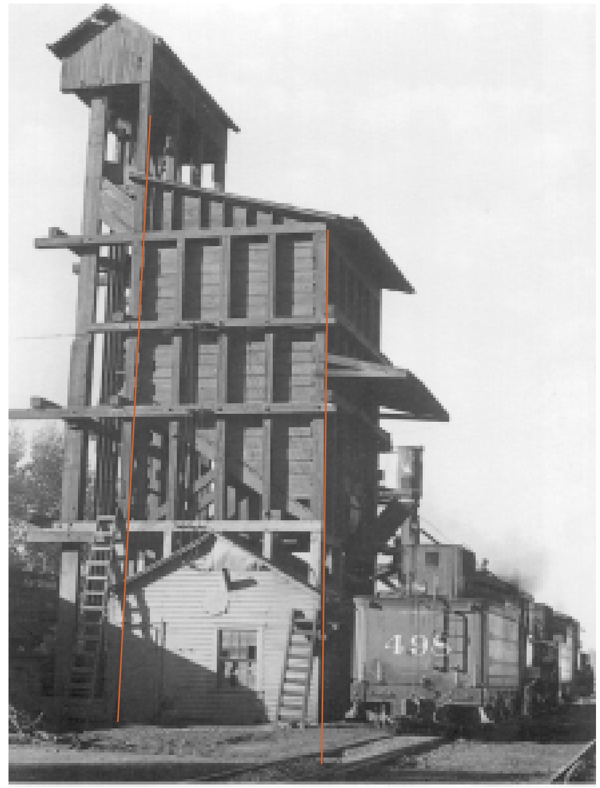
The west side's bottom sill lost significant strength when it became saturated and started to rot. As this occurred, the load of the tipple structure and its stored coal, became too great for the four western posts on the weakened sill. As the sill began to crush, support of the tipple from the four western posts was greatly diminished. The coal pocket then began to act as a cantilever, with the center row of posts and their beam acting as a fulcrum. The 3x12 planks attached to the 8x10 timber frame members that form the sides of the coal pocket provided tremendous stiffness for the cantilever action. However, because the interior of the pocket lacked the stiffness of the sides, the resulting cantilever forces were transferred to the two east-west 10x10 beams immediately above the hoist house. The stress resulting from this cantilever action has fractured the top portion of each of these two beams below the middle of the coal pocket.

The southwest corner of the tipple has dropped 2-1/8 inches as a result of the sill crushing. It is suspected that the reason for the asymmetrical movement and distress in the structure is that the south end of the west ground sill experienced a greater intrusion of moisture and therefore weakened more and sooner than did the north end of the sill. The resulting seesaw effect has caused the northwest corner to actually rise. The coal pocket has also leaned to the west as a monolithic unit, rather than distorting. As discussed above, the structure has significant north-south lateral bracing, but virtually none in its east-west axis. As a result the structure has been much more prone to east-west deflection than north-south. Apparently a significant amount of the east-west forces are being carried by the connections to the bucket guide timbers. These timbers are now acting as vertical cantilevers, a role they were not designed to fulfill.

The vertical 8x18 guide timbers that carry the tracks for the coal buckets appear to be in good condition despite the imposition of excessive horizontal forces resulting from the westward deflection of the structure. The doubling of the timbers in their centers to make the splice described

Figure 8 - Chama Yard in 1938
(from "Chama / Cumbres with a Little Chili" by Richard Dorman)





previously has in no doubt given them extra resistance against bending stresses, while possibly at the same time allowed some movement at the connection. At the time of the inspection for this report the bases of these timbers were submerged in water in the bottom of the buckets pits. These ends should be examined when the pits are dry.

The tipple's lean appears to have occurred over an extended period of time, perhaps starting not long after its completion. There is both photographic and field evidence to suggest this hypothesis. In figure 8, taken fourteen years after its completion, the structure appears to be vertical, although it is not possible to say so with certainty. However, examination of figures 9 and 10 show that by the late 1960s the tipple had achieved a substantial part, if not all of its current lean. Red lines have been drawn on these photographs of the north side, parallel to the coal pocket timber structure. Note that the lines diverge from parallel with the lower hoist house structure at the connections above the first tier of posts. Photograph 11 taken in 2001 shows approximately the same lean in the structure.

Left to Right:
Figure 9 - 1966 (Dorman)
Figure 10 - 1967 (from "Rio Grande Narrow Gauge - The Final Years, Alamosa to Chama" by Joseph P. Hereford, Jr' and Ernest W. Robart)
Figure 11 - 2001

Examination of the interior of the hoist house further reveals evidence of the age of the structure's lean. There are 5-1/4" x 5/8" tongue and groove horizontal sheathing boards on the interior of the hoist house's walls that are not shown on the drawings. (Section "A-A" of the original drawings shows exposed studs.) In the southwest corner, the siding appears to have been installed after the settlement of the corner had occurred. This is evidenced by the tapered board that was installed in this corner to accommodate the settlement. (See photograph 12) While it is possible that the tapered board is a later "fix", it does not appear to be so. In either case, whether it is a fix or original, the installation of the board post-dates the settlement of the corner.

Figure 12 - Interior South West Corner

It can be concluded from these observations that the lean began in the period between the 1940s and 1960s, or is between 40 and 60 years old. The interior sheathing boards do not show signs of ongoing movement or stresses (such as nails being pulled out of their holes), nor do the exterior photographs taken over time suggest that the movement is continuing.

In summary, the three factors that caused the lean are:

1) Concentration of moisture along the west side's bottom sill lead to the decay and failure of the member.

2) Because the coal in the coal pocket rested against its west side, it concentrated the loading unequally on the west side.

3) The lack of diagonal bracing in the east - west axis in the hoist house portion of the structure.

The "stabilizing" of the structure's deflection may be credited to several factors. Firstly, the structure has not held its full capacity of coal since the operation of the line by the Cumbres & Toltec Scenic Railroad in the early 1970s. Secondly, after reaching a certain degree of deflection the members may have "locked" themselves more rigidly together as a result of twisting of many of the connections. Thirdly, and most problematically, the vertical guide timbers have taken on a large portion of the resistance to the leaning structure's unbalanced load by becoming vertical cantilevers.

6. Structural Remediation Options

Three structural issues must be addressed in the repair of the structure:

1) Possible continued leaning and eventual collapse.

All of the bottom sills have been exposed to water and contain rot to some extent. Even if the source of water is eliminated, all of the sills are subject to further deterioration and possible failure. At some point the lean of the structure will likely again begin to increase. As it does so, it will place further forces on the guide timbers and the moment connections, and will eventually lead to collapse. The replacement of the sills would remove this future threat. The sills could be replaced with either treated timbers, or preferably with a cast-in-place concrete sill. Using either material, they could be replaced one side, or part of a side at a time.

2) Reduction of stresses within the structure.

The guide timbers have experienced bending stresses over a long period of time and have developed a permanent curvature. The only way to reduce this long "creep" curvature would be to bend the timbers in the opposite direction over a long period of time. This is neither feasible nor necessary. Jacking the west side of the structure back towards its original position will relive the bending stresses (but not the curvature) as the west side again assumes it share of the load. This will amount to unloading the cantilever that has developed as a result of the west side's bottom sill failure. Because the temporary shoring, currently in place, was installed without any jacking of the structure, the bending stresses were not likely reduced with its installation. Jacking up the structure and installing a new tight fitting bottom sill under the west side will allow the structure to be supported as it was originally designed to be.

3) Reestablishing the integrity of the structures's connections.

Because of the distortion of the connections as a result of the lean, and the deterioration of some of the members, many of the connections no longer perform as designed. The condition of the connections requires further investigation and remedial methods (using lag bolts and steel plates, and possibly spikes) be developed prior to beginning the work.

Although the structure may have experienced some degradation of member and connection strength as a result of the past conditions, it is believed that the structure will perform adequately when the proper repairs as outlined above are made. Based on the above findings, there are two repair options that can be followed.

Option 1. Replace all of the bottom sills and partially straighten the structure.

The structure would have all of its ground sills replaced, and would be jacked back into a more plumb position. The straightening should be accomplished only by jacking the structure. Because of the uncertain condition of the connections, no attempt should be made to pull or push the structure back into plumb. The existing temporary shoring timber could possibly be used as the jacking timber during the process. Jacks would be inserted under it at each end, and at the center. The latter would necessitate the cutting of a temporary hole in the hoist house roof. The jacking process should be closely monitored by an engineer and should proceed only to the point where it is believed that the existing stresses are relived and that no new stresses are being induced. Because of the long term creep and set of the timbers and their connections, there may be some residual tilt left after all of the sills are replaced and the base posts are raised to, or near to, their original positions. Because the lean developed relatively early in the structure's life, as a result of design flaws, it has in effect become part of the tipple's history, and should be interpreted as part of the structure's history. The interior and exterior sheathing, windows and doors of the hoist house have either deformed or been replaced since the lean developed. The jacking of the structure will necessitate, at least a partial rebuilding of these architectural elements, particularly on the south and west sides.

Option 2. Replace only the failed west sill and partially straighten the structure.

This option is basically the same as number one, but more temporary in nature. To prevent further leaning, and possible catastrophic failure, only the failed west bottom sill would be replaced. As stated in option 1, this can be done either with a new treated wood member, or with a poured-in-place concrete sill. The sills on the other three sides would continue to be monitored, and would be subject to replacement at a later date if they should show signs of failure.

Figure 13 - Timber Connection on East Side

7. Condition of Individual Structural Elements

Timbers and Other Wood Members

As stated in the Osmose report, the timbers and other wood members are in generally good condition. Two types of wood treatment are available that could be used on the structure. Both use poisonous wood preservative chemicals that are placed into the wood - one method uses capsules that time-release the chemical, and the other uses direct injection under pressure. According to Rick Grumke, the Osmose inspector who made the evaluation, the cost of the treatment would be in the range of twenty to thirty thousand dollars. But he emphasized that he did not think the condition of the tipple warranted this treatment.

The only significantly decayed areas, other than the bottom sills, are the tops of some members, particularly the east ends of timbers that project out around the coal buckets (Figure 13). These areas should not be covered with any flashing materials. While flashing may prevent the entry of some moisture, it also poses the risk of trapping moisture which could cause considerably more harm. However, the decayed areas can be filled with asphaltic tar to limit further decay, although they should not be completely filled.

Remnants of dark red paint were observed on all portions of the structure. This is most likely the original Rio Grande mineral red. For many decades now the tipple has been seen and photographed as a weathered wood timber structure, but it was in fact painted during much of its the period of significance, and in particular during the period when the current locomotives were introduced. The hoist house has already been painted the mineral red color. There are two reasons for considering the repainting of the entire structure - preservation of the wood, and historic interpretive value. The repainting would not interfere with the use of any wood preservatives, at this or any future date, and would provide additional protection for the wood. Additionally, repainting would aid in creating a more accurate image of the rail yard of the 1920 through 1940 period.

The recommended painting would consists of an alkyd (oil based) primer and two finish coats of latex paint. Latex paint as a primer would likely not be compatible for use over the existing paint and timbers. Prior to painting, the wood and remaining paint should be thoroughly washed and wire brushed. The “life expectancy” of paint can vary widely depending on weather exposure, and the proper preparation and application of the paint, but seven years is a reasonable average. Although with a structure, such as the tipple, it is important to consider how “new like” of a finish is desirable. As long as the paint is not peeling, it is providing protection to the structure, and a longer maintenance cycle may be considered, if a faded and “used” look is acceptable.

Figure 14 - East Wall of Coal Hopper

Concrete

The concrete foundations under the tipple and the floor slab of the hoist house show no signs of cracking or settlement. The concrete walls of the bucket pit also appear to be in sound condition, although there was standing water in the bottom at the time of inspection.

At the time of the inspection, the twin coal hoppers had coal covering most of their bottoms. However, the concrete structure that was visible, is very weathered with a very rough and irregular surface, but appears to be sound, other than one significant crack on its east side (See Figure 14). Even here there is no apparent movement in the structure. The weathered surface of the coal hopper is at least in part the result of the physical damage caused by coal being dumped against its surfaces. It may also be the result chemical action. Coal is an unstable mineral and subject to leaching-out many of its elements, particularly carbon, oxygen and sulphur, which may be the cause of the deterioration. Carbon dioxide for example, can react with the cement paste (lime) and cause its deterioration. Further, it was also common to use cinders and burned coal as aggregate in early concrete mixes.[2] These too can cause the deterioration of the cement paste. It is not known however if any of these were used in the Chama tipple. Additionally, the coal in the hopper can soak up and hold moisture. These factors, combined with the extreme freeze-thaw cycle of northern New Mexico, have no doubt produced a very severe weathering environment.

Because concrete is a porous material, it needs to breathe. When concrete is as weathered as that in the hoppers, it is inevitable that water will enter. Any attempt to seal the concrete would be only partially successful at best, and could pose a risk of causing more harm by trapping moisture. It is recommended that the hoppers be emptied to the greatest extent possible to minimize the exposure to coal and to allow the concrete to breath. The major open cracks can be sealed with a caulking to limit the entry of water into these spaces. This could greatly limit the widening of these cracks by freeze-thaw.

Figure 14 - Track Support Beam

Steel Track Support Beams

The “I” beams supporting the coal delivery tracks are losing thickness due to rust and surface delamination (Figure 14). To prevent further deterioration, perhaps to the point of no longer being able to support cars, they should be sandblasted of all loose rust, and painted. Because they were most likely unpainted when new, they should be painted color similar to unpainted steel.

8. Condition of the Architectural Fabric and Repair Recommendations

Roofs

The original drawings indicate that all of the roofs were to be covered by *5-x Elaterite*. Elateritre is a brown to black, soft, elastic hydrocarbon resin that is found in the Elaterite basin of southeast Utah. There was at one time a Western Gilsonoite and Elaterite Company located in Utah. The roofing was made by impregnating hemp fiber with the material. The 5-x likely indicted that it was a five pound product. The roof likely had a dark appearance.

The existing roofs on the sheave house, the coal pocket, and the equipment shelter are a rolled-roof type material that was installed in 1979. The roofs are in very poor condition, especially on the pocket where potions of the roof have been blown back to expose the wood deck. These roofs are all in need of replacement. The roof on the hoist house is in much better condition. However as discussed below, the numerous penetrations of the structural support timbers through the roof have been a continued source of interior leaks. The penetrations are sealed only by means of roofing cement. It is recommended that sheet-metal flashing be installed around the timbers. Because of its sheltered location and the roof’s steep pitch, the flashing would need to project only 6" above the roof and should be painted to match the timbers, so as not to be conspicuous.

All of the roofs should be replaced with new mineral surfaced 90 pound rolled-roofing installed over roofing felt. Because the original roofing was most likely black or very dark, a similar colored material should be used. Light colored materials are not appropriate to the era and the rail yard environment, and should be avoided. Prior to reroofing, the existing roofs should be removed, the roof deck inspected, and any broken or decayed boards replaced as necessary.

The Sheave House

Because of its height, the house sheltering the top sheaves was inspected only from the ground. The drawings call out "1x6 drop siding" and show it installed horizontally. In fact the boards are installed vertically. Based on the number of boards, they appear to be 1x5s. Some of the boards, particularly on the west side have fallen off and others are hanging loose. There appear to be a number of pigeons living in the house. The missing and unsound boards should be replaced and the loose boards reattached. Poultry netting should be installed on the interior and trap door installed to prevent the entry of pigeons.

The Coal Pocket

Perhaps because it was built to withstand the heavy and moving loads of coal being dumped into it, the coal pocket is the most substantially constructed portion of the structure, and remains in the best condition. Its walls are formed of 3x12 planks supported by 8 x 10 timbers placed at between 3 and 4 feet on center to resist the outward pressure of the coal. No significant deterioration was noted on the coal pocket.

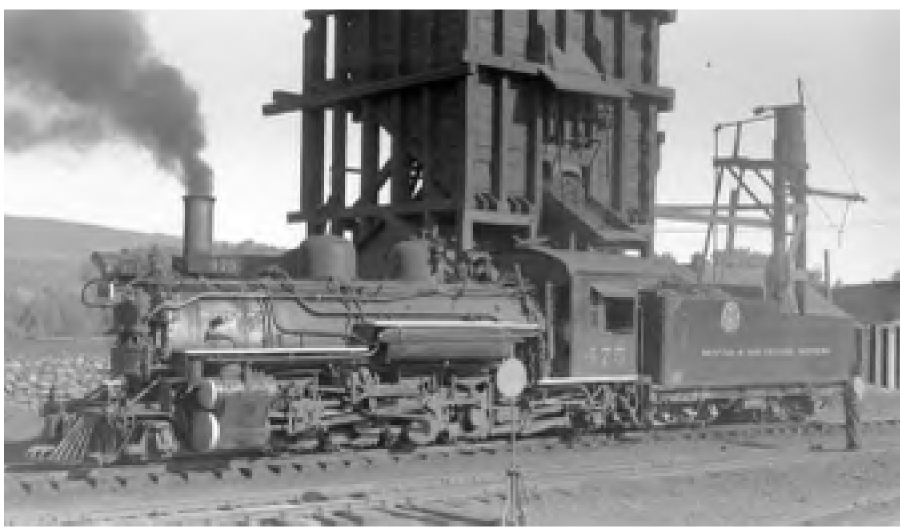


Figure 15 - West Side in 1939 showing Equipment Shelter
Otto Perry photo from Denver Public Library

Equipment Shelter

The mechanical equipment associated with the coal pocket's delivery gate and chute on the tipple's west side were not inspected as part of this investigation, but are understood to be in working order.

The equipment has a projecting roof structure to shelter it from the elements. This roof was not shown on the original drawings, and is not present in photographs dating from as late as 1939. The roof is supported at its quarter points, or approximately five feet on center by 2x8s. The only bracing for the structure are 2x6s (or 2x8s) at each end of the roof. Based on the photographic record, these members were added between 1967 and 1979. These two members are approximately 10 feet long and are dangerously bowed under their load. Because the ends of these braces are also starting to split, they are at risk of failure at their nailed connections. The shelter is sagging very significantly and may be at risk of collapsing in the near future. It poses a potential hazard to the trains and their passengers passing in front of it, as well as to visitors to the yard. The structure should be removed at this time to prevent possible injury.

Prior to the construction of the wooden roof structure, a small sheet metal canopy protected the chute mechanism, although it was not indicated on the original construction drawings (See Figure 15). Portions of this structure appear to remain in place. Because the canopy dates from early in the period of significance, and reasonable evidence of its original construction remains, it should be restored in lieu of reconstructing the later wood shelter.

The Hoist House

The exterior walls are indicated on the plans as "1x6 shiplap, paper and drop siding on outside of the studs." Drop siding is usually meant to be exterior horizontal siding, but in this usage appears to be the sheathing. The exterior siding on the west side was replaced by the Friends during the 1990s over the course of several work seasons. The cat walk along the west side and metal sheeting on the walls were also rebuilt at this time. The original sheet metal was reinstalled, but three to four inches of it that were rusted were cut off.[3] Based on photographic evidence, the siding on the south side had been replaced during, or at some point after 1979. The siding of the east side also appears to have been replaced at an unknown date. The north wall siding appears older and may be original.

The windows were replaced with new wood units in 1979 (See Figure 1). Work was also done to the windows in 1993 and 1994, apparently including the replacement of the 8 over 8 muttins. The one window on the north side may have at one time been converted to a doorway, and subsequently reconverted back to a door, based on joints in the siding below it. The interior walls are painted the same color as the exterior to approximately 8'-6" above the floor. This was done by the Friends in 1999. Prior to that they were unpainted.

There are moisture stains on the bottom (mud) sills on all four sides of the interior of the hoist house. Additionally, there are stains on the ceiling boards and timbers where they penetrate the roof. As noted previously, the ceiling leaks are the result of inadequate flashing at the roof. The roof leaks can be easily fixed by means of proper flashing. Far more troubling is the presence of moisture in the sills, because of their critical structural role. Although roof leaks may have been a partial source for this moisture, the majority has most likely come from the adjoining earth. The original drawings show the concrete floor set above the surrounding grade and the siding stopping above grade. Currently the concrete floor slab is between six and eight inches below grade. Although the surrounding fill is largely gravel, coal fragments, cinders and other generally porous materials, it does hold and concentrate moisture against the wall. The rise in grade level has probably resulted from successive ballasting of the tracks within the yard since the tipple was built. Because the area of the yard is generally flat with standing puddles of water in the near vicinity of the tipple, regrading of the surrounding site to provide positive drainage away from the tipple would be very problematic, and probably a relatively temporary fix. The recommended solution to the moisture problem is to remove the exterior wood siding at the base of the building to a height of approximately 18" above grade, and to install a polyethylene vapor barrier over the wood sheathing, prior to reinstalling the wood siding. The exterior perimeter of the building should be excavated to a depth of at least one foot adjacent to the concrete foundation and to a width of 18". The vapor barrier should be extended to the bottom of the trench and across the full width of its depth. Care should be taken in refilling the trench to prevent puncturing the barrier.

Coal Bucket Pits

The two coal bucket pits were shown as one pit divided by concrete beams on the construction drawings, but were built as two separate pits. In 2000 the Friends cleaned the two pits of one and one half feet of accumulated dirt and debris. The primary problem with the pits is that they have no drains and hold rain and show melt until it either percolates through the concrete or evaporates. The Friends have not been able to locate any drain lines originating in the pits, nor was any drain line indicated on the construction drawings. However, in the summer of 2000, the Friends were able to locate fragments of a clay tile drain line extending out from under the coal delivery track that may be the drain line for the pits. It is essential that a drain line eventually be found or constructed to keep the pits free of water. If the existing lines can be located, they can perhaps be augured and lined with a smaller diameter pipe if necessary. If they can not be located, a new line could be built using a horizontal augur.

Lightening Protection

Timber structures have been known to survive hundreds of years. Many of the original timber roof structures of European churches are now over 1000 years old. Perhaps the greatest threat to the long-term preservation of a wood structure is the prevention of fire. Aside from arson, the most likely source of a fire, particularly for a tall structure like the tipple, is lightening. Due to its small footprint, only four air terminals would be required - two on the sheave house roof and two on the coal pocket roof. The terminals are only 12“ high and 3/8” in diameter, and would be relatively inconspicuous. The 7/16" diameter copper grounding cables (conductors) should be run inside the structure where feasible and other locations as required to be as inconspicuous as possible. The system must be installed by a licensed contractor to receive an Underwriters Label, the standard for the industry. One estimate has been received, in the amount of $7,414.00, from an electrical contractor for the installation of the system.

9. Summary of Recommendations –Work Items – Estimated Costs

Item		Friends Project	Estimated Cost (Including Labor)	Contracted Work	Estimated Cost (Including OH & P)	
1	Coal Hoppers					
	a. Empty coal	X	$0.00			
	b. Seal cracks in concrete	X	104.00			
	c. Scrape rust off of steel beams	X	208.00			
	d. Paint steel beams	X	208.00			
	e. Install drain lines (horizontal auguring)			X	$11,700.00	
2	Roofs					
	a. Replace high roofs			X	1,404.00	
	b. Replace hoist house roof	X	682.50			
	c. Install flashing on hoist house	X	1,365.00			
	d. Remove equipment shelter	X	390.00			
	e. Construct new equipment shelter	X	455.00	X	455.00	
3	Wood Structure					
	a. Patch decayed timber ends with asphalt			X	650.00	
	b. Paint structure			X	14,625.00	
4	Sheave House					
	a. Replace loose and missing siding			X	782.60	
	b. Install trap door and poultry netting	X	390.00			
5	Hoist House					
	a. Reconstruct ladders	X	700.00			
	b. Install lightning protection			X	9,638.20	
6	Miscellaneous					
	a. Reconstruct ladders	X	700.00			
	b. Install lightning protection			X	9,638.20	
Total of Non-Structural Repairs			**$6,602.64**		**$49,254.80**	**$45,857.44**

Item		Friends Project	Estimated Cost (Including Labor)	Contracted Work	Estimated Cost (Including OH & P)	
7	Structural Repairs					
	a. Option 1 – Replace all bottom sills					
	Jack structure			X	$3,900.00	
	Replace sills with concrete			X	4,420.00	
	Remove temporary support	X	$390.00			
	Repairs to hoist house	X	5,200.00			
			$5,590.00		**$8,320.00**	**$13,910.00**
	b. Option 2- Replace only west bottom sill					
	Jack structure			X	3,900.00	
	Replace sill with concrete			X	1,105.00	
	Remove temporary support	X	390.00			
	Repairs to hoist house	X	5,200.00			
			$5,590.00		**$5,005.00**	**$10,595.00**

Notes

[1] Subsequent to the construction of the tipple all but two stalls of the nine-stall roundhouse and its turntable were removed. The only newer major structure in the yard is the non-historic 1977-78 engine shop.

[2] *Preservation Briefs #15, Preservation of Historic Concrete: Problems and General Approaches, National Park Service.*

[3] Chronicle from 1993