CUL-1 Mitigation Report

Scotia Recordation/Documentation of Buildings Scheduled for Demolition

The project site (a portion of APN 205-351-023 and 205-351-030) is located on land owned by the HRC and is currently designated industrial general (IG) by the Humboldt County General Plan, is zoned and classified by the County as heavy industrial/qualified (MH/Q).

To: County of Humboldt, California USA

submitted by

Humboldt Redwood Company

125 Main Street, P.O. Box 712, Scotia, CA 95565

prepared by:

Gerald T. Takano

JULY 4 2018

Photo: Scotia-mill-1989.©2016-Greg-King

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1.0 Introduction

On July 13, 2017 the Planning Commission of the County of Humboldt California approved the demolition (removal by deconstruction) or several abandoned or partially abandoned structures on the north end of the sawmill complex and the south end of the power plant complex currently owned by Humboldt Redwood Company (HRC). As part of the Conditions of Approval, HRC is required to implement the mitigation and monitoring requirements of the Environmental Impact Report:

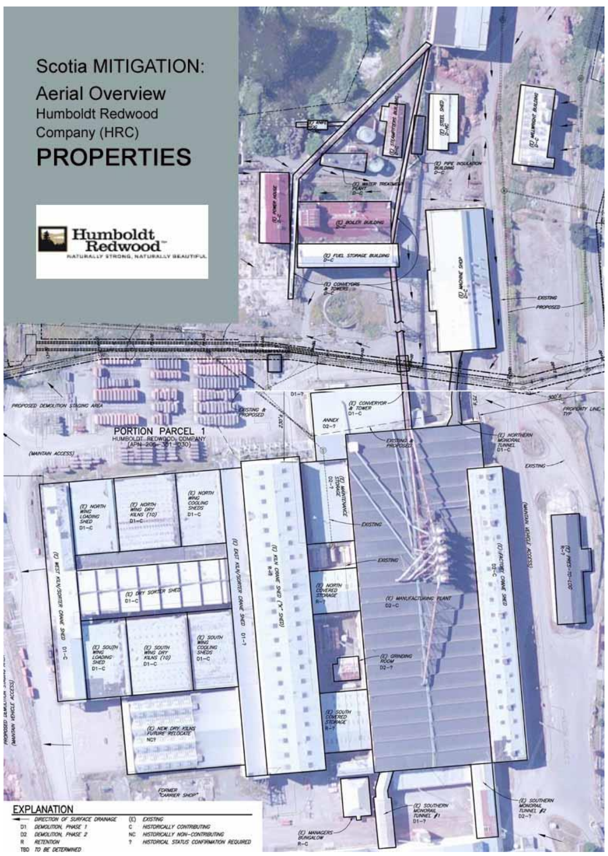


Figure 2 HRC properties, Scotia, California

Mitigation Monitoring and Reporting Program This mitigation monitoring and reporting program (MMRP) (see Table 1) has been prepared to comply with the requirements of state law (Public Resources Code Section 21081.6). State law requires the adoption of a mitigation monitoring program when mitigation measures are required to avoid significant impacts. If an impact was found to be less than significant and did not require mitigation, no monitoring would be required. The monitoring program is intended to ensure compliance during implementation of the project.

Mitigation requirements include the following:

CUL-1. Recordation. *To ensure a permanent record of the properties' present appearance and context, proposed buildings and structures slated for demolition will be recorded according to historic American buildings survey (HABS) and historic American engineering record (HAER) standards prior to any* *deconstruction activities. The HABS/HAER documentation would be filed with the California State Office of Historic Preservation, Town of Scotia Company, LLC, Humboldt State University, and other institutions or agencies. Recordation shall also include: 1) industrial process; 2) any extant machinery and equipment used; and 3) further researching the spatial arrangements, available machinery, and other details that reveal an internal machine's function. In addition, the mitigation may include general views and details of structural framing systems, including roof trusses, bents and beam systems, and pedestals that supported the building structure and the equipment and machinery.*

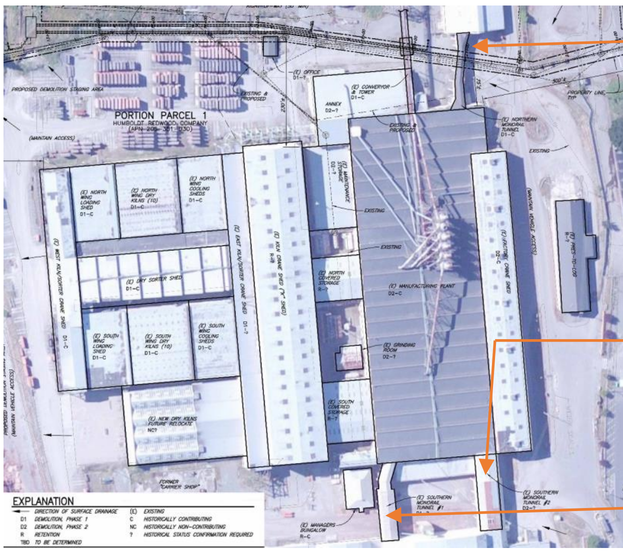
CUL-2. Scotia Archives. *Existing data and information, including photographs, will be organized and categorized in an archival system both physically located within the town of Scotia and digitally online. The archives mitigation should include archival records; organization and systemization of existing Scotia documents and records; compilation of additional oral history; creation of an interpretive framework focused on historical and cultural research; development of history-based museum activities, programs, and onsite tours of industrial logging operations, exhibits, interpretive panels, historic markers, and public installations about Scotia's industrial history; publication of tour and history information for visitors and educational purposes; neighborhood history workshops; onsite instruction into various industrial techniques, products, and processes; publication (book or online) of Scotia's industrial architecture to heighten interest in Scotia; and/or participation in State of California links with other mills to increase interest in Scotia's history and culture and take advantage of historic preservation programming.*

CUL-3. Interpretive Display. *HRC will develop a display of the photographs and documentation for public exhibition.*

CUL-4 Opportunities for Salvage.

2.0 Phasing and List of Buildings requiring Recordation

This submittal consists of **Phase 1 buildings/structures to be demolished**. *Phases 2A and 2B buildings/structures subsequently will be submitted later.*



Northern Monorail Tunnel connecting the Manufacturing Plant to the Power Plant Maintenance Shop (this structure crosses the property line between the mill complex and the power plant complex)

Southern Monorail Tunnel #1 connecting the Manufacturing Plant and Factory Crane Shed to the new Sawmill and Planer Sheds

Southern Monorail Tunnel #2 connecting the Manufacturing Plant and Factory Crane Shed to the new Sawmill and Planer Shed.

Pipe Insulation Building

Steamfitters Building

Figures 3 and 4, *Scotia HRC properties and subject buildings.*

Subsequent anticipated submittals

Phase 2A

- ***West Kiln/Sorter Crane Shed*** *running along the entire west end of the North Wing Loading Shed, Dry Sorter Shed, and South Wing Loading Shed*
- ***North Wing Loading Shed*** *located on the west end of the North Wing Dry Kilns*
- ***South Wing Loading Shed*** *located on the west end of the South Wing Dry Kilns*
- ***North Wing Dry Kilns*** *(10-block construction kilns)*
- ***South Wing Dry Kilns*** *(10-block construction kilns)*
- ***North Wing Cooling Sheds*** *on the east end of North Wing Dry Kilns*
- ***South Wing Cooling Sheds*** *on the east end of South Wing Dry Kilns*
- ***East Kiln/Sorter Crane Shed*** *running along the entire east end of the North Wing Cooling Sheds, Dry Sorter Shed, and South Wing Cooling Sheds (does not include the Kiln Crane Shed)*
- ***Dry Sorter Shed*** *running the entire distance between the East Kiln/Sorter Crane Shed and West Kiln/Sorter Crane Shed and positioned between the North Wing Dry Kilns and South Wing Dry Kilns*
- ***Conveyors& Towers***

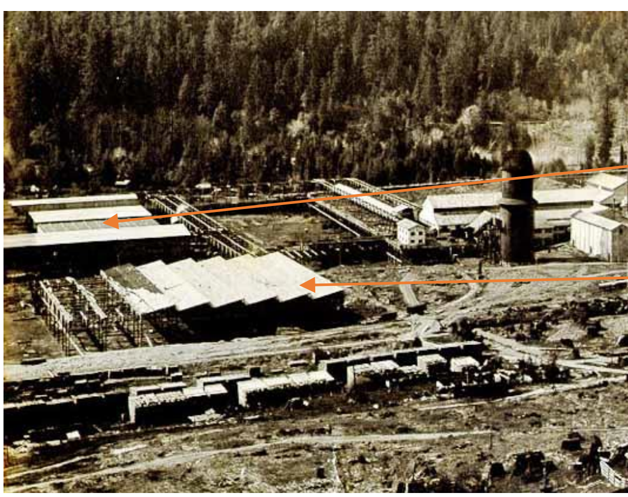
Phase 2B:

- ***Millwright Building***
- ***Machine Shop***
- ***Conveyors and Towers***
- ***Boiler Building***
- ***Fuel Storage Building***
- ***Powerhouse***
- ***Manufacturing Plant***
- ***Factory Crane Shed****, located along the east side of the Manufacturing Plant*
- ***Grinding Room,*** *located between Kiln Crane Shed and Manufacturing Plant*
- ***Ancillary buildings*** *(smaller buildings between the Kiln Crane Shed K and the Manufacturing Plant as well as those south of the Dry Sorter area)*

3.0 Context of Scotia's Industrial Typology

3.1 Logging Industrial Typology.

Electrification in American factories generally began around 1900. At first larger motors were added to line shafts, but as soon as small horsepower motors became widely available, factories switched to unit drives which allowed more efficiency in the factory layout to be more efficient and provided sequential automation using relay logic. As with other factories Scotia now had the ability to design and operate manufacturing facilities important to the manufacturing Scotia organization. Investment efficiency required Scotia experiment with multi-timber product lines without major retooling, resource reconfiguration, or replacement of equipment. However the production of lumber boards remained the primary commodity. Scotia, like other manufacturing facilities, exhibited high levels of flexibility despite significant changes in their operating requirements though its employees, machines and other facilities. The Scotia's employers needed to position employees, materials, machines, equipment, and other support systems to create the most effective plant layout while keeping production constantly continue on. The intended type of wood products influenced the layout.



kiln, crane, drying and sorter location, 1917.

Figure 5. Manufacturing Plant under construction, aerial west facing view from south (left) to north (right), 1917.

As such, the most important indicator of Scotia's history and purpose is the aggregation and interrelated industrial buildings and structures. The industrial typology, with minimal ornament and revival details, is best expressed by the function and utilitarian manufacturing of wood as a primary building material. Rather than stylized fashions and trends of the times, Scotia's industrial building designs were simple, basic and wood produced from its mills. Towns such as Scotia were not originally planned as company towns but evolved as the logging industry expanded its production and operations (ref: James Allen, *The Company Town in the American West, date).* Industrial operations depended upon the efficient management of two components, the industrial site and the labor as railroad workers became an important component in running and maintaining mill operations. When Scotia's Mill B was completed in 1910 with then the world's largest redwood sawmill, operations installed the overhead monorail system, to move materials around the mill to speed up production with the use of automatic carriages, cranes, and beltways. Five years later in 1915 finished lumber products were produced requiring new buildings and structures. Along with standard lumber products, the company began more efficient ways to use the by-products of the milling and manufacturing processes. Bark, sawdust and wood scraps had typically been incinerated in the conical metal "teepee" or "slash" burners.

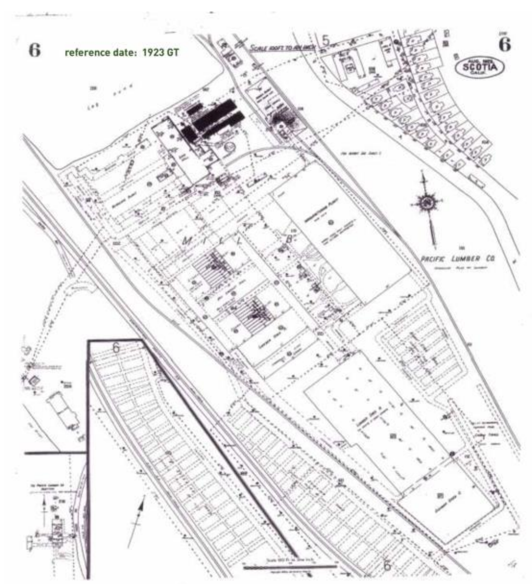


Figure 6. Scotia Mill B, Manufacturing Plant, Kiln, crane, drying and sorter operations, 1924.

By 1917, the company became the first in the redwood industry to acquire machinery for making cigar box lumber which could be created from smaller pieces of wood. While untreated bark, used locally to insulate cold storage boxes, also became a commercially viable product. By 1929, a bark recovery plant had been constructed to turn redwood bark into insulation. In addition in 1934, under license from the Potlatch Corporation, a Pres-to-log plant

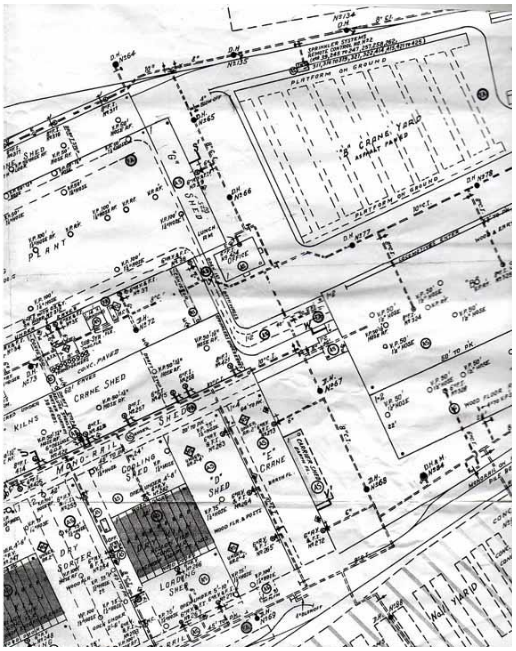


Figure 7 Scotia plan, 1944.

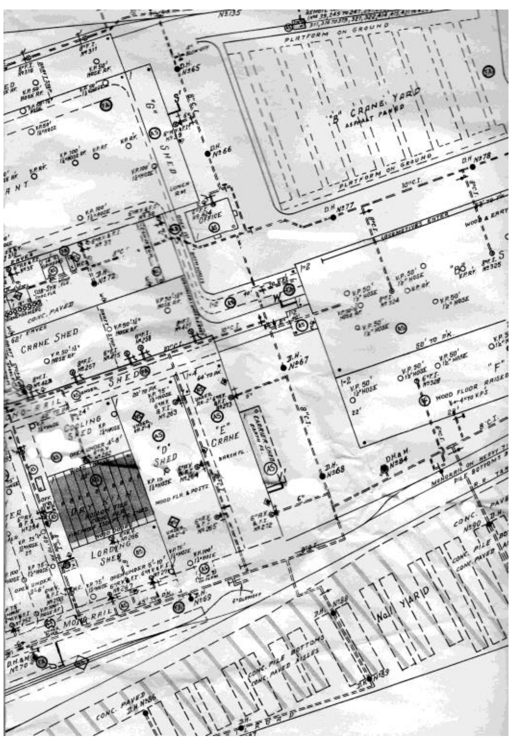


Figure 8 Scotia plan, 1955.

with four machines was constructed that would turn sawdust and green waste into small, compressed logs and required no chemical binders.

Since Scotia's production of lumber included enormous waste, the wastage by the 1920s was converted into marketable products including the manufacture of pulp, paper, briquettes and other products. Redwood bark was also used as an insulating material and sound deadener. The most common use for Scotia's mill wastes, however, was for fuel. Waste burners were gradually eliminated and much of the refuse was used in boilers for power purposes. Hogging machines for reducing wood wastes to smaller sizes for easier Other new products such as plywood were introduced within the decade, along with new equipment to create laminates from scrap wood. The overall strategy was to improve efficiency, reduce costs and remain competitive in the future. The company experimented with the production of both redwood fiber for textiles and chemical by products from processed bark. The main laboratories were located in San Francisco, and labs on site at Scotia focused on quality control and sampling.

The company's approach to waste reduction, sustainability, and innovation complimented Scotia's sophisticated industrial operation and lumber production.

Buildings. Buildings outdated for the current milling practices were often demolished or expanded with additions. Wood framed structures followed the tradition of early logging mill construction in Scotia. Wood as a building material has high tensile strength and elasticity and efficient resistance to loads and greater flexibility in the use of space. However by 1910 masonry and reinforced concrete construction was incorporated as the material of choice for fireproofing, particularly in industrial buildings with combustible and hazardous conditions.

Most buildings were clad with wood and metal. Roof forms were varied including open gable, hipped, double hipped, shed and flat roofs. Double hung windows and single windows are placed symmetrically through the complexes. Large openings were designed to accommodate transport and equipment into and out of the buildings. Windows were practically designed to allow light into the large interior spaces; columns, beams, trusses, and brackets were exposed and designed to allow vast expansive spaces for the milling operations below.

The interior framing of Scotia's industrial buildings was designed to provide solidity and steadiness but also with elasticity to withstand vibration. To minimize oscillation buildings were reinforced, especially along the exterior walls. Pratt and other types of truss systems were also construction under flooring and for roof plank. Some buildings were designed to limit and diffuse such forces by constructing balanced and bonded walls as if they acted as pilasters to offset long walls. This was because thick load-bearing walls alone could not limit the effects of oscillation and vibration. The design of the roof and the interior framing could transfer its weight to concentrated bearings. In addition, joist-framed floors were stiffer to accommodate jarring and reciprocating pounding movements. In Scotia, the use of heavy timbers and planks for slower-burning construction was often combined with steel reinforcement to reduce vibration.

The Steamfitters Building and Pipe Insulation buildings are typical of the simple, smaller building types in Scotia. The truss and bent systems in the interior of both buildings illustrate the craftsmanship, knowledge and skill of the Scotia workers and its engineers.

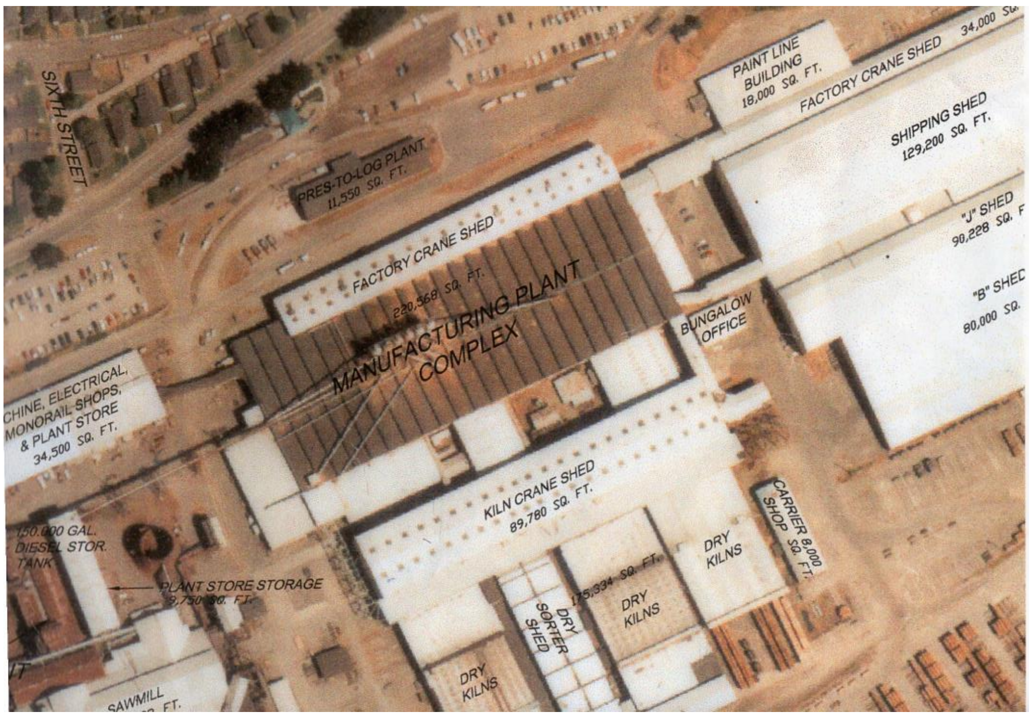


Figure 9 Aerial photo of Manufacturing Plant, Kiln Crane Shed, Dry Kilns, Dry Sorter, Shipping Shed, J shed, B shed, 1955.

3.2 Monorails and Cranes. In addition to the advent of electricity for Scotia in the early 1900s, new equipment and technology such as those for the elevated monorail system's tolleys and cranes would have a significant impact on the layout of the facilities. The monorail system ran until the 2000s when the final switch to trucks and haulers was made. By 1914, according to writer Bruce Evans**,** Scotia had plans for an elevated trolley system powered by electricity, one which would be suspended on a mono-rail that ran throughout the sprawling facility. The mono-rail, suspended on a huge timber truss-work, Evans explains, moved carriages with a winch mechanism and lifting arms that would grab a unit of lumber for transport to another location in the mill. The truss-work ran for hundreds of feet, entering the inner confines of Mill "B" (now demolished), running to the storage areas outside, and over railroad tracks where flat cars were loaded and unloaded.

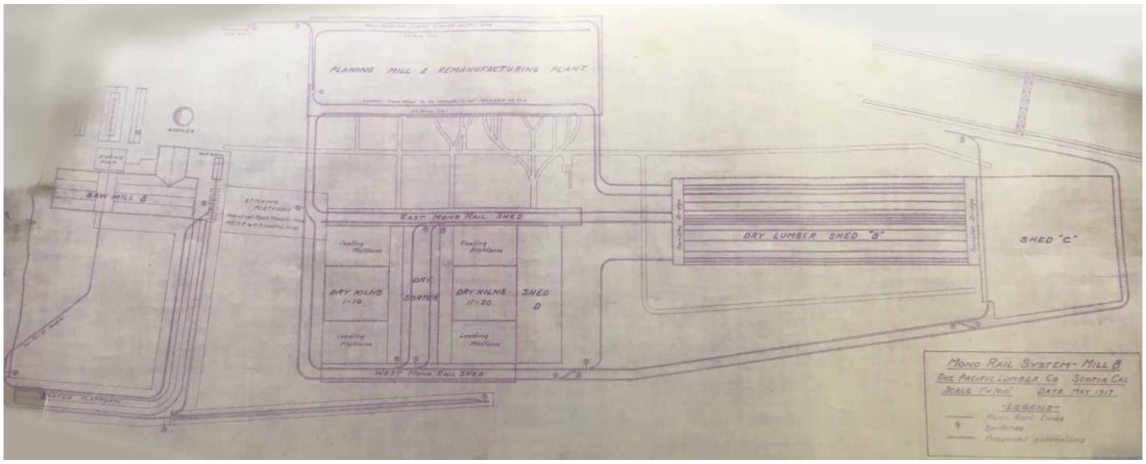


Figure 10 proposed monorail system, PALCO, May 1917.

Massive 12″ by 12″ timbers supported the truss-work, many of which were sandwiched with 6″ by 12″ planks on each side. The overhead portion of the truss-work contained more 12 by 12's, with 10″ by 12″ diagonal braces. The whole truss system was held together with hundreds of ¾" bolts, and 1″ upset rods. The carriages consisted of several components that made up the actual lumber moving system. The dolly was a steel beam with two pairs of rollers on each end that grabbed the monorail. Each set of four rollers had its own travel motor. Attached to the dolly was a hoist motor which raised and lowered the set of four grab arms that secured to the lumber unit. The grab arms themselves were turned by yet another motor. The array of motors and controls operated on dual voltage direct current—120 and 220 volts. The whole mechanism was controlled by an operator who sat in a tiny booth (about 3-1/2 feet square) suspended from one end of the dolly. In this booth were two simple controls: move left and right, raise and lower the winch. Also in the booth were grab arm controls, alarm and limit devices, and a small electric heater. The capacity of these overhead lumber-moving carriages was 5000 pounds.

Although no records have been found to verify the construction dates, South Monorail Tunnel #1, South Monorail Tunnel #2 and the North Monorail Tunnel were built in the 1950-1960s to provide the rails and trolleys/cars protection above any traffic below. These monorails replaced the overly complex, mono rail car serviced at "B" shed located at the East Mono Rail Shed line shown in the 1917. The monorail car would carry a load of dried lumber down the East Line to the B Shed and, car and all, would drive onto a traversing section of rail stopping at the corresponding line that the unit was to be stored in the shed. Both ends of the shed had the rolling rail system so cars could work on both ends of the shed. This was a mechanically complicated system later replaced with the "K" shed, located on the east side of the East Monorail Line in the early 1940s. The "J", "O" and "S" sheds and storage and shipping buildings featured newer bridge cranes that were much better at traversing a warehouse than monorail cars. In time "B" shed became obsolete and eventually torn down. The relocated South Monorail Tunnel #2 is the remnant of the line that led to "B" shed. The South Monorail Tunnel #1 that line cut off outside of "K" shed was the second route to "B" shed. In the 1960s, the existing monorail lies were extended into the new warehouses of the south section of Scotia's new mill area and old lines were abandoned. As the fastest way to move material from the Kilns and Manufacturing facilities to the bridge cranes, the monorail system's cars remained a more efficient operation due to their free lateral movement.

Figure 11 Monorail I-beam rail, prototypical trolley/ car, photo date unknown.

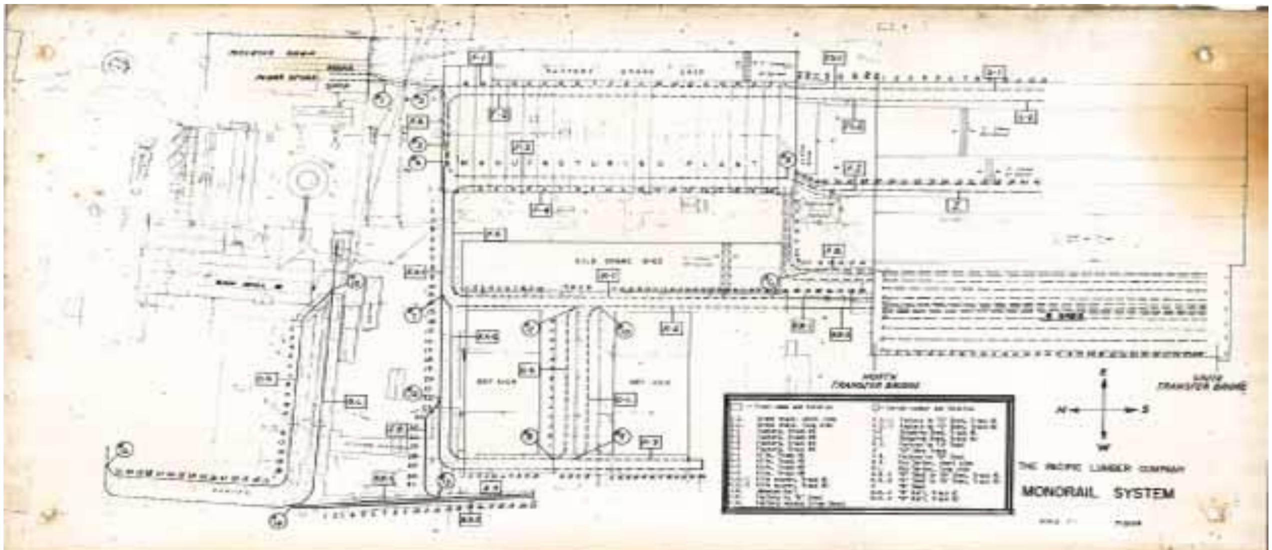


Figure 12 Scotia Monorail system, 1984.

Figure 13 defunct monorail trolley/car at Scotia, PALCO, date 2016.

Cranes used in handling lumber included cantilever cranes and locomotive types. The cantilever cranes were used for high piling, heavy loading and unloading cars and vessels. The locomotive crane was used to transport lumber from the assorting table to the storage yard, to place lumber on piles for stacking and also to load and unload cars and vessels equipped with a boom to swing in a complete circle. A trolley was placed on the under-side of the boom running back and forth between the cab and the end of the boom by means of cables. Other types of cranes in use after the 1920s included cranes (run by electricity) and stationary cantilever-arm cranes for conveying lumber from the assorting table to the dock. A trolley running back and forth on the crane arm enabled the machine to pick up or deposit packages of lumber on either side of the crane or to place them on the storage base. The machine took packages from the assorting table, stores them on the crane platform and then under its own power transported them to the temporary storage areas along the track, or else took the packages directly to the loading dock. In time, lumber was also taken to the storage area on trucks or on small rail cars. Lumber from the assorting table was also directly taken to the yards or to other parts of some plants on small four-wheeled cars or trucks running on light rails, either wooden or steel.

Scotia's B yard site was serviced by 2 cranes, the 50' wide "O" crane on the west side and the 100' wide "S" on the east side. Installed in about 1966, these crane structures were, and are, an integral component to the newer facility. Today the building (to the east of the security entry and south of South Tunnel #1, contains the Planer system. The J crane is in a separate 1960s building just west with the sawmill timber line, grading stations, tray sorter and stacker for the sawmill. The steel building further to the west, on the former site of B shed, was erected in the 1980s and houses the current sawmill. The F crane is at the east side of the Factory/ Manufacturing Building and the K crane is on the east side of the East Monorail Rail line at the Kilns.

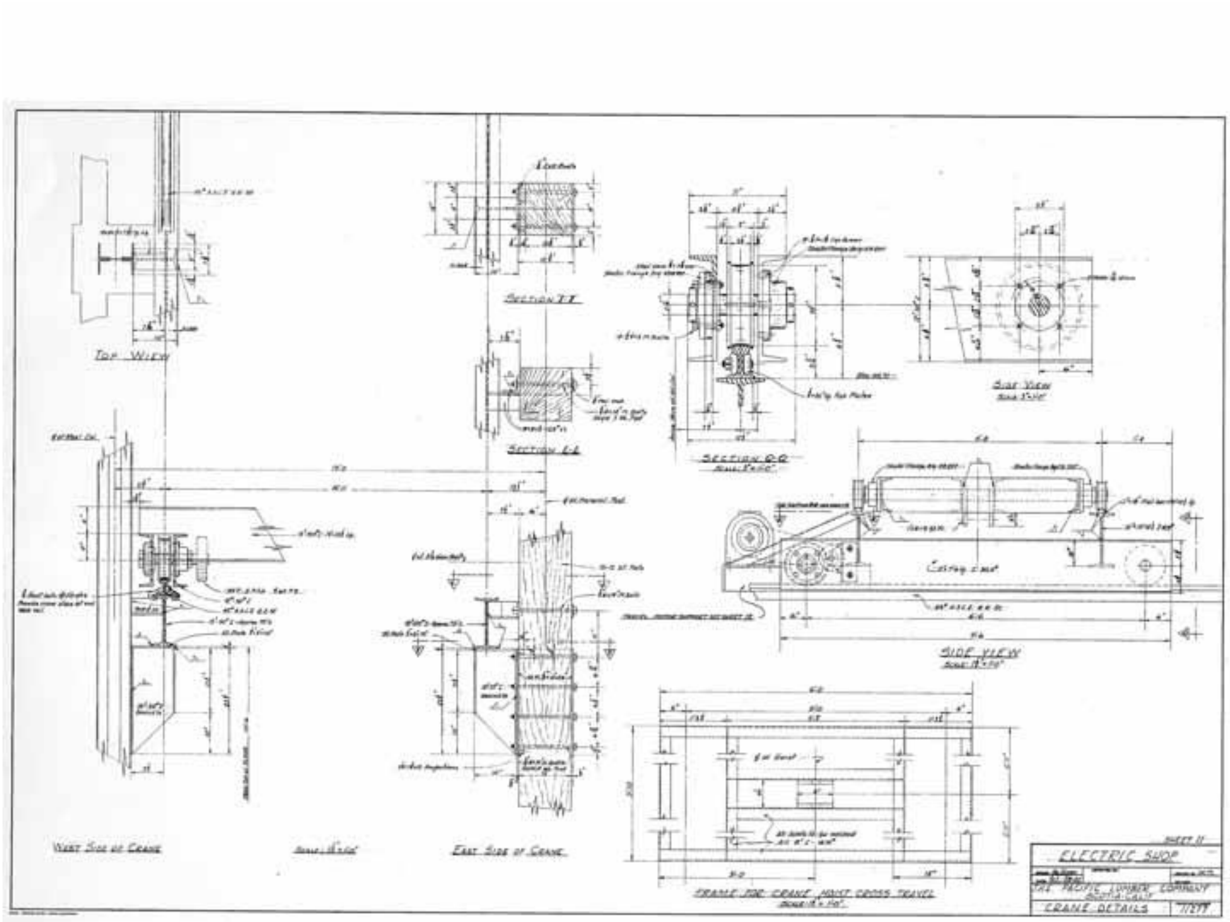


Figure 14 Scotia Crane assemble Details, PALCO, 1952.

For additional photographs, drawings and information on the Monorail system, see 7.0 Appendices.

3.0 Phasing and List of Buildings requiring Recordation

This submittal consists of **Phase 1 buildings/structures to be demolished**. Phases 2 and 3 buildings/structures subsequently will be submitted later.

Phase 1

- **Southern Monorail Tunnel #1** connecting the Manufacturing Plant and Factory Crane Shed to the new Sawmill and Planer Sheds
- **Southern Monorail Tunnel #2** connecting the Manufacturing Plant and Factory Crane Shed to the new Sawmill and Planer Sheds
- **Northern Monorail Tunnel** connecting the Manufacturing Plant to the Power Plant Maintenance Shop (this structure crosses the property line between the mill complex and the power plant complex)
- **Pipe Insulation Building**
- **Steamfitters Building**

Phase 2A

- ***West Kiln/Sorter Crane Shed*** *running along the entire west end of the North Wing Loading Shed, Dry Sorter Shed, and South Wing Loading Shed*
- ***North Wing Loading Shed*** *located on the west end of the North Wing Dry Kilns*
- ***South Wing Loading Shed*** *located on the west end of the South Wing Dry Kilns*
- ***North Wing Dry Kilns*** *(10-block construction kilns)*
- ***South Wing Dry Kilns*** *(10-block construction kilns)*
- ***North Wing Cooling Sheds*** *on the east end of North Wing Dry Kilns*
- ***South Wing Cooling Sheds*** *on the east end of South Wing Dry Kilns*
- ***East Kiln/Sorter Crane Shed*** *running along the entire east end of the North Wing Cooling Sheds, Dry Sorter Shed, and South Wing Cooling Sheds (does not include the Kiln Crane Shed)*
- ***Dry Sorter Shed*** *running the entire distance between the East Kiln/Sorter Crane Shed and West Kiln/Sorter Crane Shed and positioned between the North Wing Dry Kilns and South Wing Dry Kilns*
- ***Conveyors & Towers***

Phase 2B:

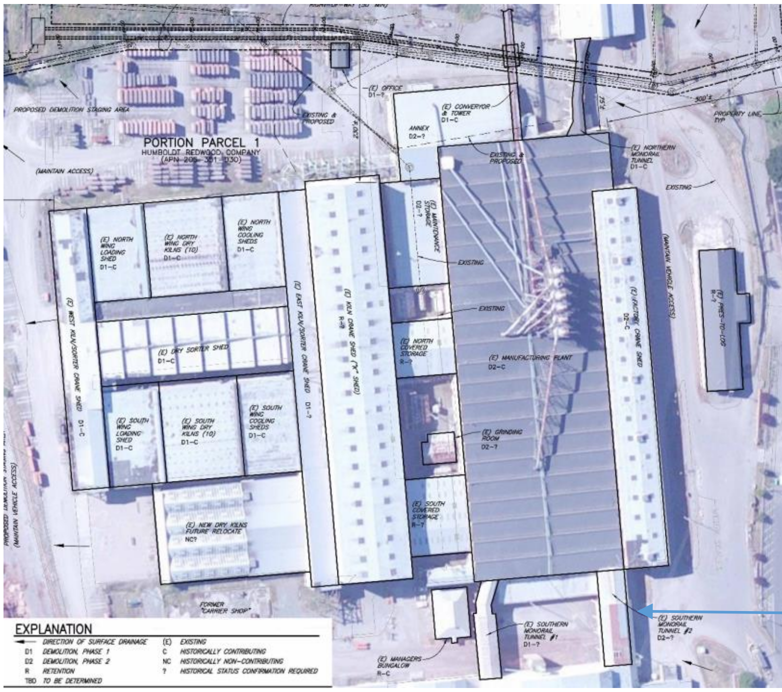
- ***Millwright Building***
- ***Machine Shop***
- ***Conveyors and Towers***
- ***Water Treatment Plant***

- ***Boiler Building***
- ***Fuel Storage Building***
- ***Powerhouse***
- ***Manufacturing Plant***
- ***Factory Crane Shed****, located along the east side of the Manufacturing Plant*
- ***Grinding Room,*** *located between Kiln Crane Shed and Manufacturing Plant*
- ***Ancillary buildings*** *(smaller buildings between the Kiln Crane Shed K and the Manufacturing Plant as well as those south of the Dry Sorter area)*

4.0 Recordation and Documentation: Phase 1 buildings and structures

- Southern Monorail Tunnel #1
- Southern Monorail Tunnel #2
- Northern Monorail Tunnel
- Steamfitters' Building
- Pipe Insulation Building

Figure 15
SOUTHERN MONORAIL TUNNEL #1



Southern Monorail Tunnel #1
Owner:

Humboldt Redwood Company LLC
169 Main Street
Scotia, California 95565
Construction date:
c. 1950s-1960

N

Background and Description. The purpose of Southern Monorail Tunnels #1 and #2 and Northern Monorail Tunnel is to provide protection for the elevated monorail system on fixed tracks from the weather while ensuring trucks and equipment to operate below. The term, originating from joining "mono" (one) and "rail" (rail), was first used in 1897, credited to German engineer Eugen Langen. The single-line monorail system at Scotia was adapted to log storage and assorting purposes. The logging railroad track crosses the main line and spurs of the monorail system, and the logs are taken from the cars in bundles containing about 800 feet, log scale, which are either delivered at the terminus of an endless chain leading to the jack ladder or placed in piles between the monorail trestle legs.

The surplus logs were decked in piles to a maximum height of 24 feet, the storage capacity at a plant being limited only by the length of main line and spurs provided. When logs were taken from the cars directly to the endless chain, the capacity of one monorail hoist was about 65,000 feet, log scale; when logs are assorted and a portion of them decked and the remainder taken to the mill, the daily capacity of one hoist may be reduced to 40,000 feet, log scale. Most of the tracks at the South Monorail Tunnel #1 were removed from the structure.

A winch mechanism onto the mono-rail was suspended on the timber truss with lifting arms to grab and transport a unit of lumber to move carriages. Truss supports ran for hundreds of feet, entering the inner confines of the mills and the storage areas outside. Over railroad tracks were also used with loaded and unloaded flat cars.

The lumber moving system carriages were made up of a dolly on a steel beam with two pairs of rollers on each end that grabbed the monorail. Attached to the dolly was a hoist motor which raised and lowered a set of four grab arms secured to the lumber unit. An array of motors and controls were operated on dual voltage direct current of120 and 220 volts. An operator, who controlled the whole mechanism, sat in a tiny booth (about 3-1/2 feet square) suspended from one end of the dolly. The booth had two controls: move left and right, raise and lower the winch. The capacity of these overhead lumber-moving carriages was 5000 pounds.

PALCO electric trolley served the mill well for several decades—long after the heyday of steam—and long after gas and diesel forklifts and loaders showed up. The last certification date for the trolleys is July 24, 2001. Reference: Timber Heritage Association in Humboldt County.

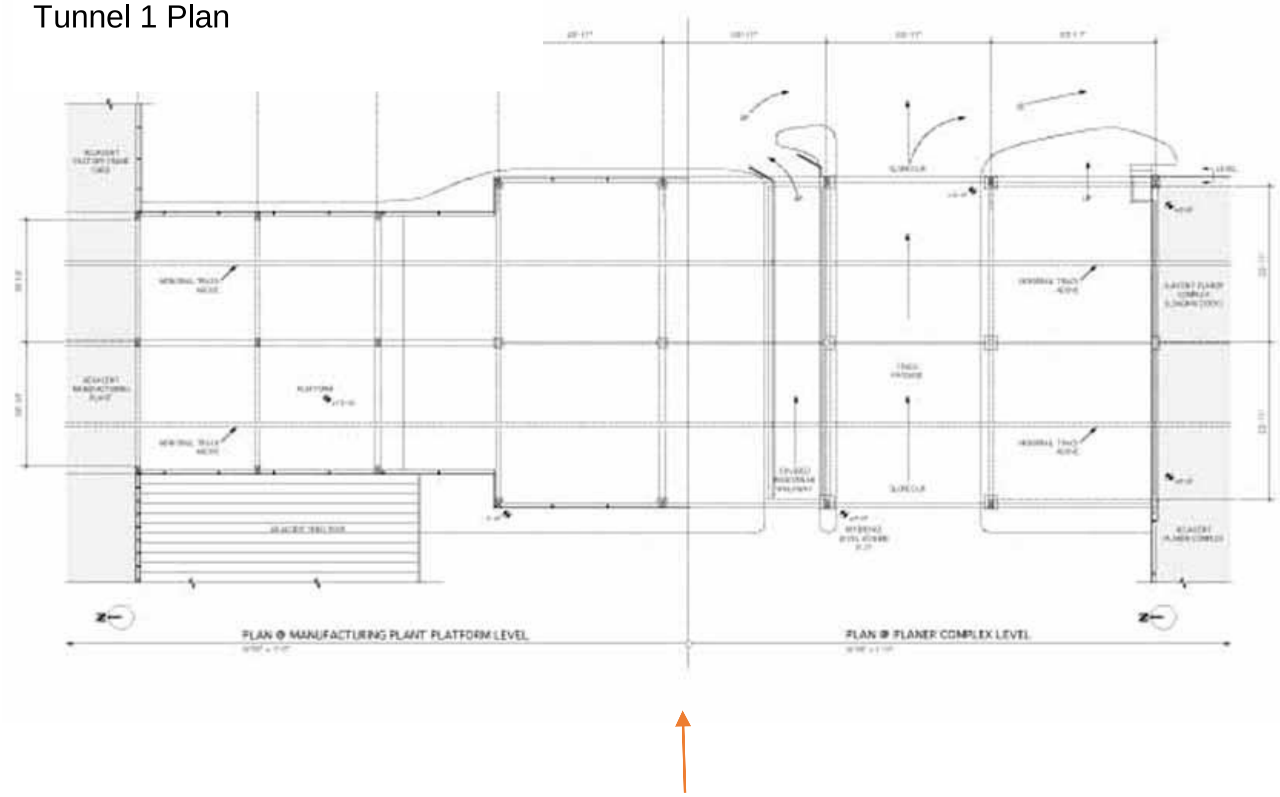
The frame of the structure consists of timber columns on reinforced concrete piers and, on some columns, steel beams are placed on the columns for reinforcement. Massive 12″ by 12″ timbers supporting the truss have 6″ by 12″ planks on each side.

The overhead portion of the truss also contains 10″ by 12″ diagonal braces held together with hundreds of ¾” bolts, and 1″ upset rods.

The columns form a 20 foot longitudinal grid layout perpendicular to a primary roadway frequented by logging trucks and other operational equipment. The above covered section of the Monorail Tunnel consists of lateral wood beams and wood sheathing. The gamble roof system is supported by a simple truss with braces and rafters. Metal corrugated panels are attached to the roof rafters.

1.A

Figure 16 Southern Monorail Tunnel 1 Plan



1.B

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Figure 17 1.A east view of the structure.

Figure 18 1.B west view of structure.

Figure 19 1.C north view of Monorail Tunnel metal roof

Figures 20, 21 1.D, 1.E west view of the Southern Monorail Tunnel #1.

Figure 22 1F north view open ceiling and exposed truss, beams and rafters

Figure 23 1.G underside of structure with exposed ceiling, wood/metal frame, and columns

Figure 24 1.H detailed of exposed metal corrugated panel secured to wood/ metal frame.

Figure 25 1.I typical 12 x 12 timber columns secured to reinforced concrete piers.

Figure 26 1.J structure interface and connection with the Manufacturing building.

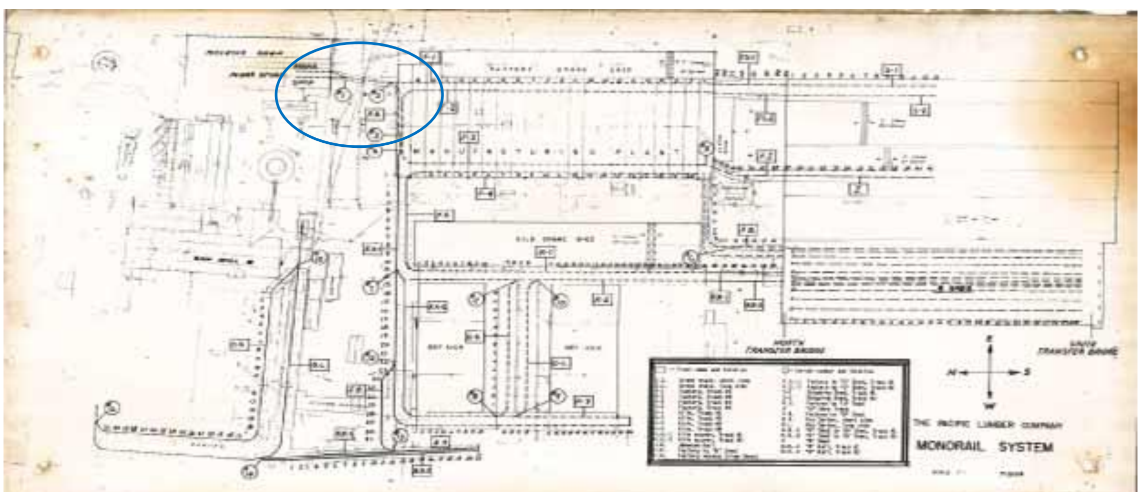
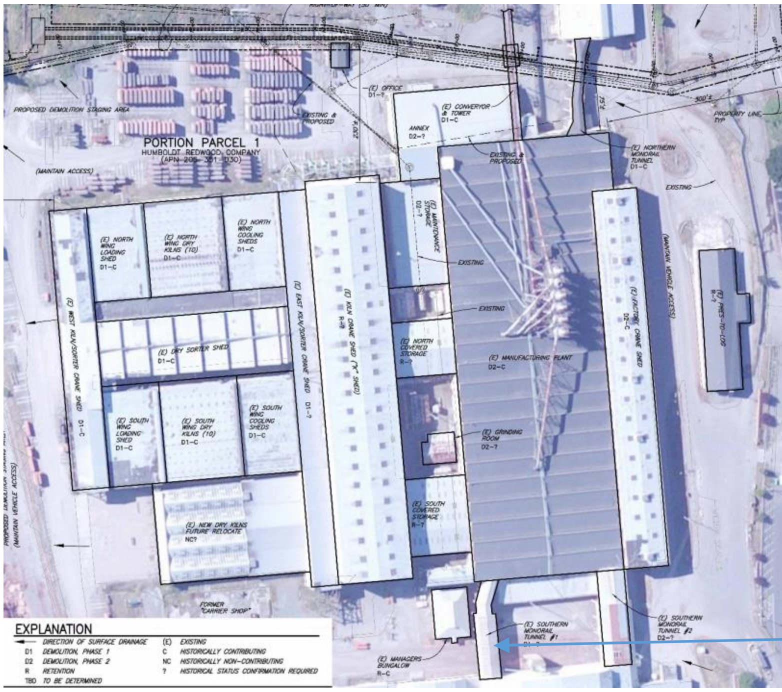


Figure 27 1.K Southern Monorail Tunnel #1 and Monorail System at Scotia, 1984.

Resources. *the primary source for additional drawings, reports and documents for these buildings are located in the Town of Scotia archives.*

Figure 28 Southern Monorail Tunnel #2



Southern Monorail Tunnel #2
Owner:

Humboldt Redwood Company LLC
169 Main Street
Scotia, California 95565
Construction

date: c. 1950s-

N

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A winch mechanism onto the mono-rail was suspended on the timber truss with lifting arms to grab and transport a unit of lumber to move carriages. Truss supports ran for hundreds of feet, entering the inner confines of the mills and the storage areas outside. Over railroad tracks were also used with loaded and unloaded flat cars.

The lumber moving system carriages were made up of a dolly on a steel beam with two pairs of rollers on each end that grabbed the monorail. Attached to the dolly was a hoist motor which raised and lowered a set of four grab arms secured to the lumber unit. An array of motors and controls were operated on dual voltage direct current of120 and 220 volts. An operator, who controlled the whole mechanism, sat in a tiny booth (about 3-1/2 feet square) suspended from one end of the dolly. The booth had two controls: move left and right, raise and lower the winch. The capacity of these overhead lumber-moving carriages was 5000 pounds.

PALCO electric trolley served the mill well for several decades—long after the heyday of steam—and long after gas and diesel forklifts and loaders showed up. The last certification date for the trolleys is July 24, 2001. Reference: Timber Heritage Association in Humboldt County.

The frame of the structure consists of timber columns on reinforced concrete piers and, on some columns, steel beams are placed on the columns for reinforcement. Massive 12″ by 12″ timbers supporting the truss have 6″ by 12″ planks on each side. The overhead portion of the truss also contains 10″ by 12″ diagonal braces held together with hundreds of ¾” bolts, and 1″ upset rods.

The columns form a 20 foot longitudinal grid layout perpendicular to a primary roadway frequented by logging trucks and other operational equipment. The above covered section of the Monorail Tunnel consists of lateral wood beams and wood sheathing. The gamble roof system is supported by a simple truss with braces and rafters. Metal corrugated panels are attached to the roof rafters.

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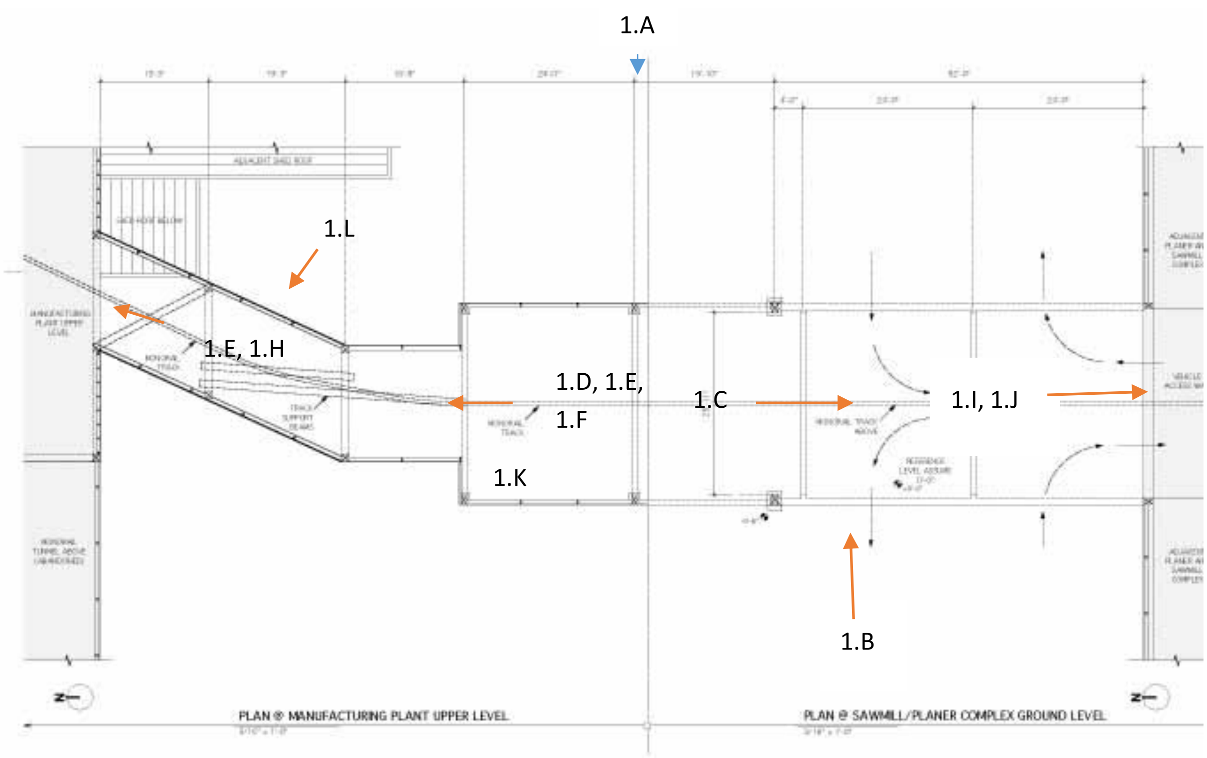


Figure 29 Southern Monorail Tunnel #2 plan

Figure 30 2.A east view of the structure

Figure 31 2.B west view of structure.

Figure 32 2.C north view of Southern Monorail Tunnel metal roof

Figure 33 2.D underside of tunnel with defunct monorail mechanism and track.

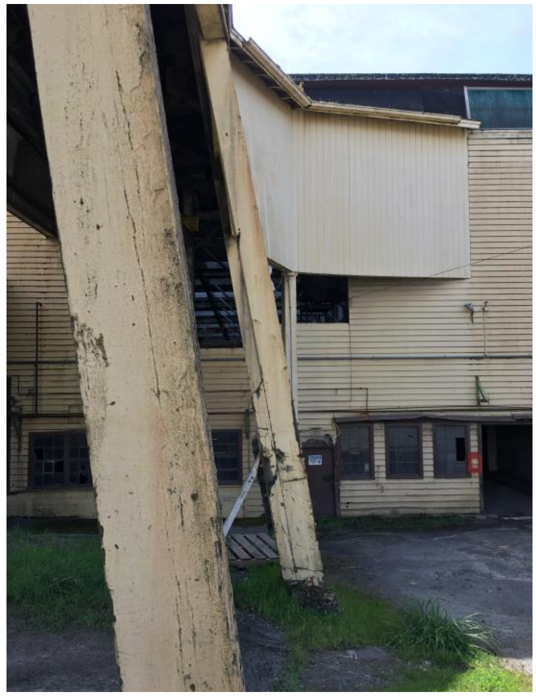
Figures 34, 35 2.E, 2.F underside of Southern Monorail Tunnel #2, tracks traverse at an angle into/from Manufacturing Building.

Figure 36 2.G interface of Tunnel #2 with the Manufacturing Building and underside of monorail cab support.

Figure 37 2.H tunnel wood frame support and curved junction of monorail track.

Figures 38, 39 2.I, 2.J view of south portal interface with the Sawmill building.

Timber column, foundation, metal straps, bolts.



Figures 40, 41. 2.K, 2.L timber structural columns and reinforced concrete pier supports.

Figure 42 2.M exterior curved wall, open eaves, vertical wood sheathing, structural timber column, exterior lighting fixture.

Resources. *the primary source for additional drawings, reports and documents for these buildings are located in the Town of Scotia*

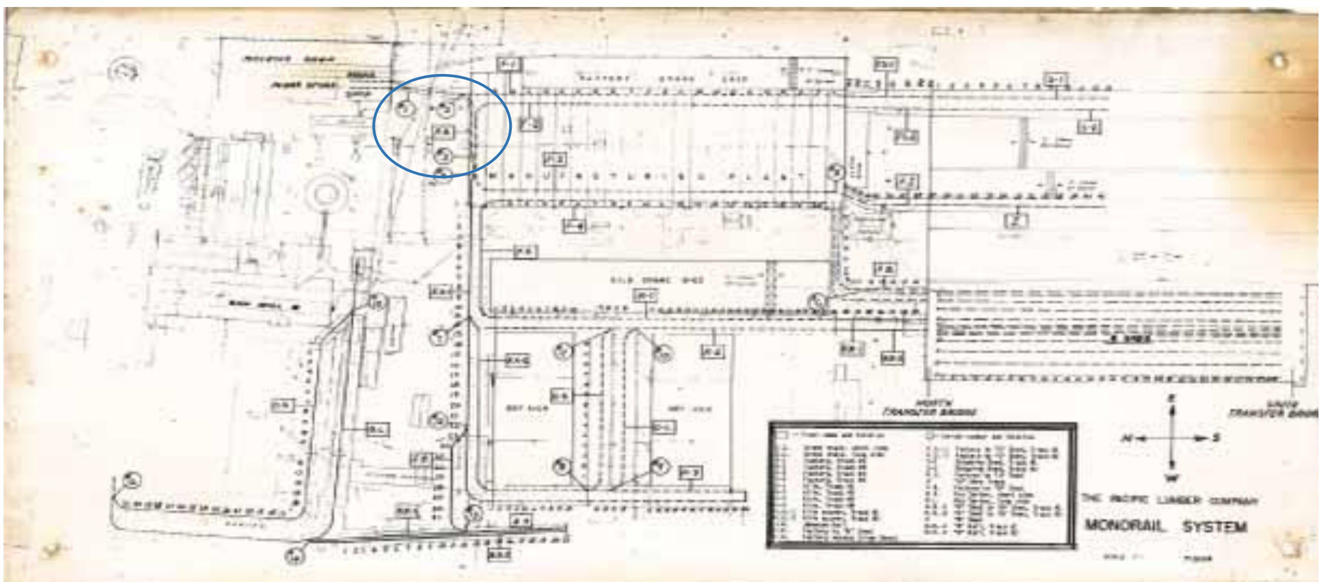
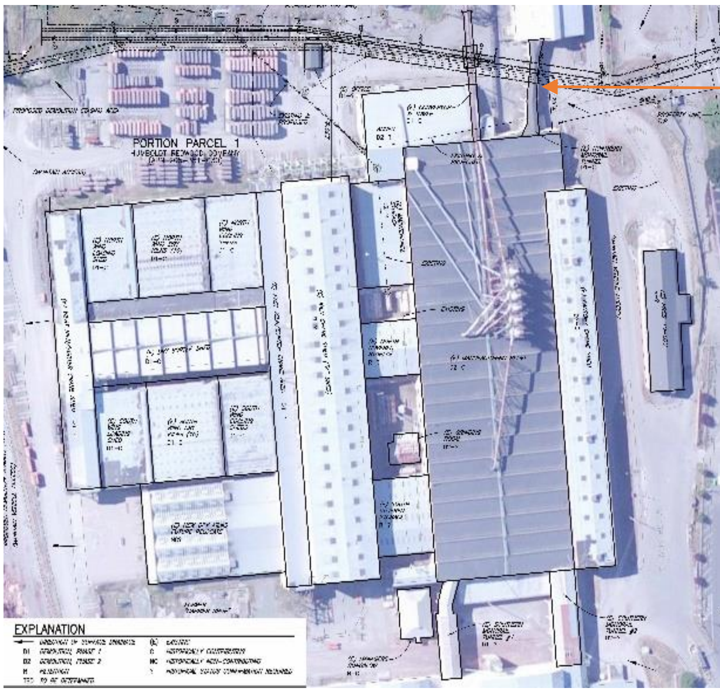


Figure 43 2.N Southern Monorail Tunnel #1 and Monorail System at Scotia, 1984.

NORTHERN MONORAIL TUNNEL
Figure 44



Northern Monorail Tunnel

Owner:

Humboldt Redwood Company LLC
169 Main Street
Scotia, California 95565
Construction date: c. 1950s-1960

Background and Description. The purpose of Southern Monorail Tunnels #1 and #2 and Northern Monorail Tunnel is to provide protection to the elevated monorail system on fixed tracks from the weather while ensuring trucks and equipment to operate below. The term, originating from joining "mono" (one) and "rail" (rail), was first used in 1897, credited to German engineer Eugen Langen. The single-line monorail system at Scotia was adapted to log storage and assorting purposes. The logging railroad track crosses the main line and spurs of the monorail system, and the logs are taken from the cars in bundles containing about 800 feet, log scale, which are either delivered at the terminus of an endless chain leading to the jack ladder or placed in piles between the monorail trestle legs. The surplus logs were decked in piles to a maximum height of 24 feet, the storage capacity at a plant being limited only by the length of main line and spurs provided. When logs were taken from the cars directly to the endless chain, the capacity of one monorail hoist was about 65,000 feet, log scale; when logs are assorted and a portion of them decked and the remainder taken to the mill, the daily capacity of one hoist may be reduced to 40,000 feet, log scale. Most of the tracks at the South Monorail Tunnel #1 were removed from the structure.

A winch mechanism onto the mono-rail was suspended on the timber truss with lifting arms to grab and transport a unit of lumber to move carriages. Truss supports ran for hundreds of feet, entering the inner confines of the mills and the storage areas outside. Over railroad tracks were also used with loaded and unloaded flat cars.

The lumber moving system carriages were made up of a dolly on a steel beam with two pairs of rollers on each end that grabbed the monorail. Attached to the dolly was a hoist motor which raised and lowered a set of four grab arms secured to the lumber unit. An array of motors and controls were operated on dual voltage direct current of120 and 220 volts. An operator, who controlled the whole mechanism, sat in a tiny booth (about 3-1/2 feet square) suspended from one end of the dolly. The booth had two controls: move left and right, raise and lower the winch. The capacity of these overhead lumber-moving carriages was 5000 pounds.

The frame of the structure consists of timber columns on reinforced concrete piers and, on some columns, steel beams are placed on the columns for reinforcement. Massive 12″ by 12″ timbers supporting the truss have 6″ by 12″ planks on each side. The overhead portion of the truss also contains 10″ by 12″ diagonal braces held together with hundreds of ¾" bolts, and 1″ upset rods.

The columns form a 20 foot longitudinal grid layout perpendicular to a primary roadway frequented by logging trucks and other operational equipment. The above covered section of the Monorail Tunnel consists of lateral wood beams and wood sheathing. The gamble roof system is supported by a simple truss with braces and rafters. Metal corrugated panels are attached to the roof rafters.

PALCO electric trolley served the mill well for several decades—long after the heyday of steam—and long after gas and diesel forklifts and loaders showed up. The last certification date for the trolleys is July 24, 2001. Reference: Timber Heritage Association in Humboldt County.

As with South Tunnels #1 and 2, the frame of the structure consists of timber columns on reinforced concrete piers and, on some columns, steel beams are placed on the columns for reinforcement. Massive 12″ by 12″ timbers supporting the truss have 6″ by 12″ planks on each side. The overhead portion of the truss also contains 10″ by 12″ diagonal braces held together with hundreds of ¾" bolts, and 1″ upset rods.

The columns form a 20 foot longitudinal grid layout perpendicular to a primary roadway used by logging trucks and other operational equipment. The above covered section of the Monorail Tunnel consists of lateral wood beams and wood sheathing. The gamble roof system is supported by a simple truss with braces and rafters. Metal corrugated panels are attached to the roof rafters.

Monorails were served at the Machine, Electrical, Monorail shop and Plant Store building to the north of the tunnel.

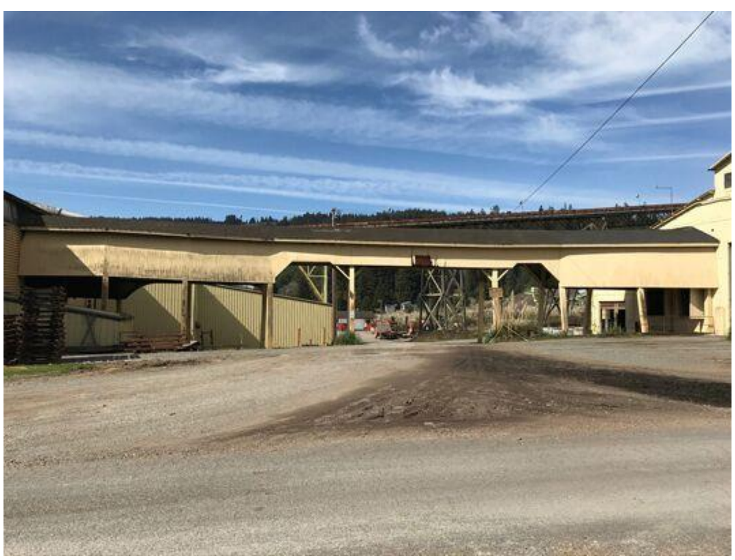


Figure 45 3.A Northern Monorail Tunnel view from the east.

Figures 46, 47 3.B, 3C Northern Monorail Tunnel view from the west.

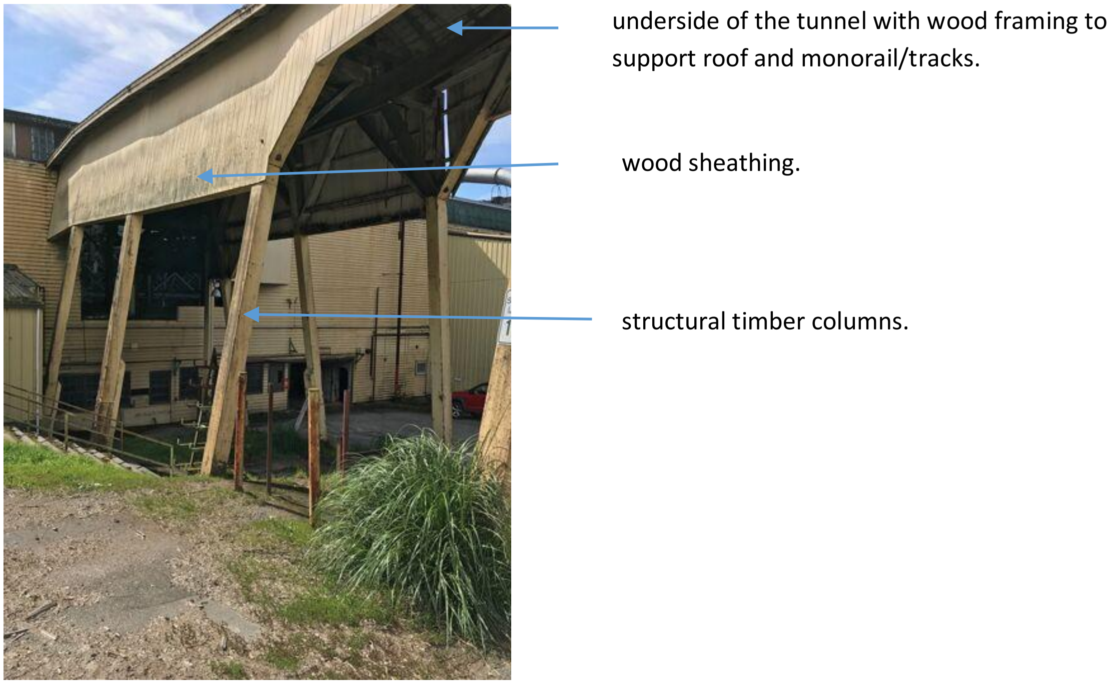
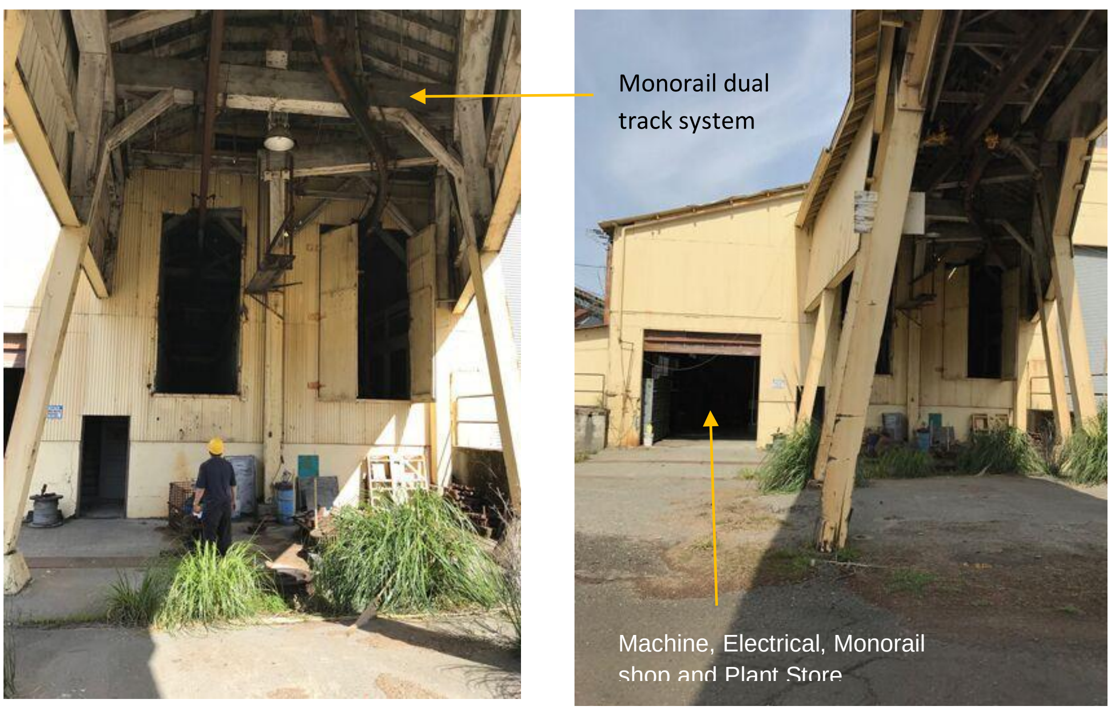


Figure 48 3.C wood siding, structure timber angled columns on north side of the tunnel.



Figures 49, 50 3.D, 3E tunnel interface with the Machine, Electrical, Monorail shop and Plant Store building.

Figures 51, 52 3.E tunnel interface with the Manufacturing Building to the south

Figure 53, 54 3.F support columns and underside of the building sheltering the monorail.

Figure 55 3.G monorail tracks and column bracket supports.

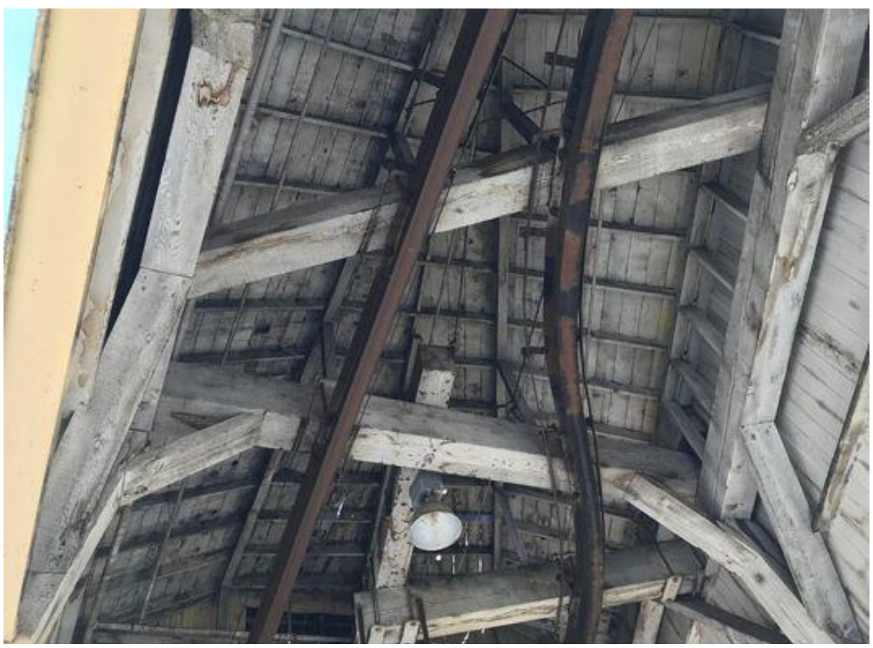


Figure 56 3.H monorail tracks, structural frame of covered area, beams, rafters, electrical light fixture.

Figure 57 3.I vertical board siding, timber structural supports, open eaves, roof system.

Resources: *the primary source for additional drawings, reports and documents for these buildings are located in the Town of Scotia archives.*

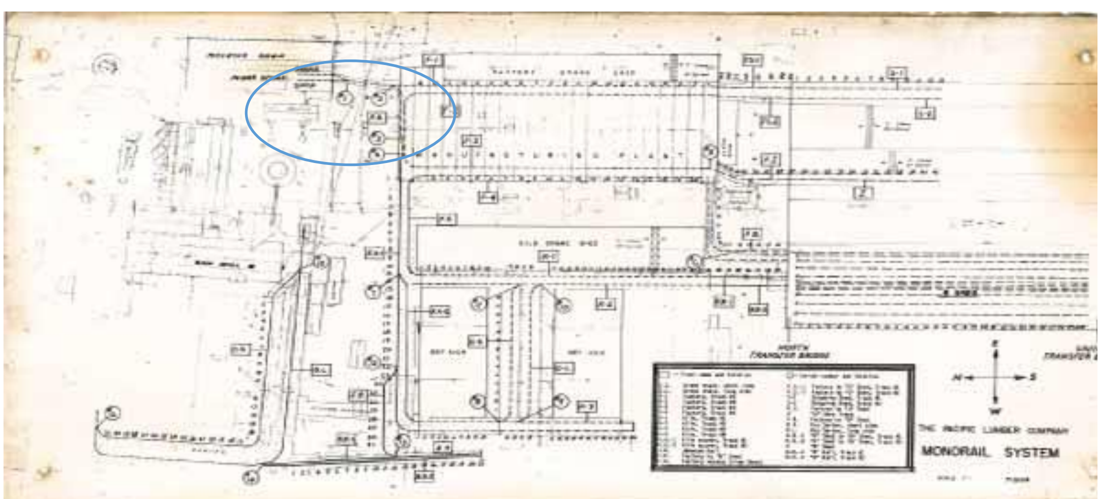
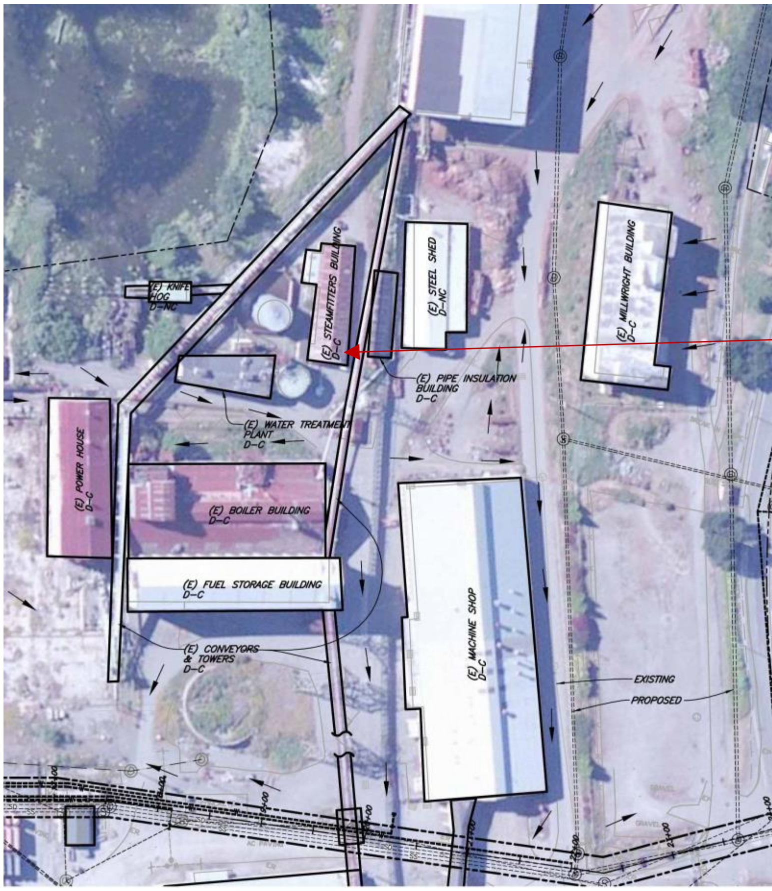


Figure 58 3.J Northern Monorail Tunnel and Monorail System at Scotia, 1984.

Figure 59 Steamfitters Building



STEAMFITTERS' BUILDING

Owner:

Humboldt Redwood Company LLC
169 Main Street
Scotia, California 95565
Construction date: c.1930s

N

Description: The primary purpose of the Steamfitters' building was for the storage of records and to monitor water quality for the water treatment plant of the steam generated energy system. In the 1980s the building became the computer lab for the technological transition of the mill operations to a computerized system. Similar to the Pipe Insulation building, the Steamfitters' Building is a simple one story, side gable, wood stud framed building. The building was built of available, inexpensive and reliable structural milled wood. Unlike the Pipe Insulation Building, the original rectangular form was been altered with new non-contributing additions.

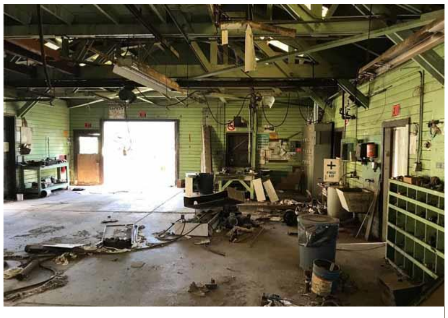


Figure 60 4.1 interior.

Figure 61 exterior.

Figure 62 double hung windows.

Foundation: The foundation is made of reinforced *poured in place* concrete similar to the Millwright Building.

Walls: Similar to both the Millwright and Pipe Insulation buildings simple wood stud walls carry vertical loads to the foundation. Wood wall sheathing is applied directly on the studs to help resist lateral forces. Horizontal wood siding is used the exterior walls, however the new addition located on the south wall has vertical wood siding.

Roof: The Steamfitters Building has a gable side facing wood roof with exposed ridge beams and open eaves. The roof is also supported by modified fan trusses and exposed rafters located along the building's grid system. Typically these trusses include diagonal members to carry the direct load from the purlin. The distance between the panel points and the purlins is approximately 8 feet. Metal and translucent corrugated roofing panels are used for roofing coverings. There are four metal ventilation vents above the roof.

Fenestrations: Wood framed double hung windows are located on three sides of the building. Windows on the addition along the south wall appear to be prefabricated sliding glass windows. Wood window surrounds are simple and consistent in size and dimensions.

Figures 63, 64 doors and surrounds

There are two basic types of wood doors on the contributing building. The first type is a fire rated door with top, locks and bottom rails, stiles and muntins. A few doors also have glass cut-out light openings on the upper section of the door. The second type is a simple, horizontal side door and panels on rollers and tracks. All doors are framed and hinged with wood surrounds attached to the lateral wall surfaces. Many existing doors are not fire rated.

Figure 65 interior open ceiling.

Interior: The interior space consists of an open room without drop ceiling or wall to wall partitions. The truss supporting the roof above is exposed. Fluorescent and incandescent lighting suspended from the ceiling.

electrical conduits, fed by an electrical distribution panel inside the building, provided power to various pumps and equipment involved in the steam condensate recovery process.

non-contributing "lean-to" addition.

Figure 66 exterior electrical distribution panel.

Other. Signage identification is located on the side facing elevation and entry of the building. Electrical conduits enter the building from the south side. There are also three non-contributing "lean-to" additions and extensions to the main building. These were built as an office and for storage accessed from the exterior of the Steamfitters' building.

Building identification signage

Figure 67 Exterior signage.

References: *the primary source for additional drawings, reports and documents for these buildings are located in the Town of Scotia archives.*

source: Steamfitter shop and chemical storage building, PALCO, drawing # 11574, April, 17, 1957, Town of Scotia archives.

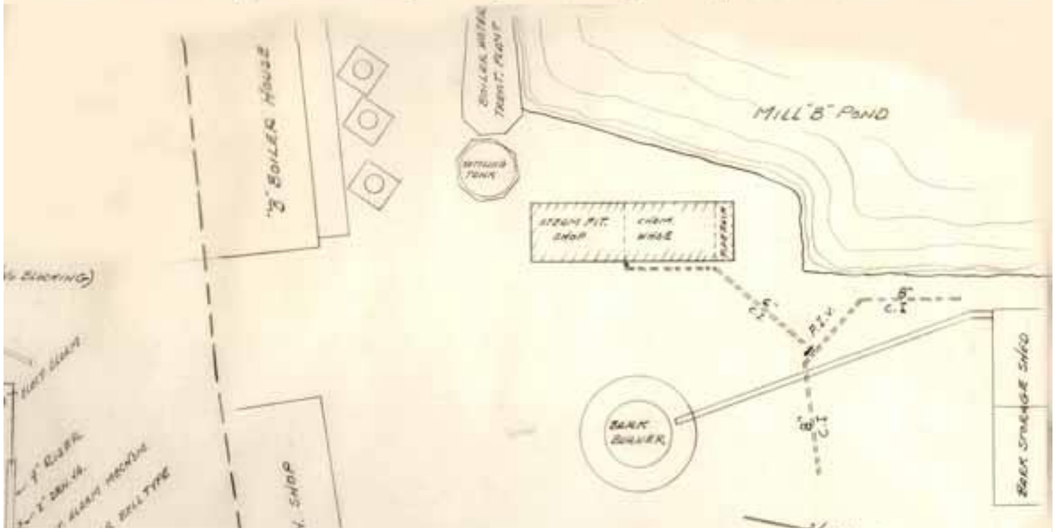


Figure 68 location of Steamfitter shop and chemical storage, PALCO, 1957.

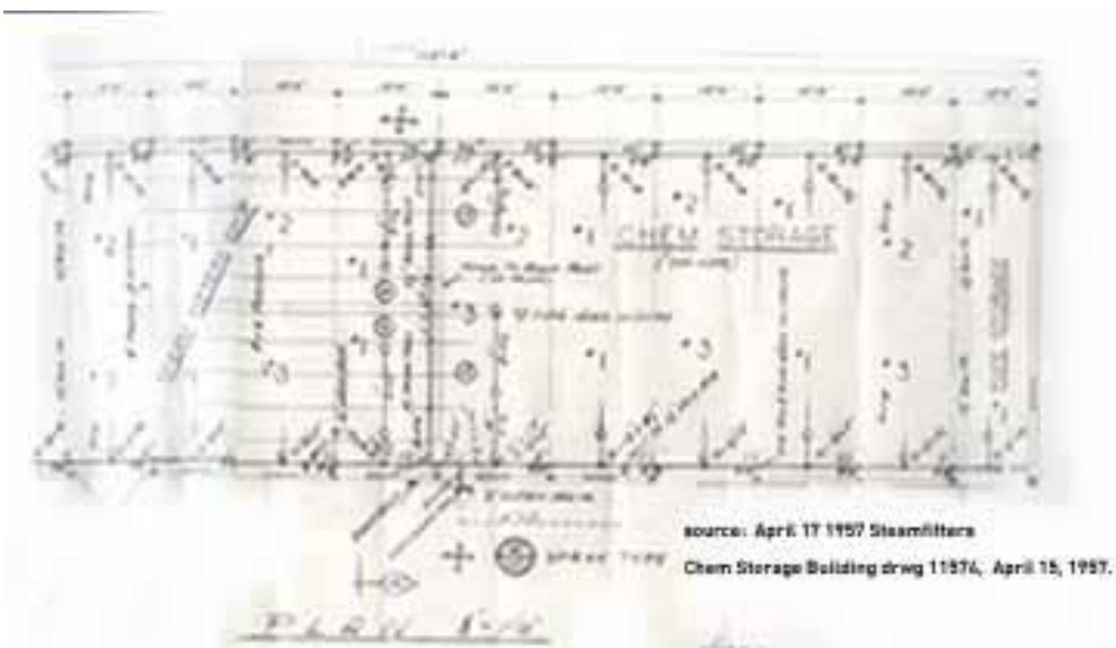


Figure 69 Plans, PALCO 1957.

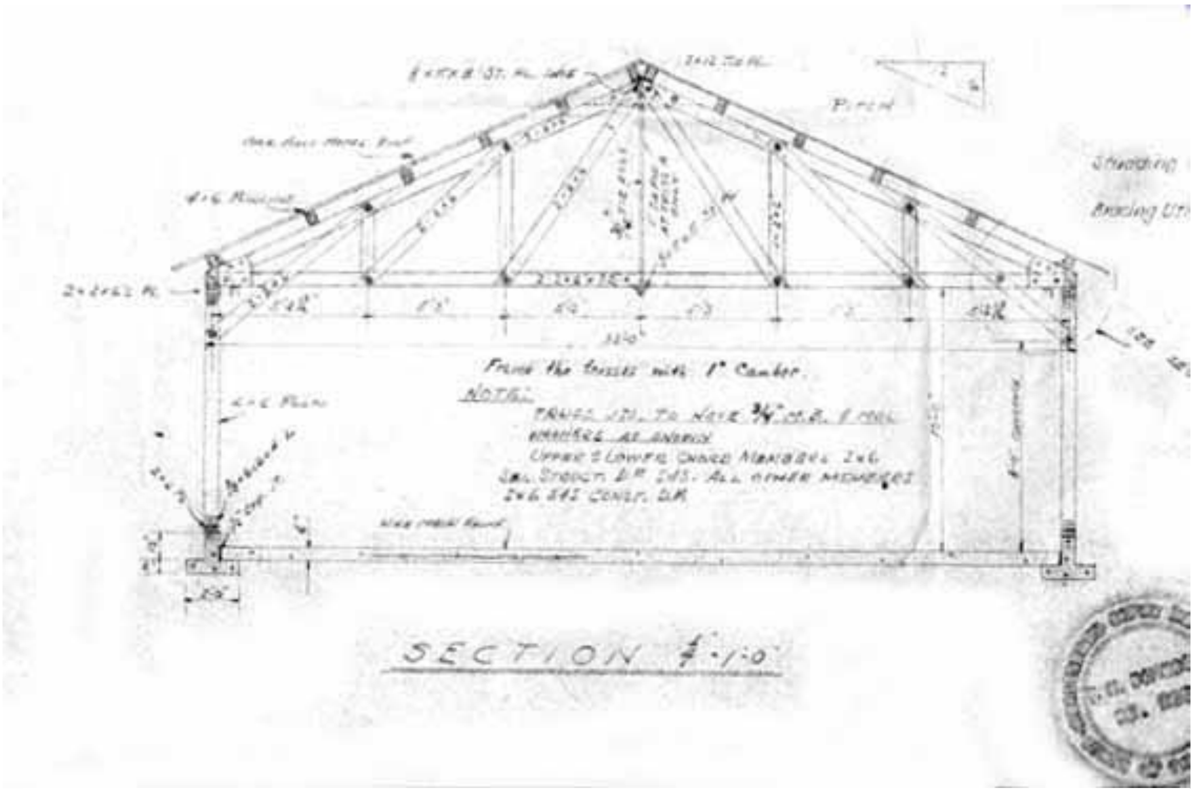


Figure 70 Chemical Storage and Steamfitters Building, Structural Detail, Sheet 1, #11574, PALCO, Scotia, California, March 3, 1957 (Town of Scotia).

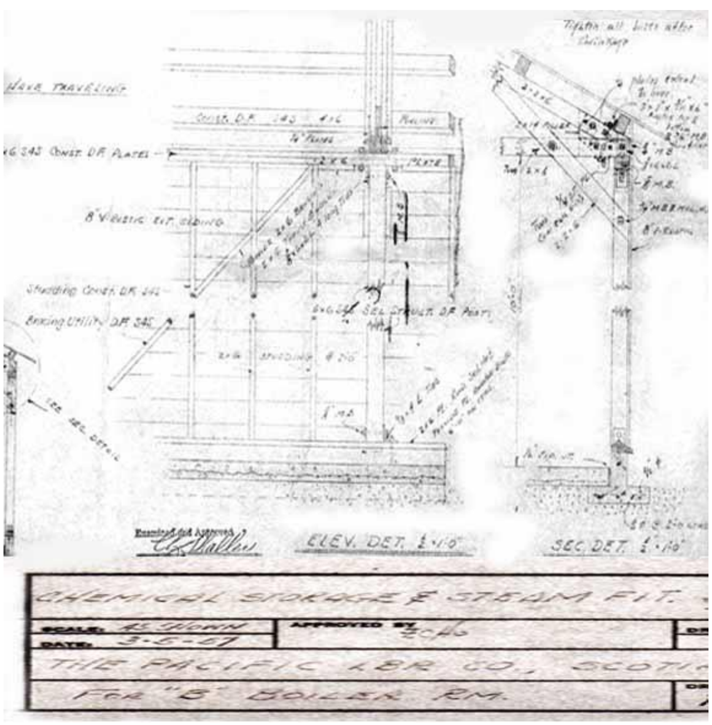


Figure 71 Chemical Storage and Steamfitters Building, Structural Detail, Sheet 1, #11574, PALCO, Scotia, California, March 3, 1957 (Town of Scotia).

Figure 72

Steamfillters Building West and South ELEVATIONS

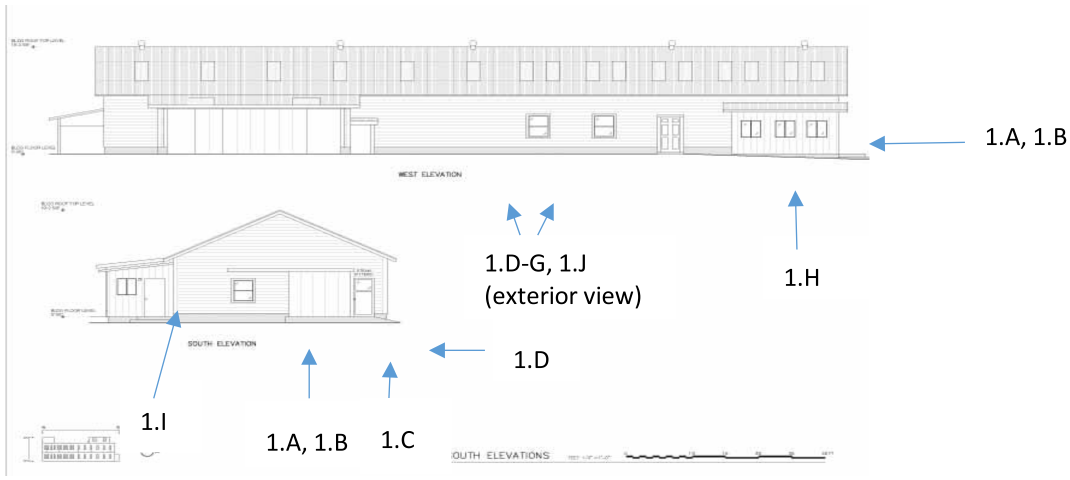


Figure 73 (1.A, 1.B) north view.

Figure 74, 75 (1.D) north, west view.

Open roof eaves
Wood exterior sheathing

Column at base of Monorail system (above)
Wood sliding double door
Apex of the side-facing gable building and roof
Double hung wood framed window
Front facing building entry (east)

1.C view to the north, building relationship to the steel monorail column.

Figure 76 steel monorail column, and east elevation sliding door.

Figure 77 wood horizontal siding (typical) on exterior wall.

Figure 78 1.D west exterior wall, wood horizontal siding, double-hung windows and frames, standard door to interior. Metal corrugated roofing.

Figure 79 1.E non-contributing addition with metal corrugated roofing on original building.

Figure 80 non-contributing addition (left) adjacent to original building with interfacing utility connections.

Figure 81 1.F west facing exterior wall with non-contributing addition.

Figure 82 north facing side gable double sliding wood door with tracks cover, horizontal wood sheathing, open eaves.

Figure 83 'Steamfitters' exterior sign on north side-facing wall above side single door with glassed opening and removed wood surround. Double rolling door to the left of entry.

Figure 84

Steamfitters Building North East ELEVATIONS

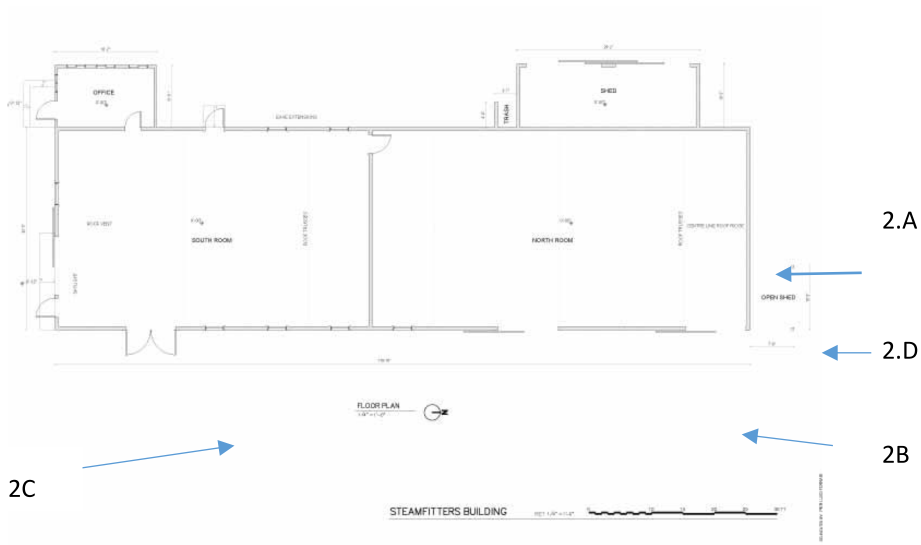


Figure 85 2.5 north facing exterior view.

Figure 86 2.B east facing exterior wall from southeast, sliding wood door, double hung windows, horizontal wood sidings, metal corrugated roofing.

Figure 87 2.C east facing exterior wall from the north with monorail column.

Figures 88, 89 2.D north facing elevation non-contributing additions.

Figure 90
Steamfitters Building Interior 1

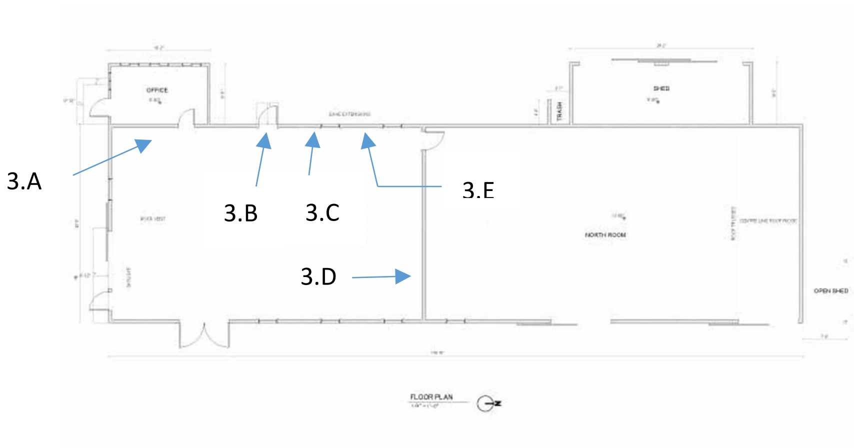


Figure 91 3.A horizontal interior siding, truss and support brackets, pulley system, sink and various movable items.

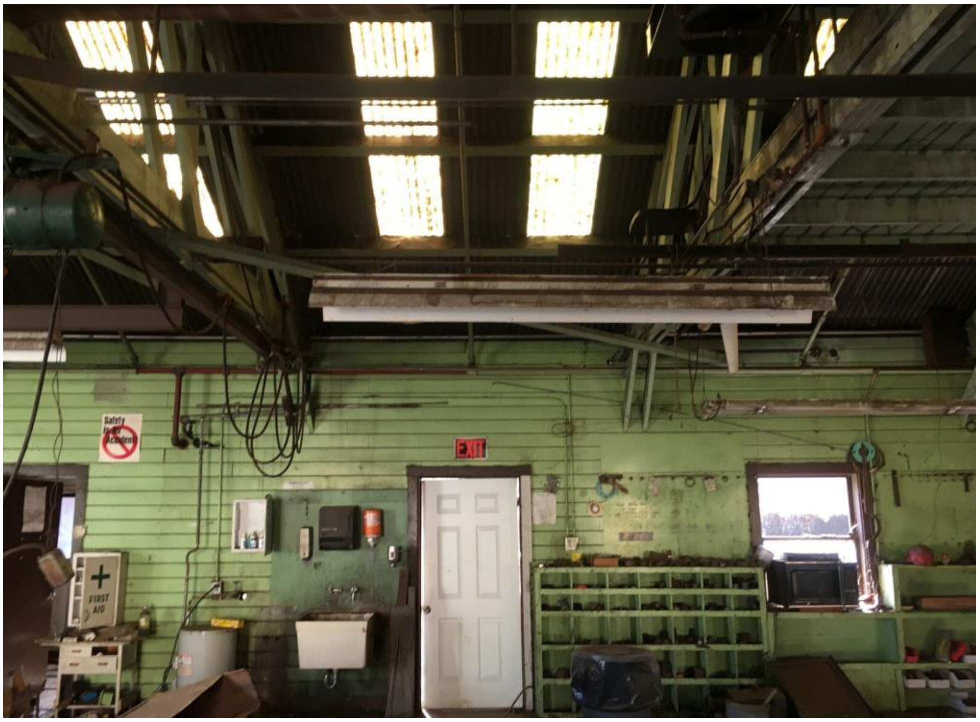


Figure 92 3.B typical wood door with frame and surround, sink, and wood cabinets and shelves, electrical light fixture, open ceiling, truss system and translucent panels above.

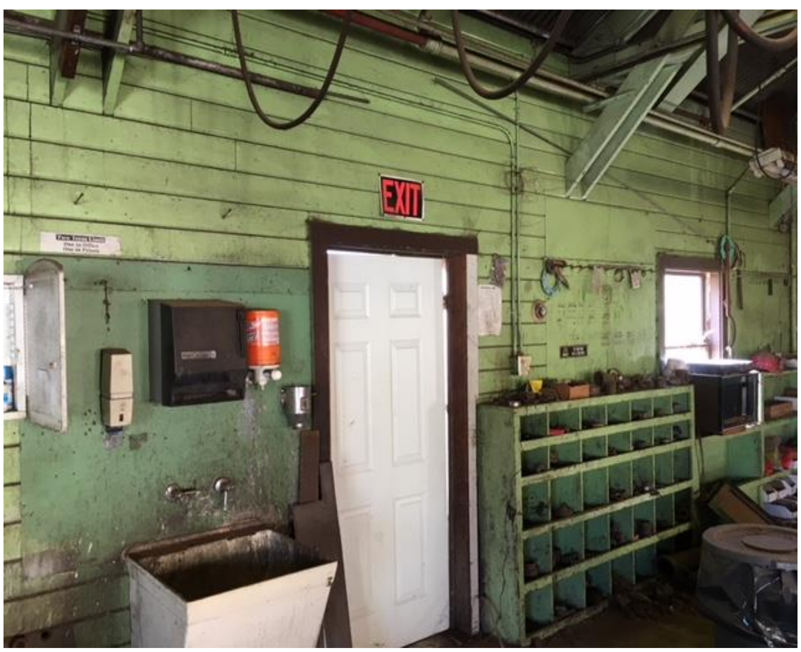


Figure 93 3.C typical wood door with frame and surround, sink, and wood cabinets and shelves.

Figure 94 3.4 pair of double-hung wood windows with wood surround and frame, horizontal interior wood siding, electrical outlets.

Figure 95, 96 3.E typical double hung wood window with wood surround and frame.

Figure 97
Steamfitters Building Interior 2

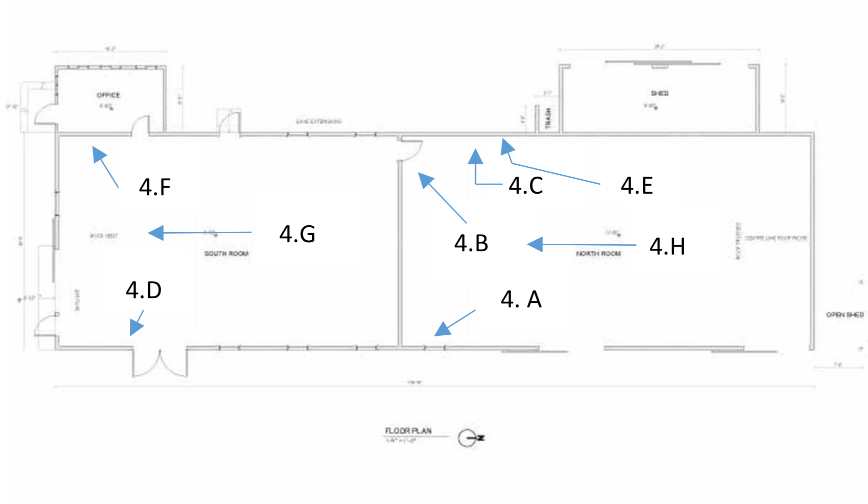


Figure 98 4.A double hung wood window, frame and surround, horizontal interior siding, and floor to roof partition wall.

Figure 99 4.E interior partition wall runnning west to east, horizontal wood siding, interior door.

Figure 100 4.C partition wall, door, double hung wood windor with frame and surround, lighting, open ceiling with translusent panels.

Figure 101 4.D south – east interior corner of building with wood sliding doors, single door, horizontal wood siding, and truss brackets and horizontal chord.

Figure 102 4.E double hung wood windows, frame and surround, horizontal wood siding, at the west wall.

Figure 103 4.F pulley hoist and metal lockers.

Figure 104 4.G south view from the interior space.

Figure 105 4.H view of truss members, open ceiling, and underside of metal corrugated panels on roof.

Figure 106
Steamfitters Building Interior 3

Figure 107 5.A addition, non-contributing.

Figure 108 5.A addition, non-contributing**.**

Figure 109 Steamfitters Building Trust systems

Figure 109 modified fan truss system and open ceiling.

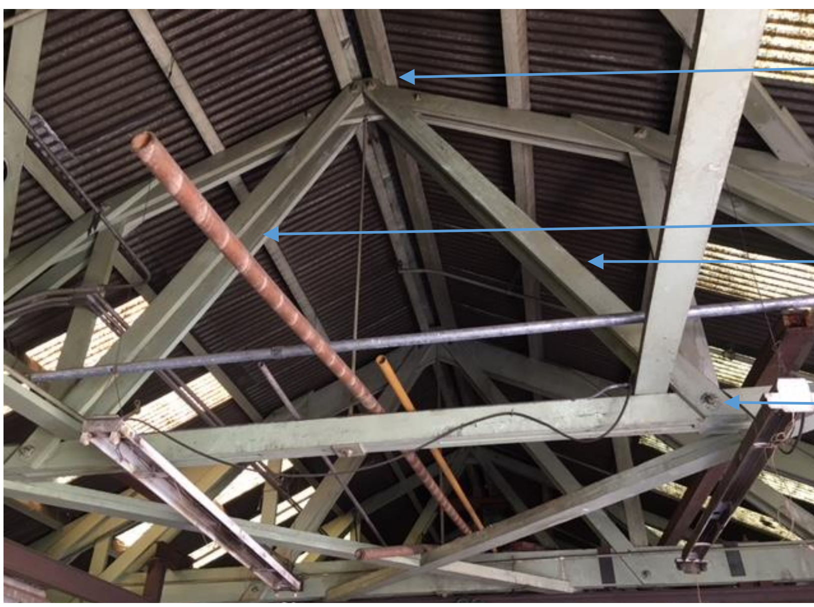


Figure 110 modified fan truss system and open ceiling.

Figure 112 modified fan truss system and open ceiling.

Figure 113 modified fan truss system and open ceiling.

Figure 114 curtain and metal rail

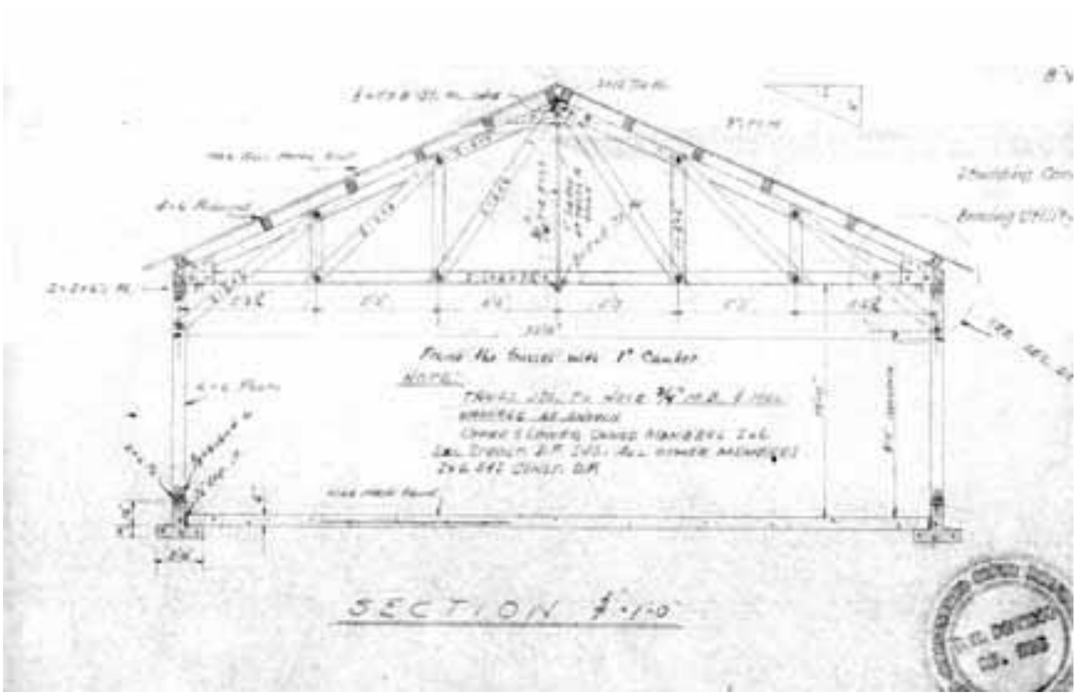


Figure 115 structural detail, sheet 1, Chemical Storage & Steam fitters shop building, Pacific Lumber Company, Drawing 11574m , "B" boiler room, 3.5.1957.

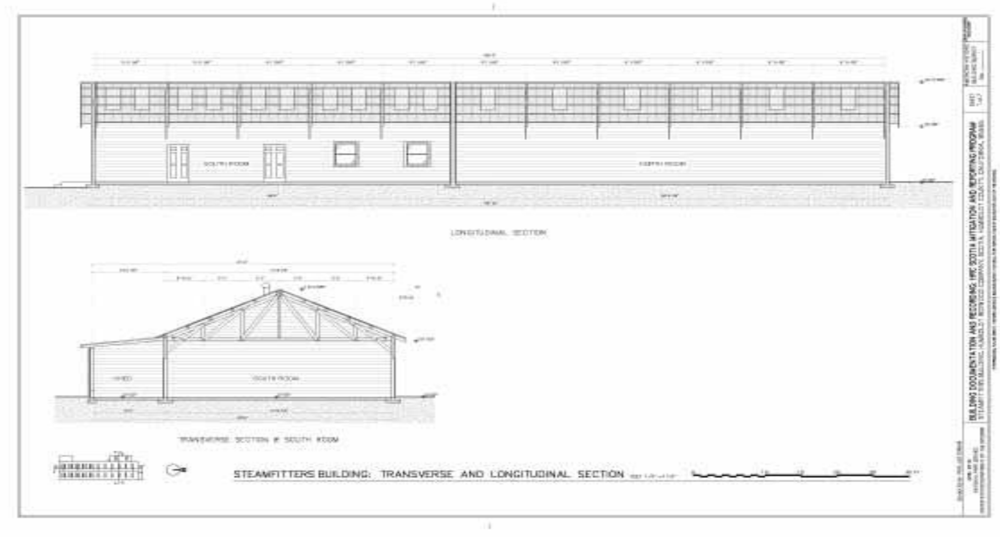


Figure 116
Steamfitters Building Interior Longitudinal SECTION

Figure 117 Roof Plan.

Figure 118 west side facing view with metal corrugated roofing, vents, open eaves.

Figure 119 west side facing exterior non-contributing addition with corrugated roofing.

Figure 200 typical roof beams and translucent corrugated panels for light.

Figure 201 view from the west of the single hipped roof system with corrugated metal roofing and translucent corrugated panels.

5.0 PLANS, ELEVATIONS, SECTIONS (fold-outs 11 x 17)

Figure 202 Pipe Insulation Building

PIPE INSULATION BUILDING

Owner:

Humboldt Redwood Company LLC
169 Main Street
Scotia, California 95565
Construction date: c.1920s (site of Sawdust Building – see 1924 map)

N

Figure 203 north view.

Description: The building's earlier use was as a Fiber Plant (1942). Wood was made into an insulation material in diesel engine oil filters, as a soil conditioner, etc. Fiber A was produced for blending with certain textile fibers. Fiber AR and PALCO Seal were also used in other by products. After use to produce fiber, the building was repurposed as the Pipe Insulation building, located adjacent directly to the east of the Steamfitters Building. The building remains a simple and utilitarian one story wood-framed structure. Material available from the Scotia mills (like many other wood framed buildings) was used to construct the building with wood frames, trusses, beams, columns and sheathing. The building has utilitarian; sliding wood and metal doors, opening directly to the narrow roadway, to allow easy access for material transported into and out of the space. The interior space is divided into three distinct sections include storage and work areas.

Foundation: The foundation is made of reinforced poured in place concrete similar to the Millwright Building.

Figures 204, 205 interior.

Walls: Wood stud walls carry vertical loads to the foundation. Wood wall sheathing is applied directly on the studs to help resist lateral forces. Horizontal wood siding is used the exterior walls.

Figures 206, 207 exterior roof, interior ceiling.

Roof and Ceiling: The building consists of a gable side facing wood roof with exposed ridge beams and open eaves. The roof framing is supported by interior wood fink trusses and exposed rafters. Metal and translucent corrugated roofing panels are used for roofing coverings. Four equally spaced metal ventilation vents penetrate the roof system. The interior ceiling of the office space (north) is made of wood attached in place on the horizontal truss chord above. The other interior spaces have open ceiling with exposed trusses and under-sheathing of the roof system attached on the rafters and beams.

Figure 207 interior truss system

Figure 208 interior truss system.

Trusses: The Pipe Insulation Building's trusses are a modified fan truss with struts supported at the feet by a common suspension member from which members radiate and diverge. These particular fan trusses are modified with diagonal webs to strengthen each system.

Figure 209 double hung windows.

Fenestrations: There are two basic types of wood doors on the contributing building. The first type is a standard door with top, lock and bottom rails, stiles and muntins. The second type is a simple, horizontal side door and panels on rollers and tracks. All doors are framed with wood surrounds attached to the lateral wall surfaces. Few, if any, of the doors are fire rated.

Figures 210, 211 doors and entrances

Exterior surface sliding, fire doors laterally are set along a metal overhead track on the longitudinal, front facing walls of the building. Wood framed double hung windows are located on three sides of the building. Wood louvered vents are located at the apex of the side facing walls.

Interior: The two larger rooms have open ceiling separated by a wall to wall partition. Fluorescent and incandescent lighting suspended from the ceiling. No mechanical heating or cooling system is evident.

Figures 212, 213 partition and exterior walls.

Figure 214

Pipe Insulation Building West and South Elevations

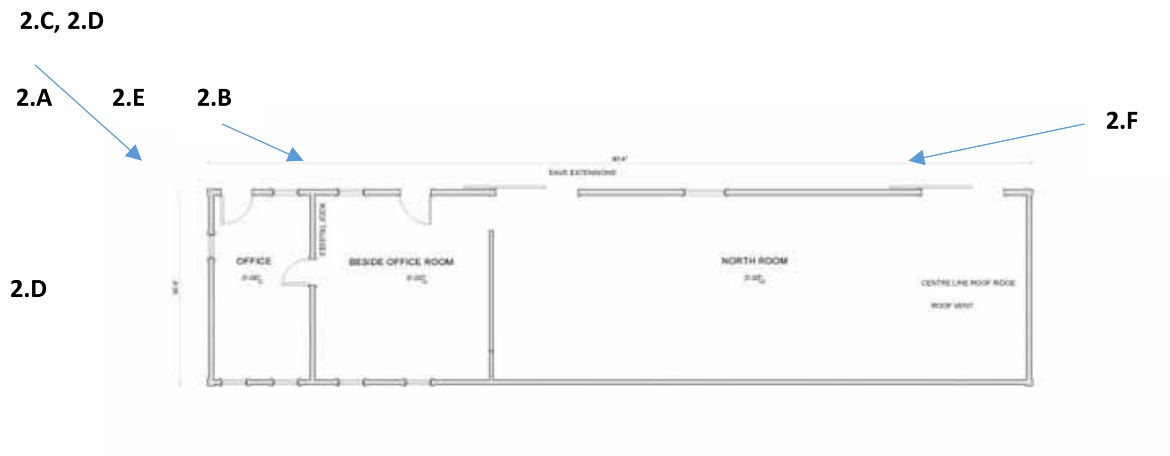


Figure 215 2.A south view of building, side-facing gable, typical double hung wood windows, wood doors, horizontal wood sheathing, vent at apex of north wall.

open eaves, exposed rafters, corrugated metal roofing

single and sliding wood doors and typical double hung wood windows with frames and surrounds

Figure 216 2.B north view

West facing exterior under monorail line with single wood door and frames, sliding wood doors, and double-hung wood windows with surround frames. Building has open eaves, exposed rafters, and metal corrugated roofing.

West exterior wall

Figure 216 2.C west exterior wall.

North exterior
Side of building

Figure 217 2.D northeast view.

North-south roadway separating building from Steamfitters building

Figure 218 2.E northeast view of building with roadway separates the Pipe Insulation building from the Steamfitters building and monorail system's column.

Figure 219 2.F north view of west facing exterior wall, sliding wood doors, open eaves and exposed rafters.

Figure 220

Pipe Insulation Building East and North Elevations

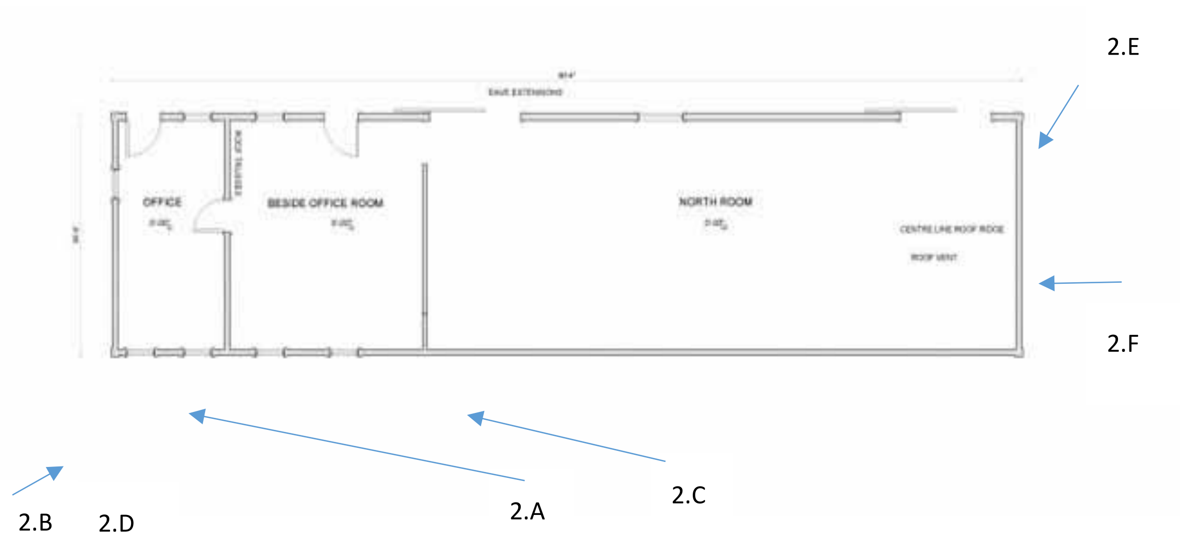


Figure 221 2.A east view of building, with double hung wood windows, frames and surrounds, horizontal wood sheathing, exposed rafters and corner boards.

Figure 222 2.B north and east exterior walls.

Figure ___

Figure 223 2.C monorail system running above to the west of the building, pipes along the east side of the building.

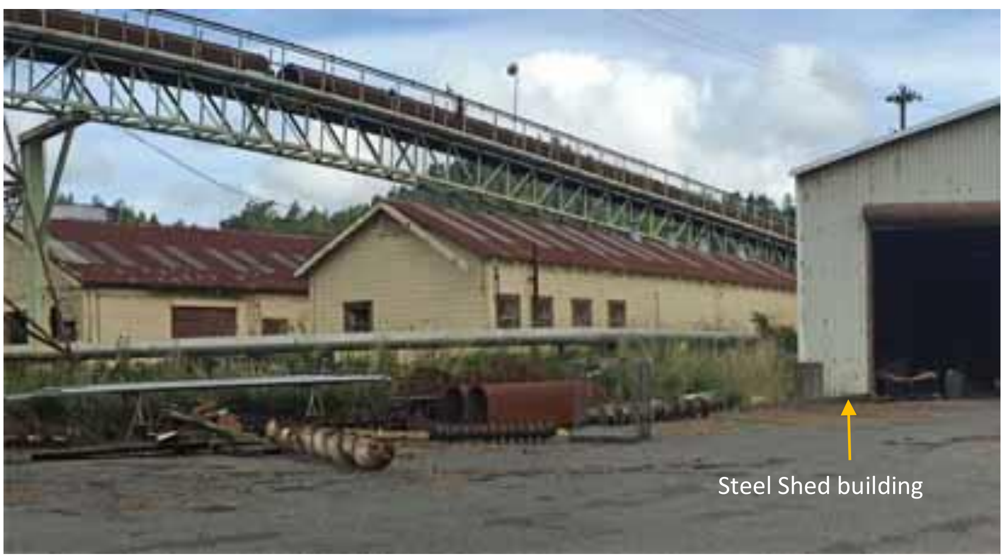


Figure ___

Figure 224 2.D south-east view.

Figure 225 2.E north facing exterior wall.

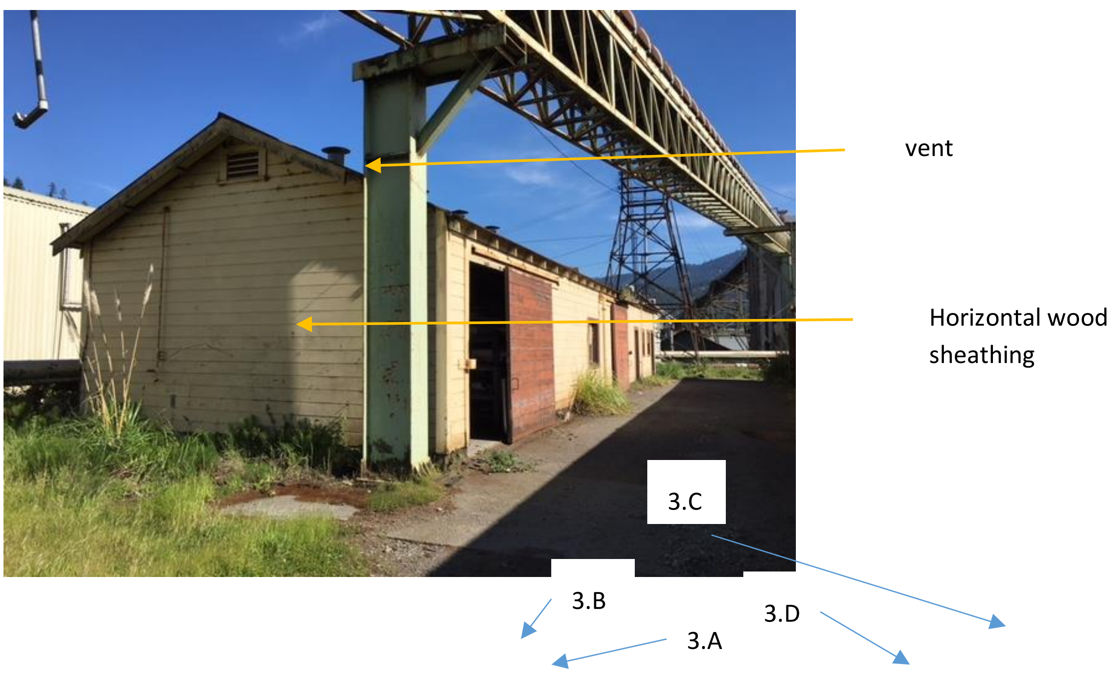


Figure 226 2.F north and west facing exterior walls.

Figure 227 interior

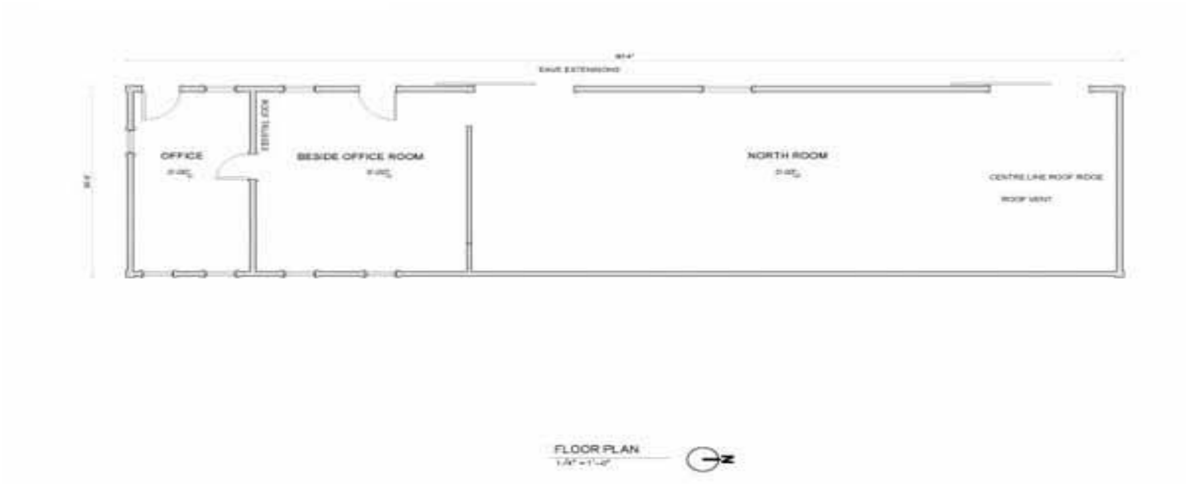


Figure 228 3.A interior

Figure 229 3.B interior

Figure 230 3.D interior.

Figure 231 interior.

Figure 230 (3.D) interior.

Pipe Insulation Building Interior 2 miscellaneous

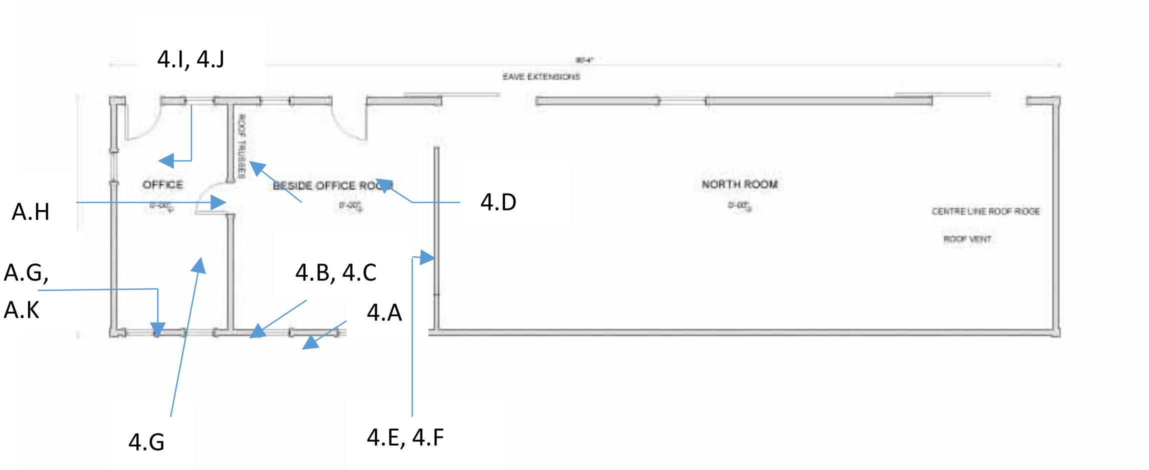


Figure 232 4.A interior double hung wood windows with frame and surround, two lateral/diagonal brace.

Figure 233 4.B partition across the width of room, horizontal lateral siding.

Figure 324 4.C cabinet adjacent to east interior wall.

Figure 325 4.D door on the east wall to the roadway.

Figure 326 4.E opening and plywood boards used to reduce width of opening.

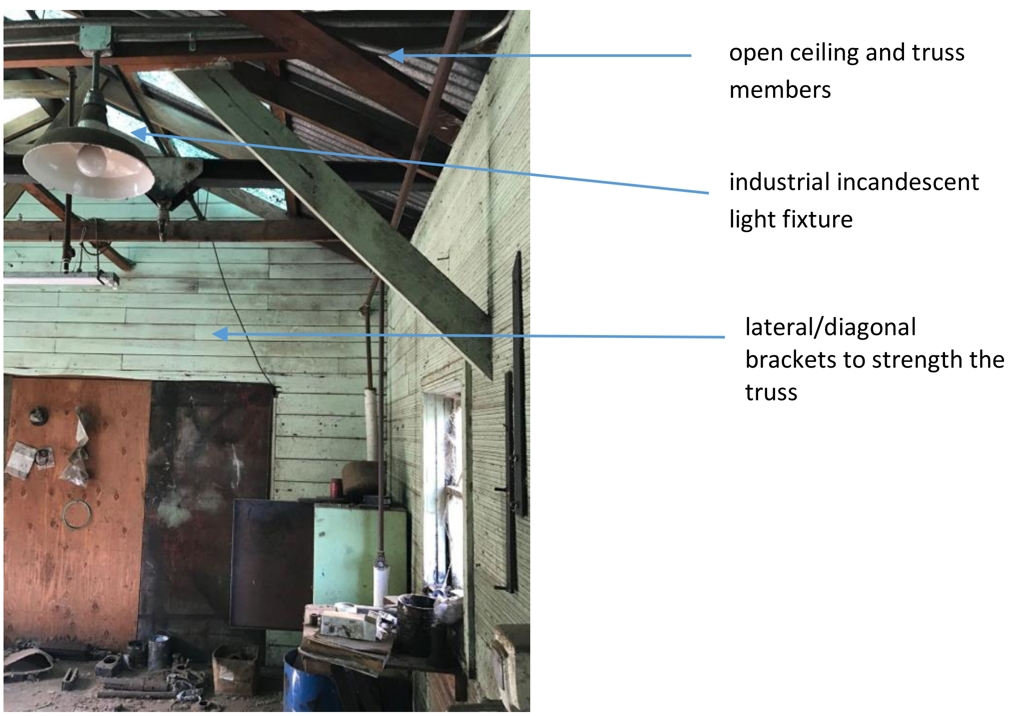
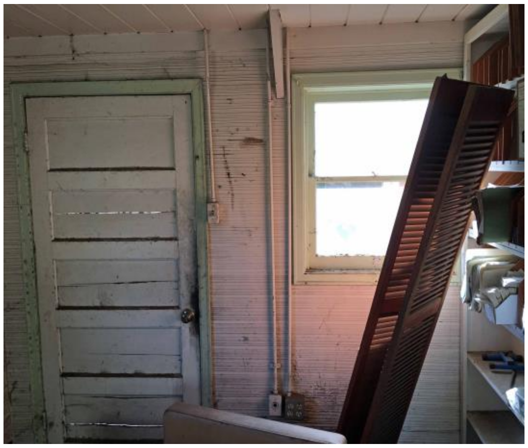


Figure 237 4.F lateral/diagonal brackets, open ceiling, truss, and industrial incandescent light fixture.

Figure 238 4.G small office space on the south side of the building.
to east interior wall.

Figure 239 4.H wood planks used for ceiling of small office.

Figures 240, 241 4.I additional views of small office space.

Figures 242, 243 4.J, 4.K additional views of small office space.

Figure 244 Pipe Insulation Building West and South Elevations

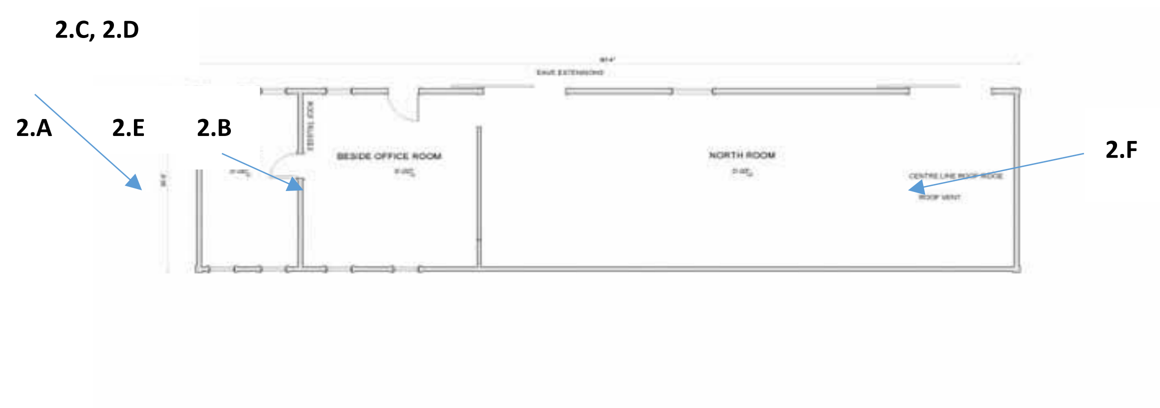


Figure 245 2.A south view of building, side-facing gable, typical double hung wood windows, wood doors, horizontal wood sheathing, vent at apex of north wall.

Figure 246 2.B west facing exterior under monorail line with single wood door and frames, sliding wood doors, and double-hung wood windows with surround frames. Building has open eaves, exposed rafters, and metal corrugated roofing.

Figure 247 2.C view of west-facing exterior wall and south-facing side.

North exterior
Side of building

Figure 248 2.D northeast view of building.

North-south
roadway
separating
building from
Steamfitters
building

Figure 249 2.E northeast view of building with roadway separates the Pipe Insulation building from the Steamfitters building and monorail system's column.

Figure 250 2.F north view of west facing exterior wall, sliding wood doors, open eaves and exposed rafters.

Figure 251

PIPE INSULATION Building PHOTOS: East and North Elevations

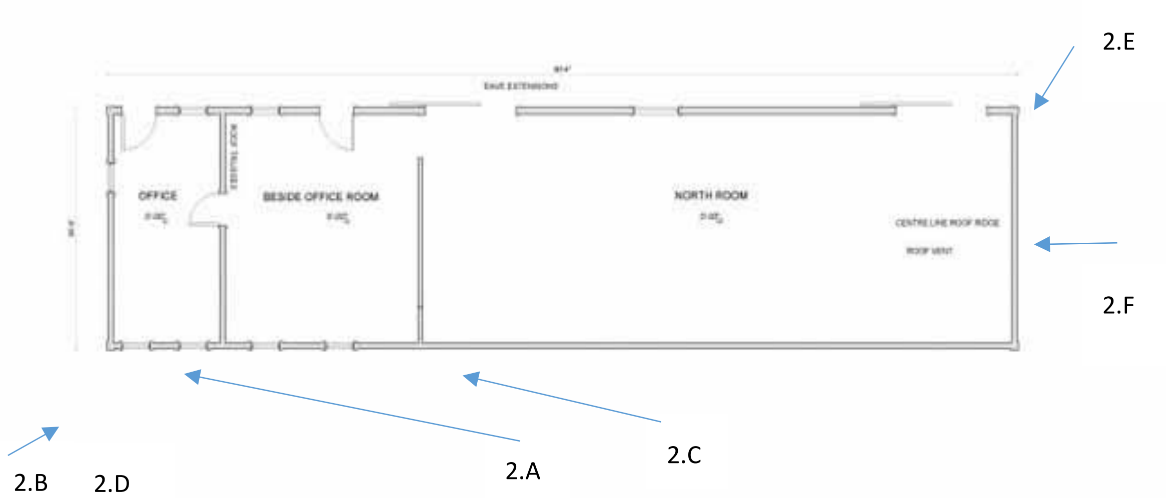


Figure 252 2.A east view of building, with double hung wood windows, frames and surrounds, horizontal wood sheathing, exposed rafters and corner boards.

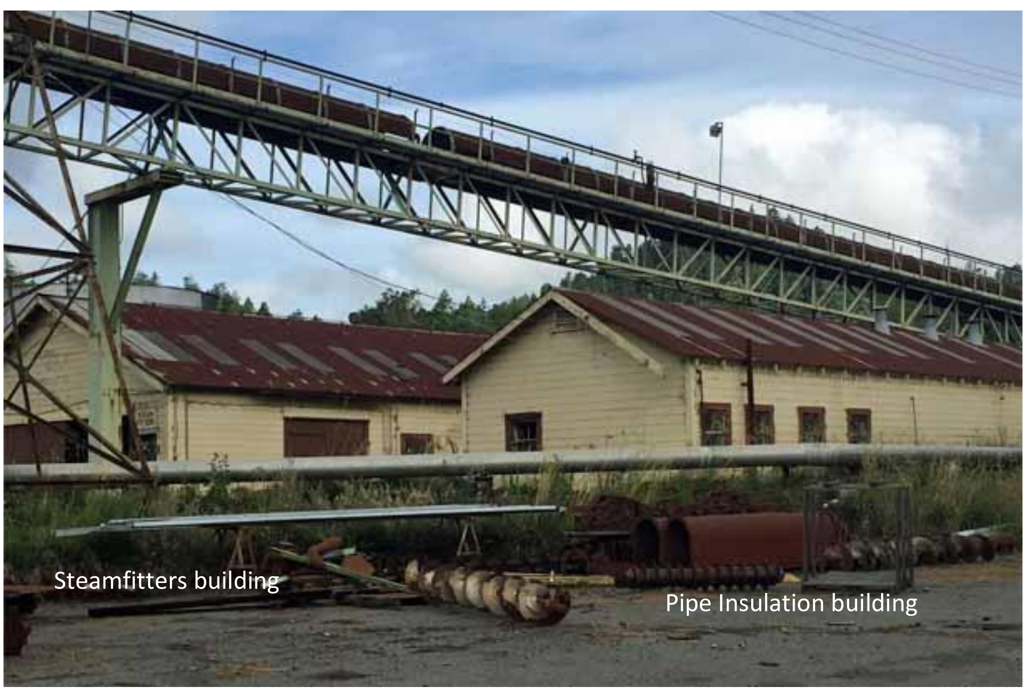


Figure 253 2.B north and east exterior walls.

Figure 253 2.C monorail system running above to the west of the building, pipes along the east side of the building.

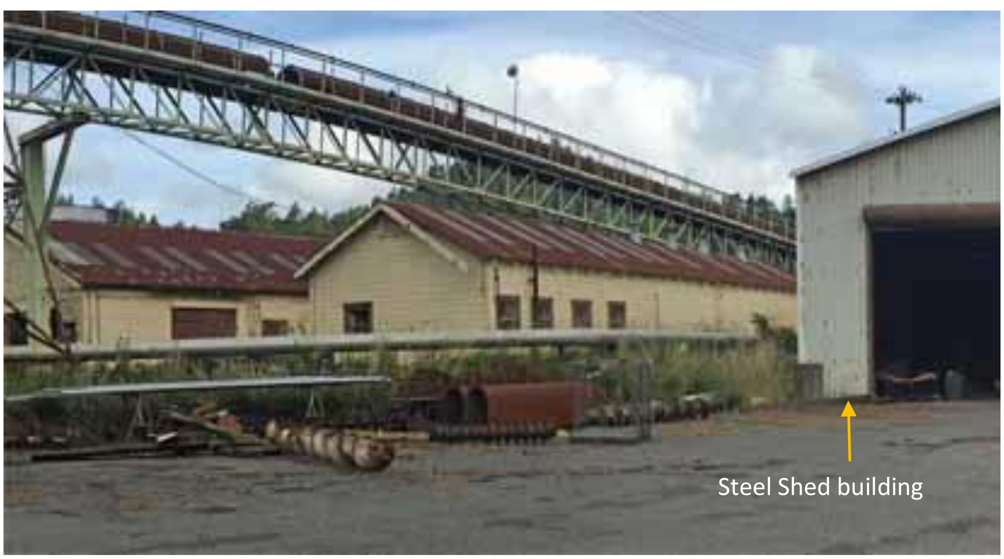


Figure 254 2.D view of the building from the south-east.

Figure 255 2.E north facing exterior wall.

Figure 256 2.F north and west facing exterior walls.

Figure 257
Pipe Insulation Building Interior 1

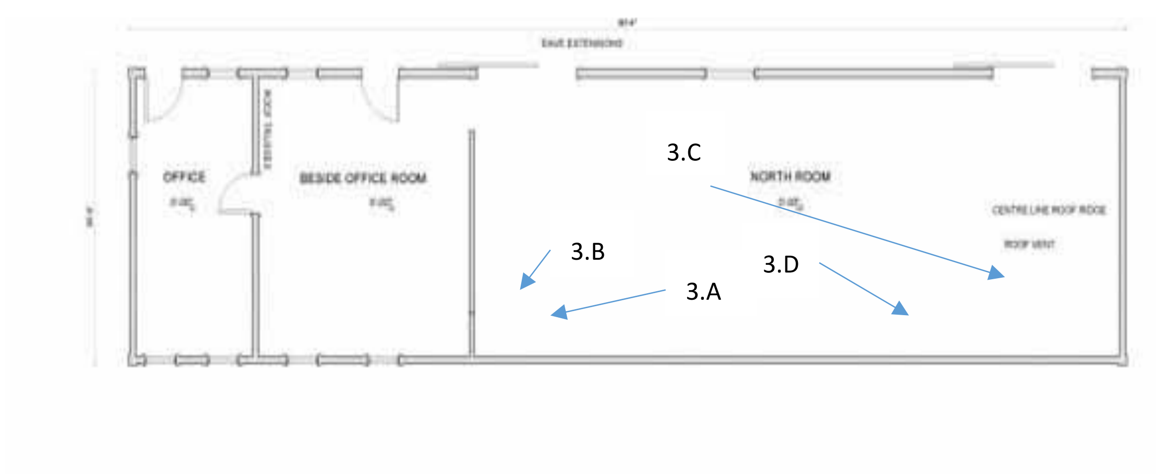


Figure 258 3.A interior.

Figure 258 3.B interior.

Figure 259 3.C interior.

Figure 260 3.D interior.

Figure 261
PIPE INSULATION Interior 2 miscellaneous

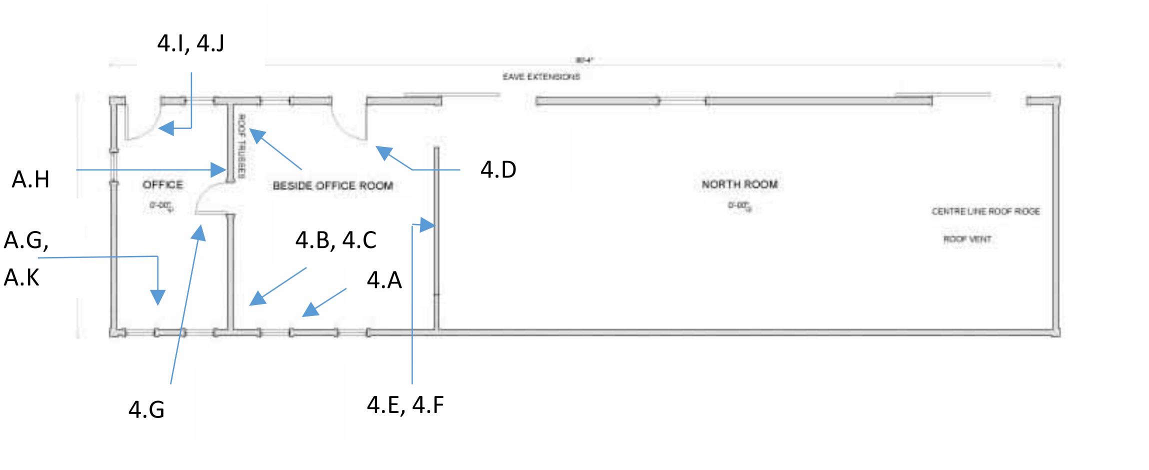


Figure 262 4.A interior double hung wood windows with frame and surround, two lateral/diagonal brace.

Figure 263 4.B partition across the width of room, horizontal lateral siding.

Figure 264 4.C cabinet adjacen to east interior wall.

Figure 265 4.D door on the east wall to the roadway.

Figure 266 4.E opening and plywood boards used to reduce width of opening.

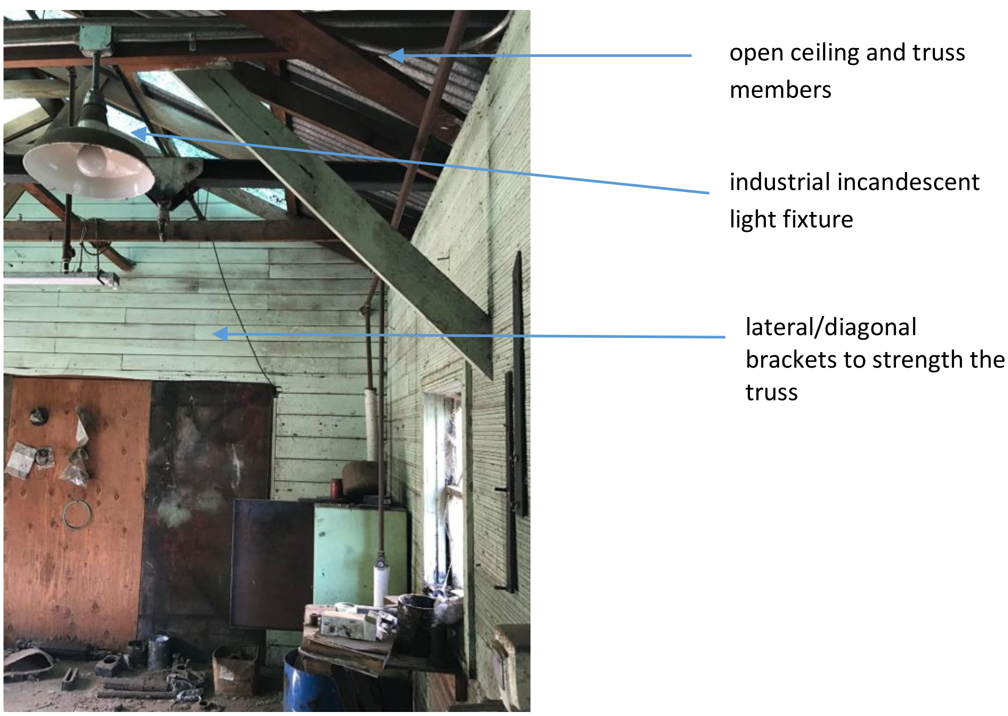
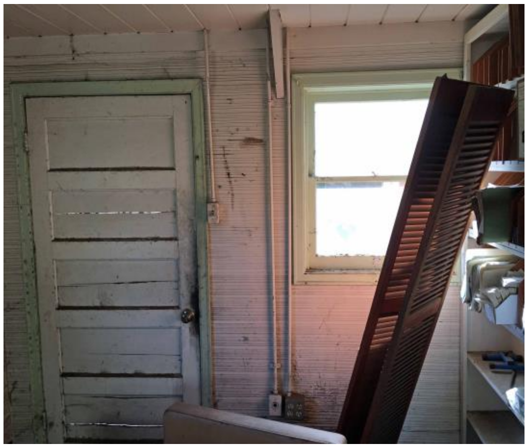


Figure 267 4.F lateral/diagonal brackets, open ceiling, truss, and industrial incandescent light fixture.

Figure 268 4.G small office space on the south side of the building.

Figure 269 4.H wood planks used for ceiling of small office.



Figures 270, 271 4.I, 4.J additional views of small office space.

Figure 272, 273 4.K, 4.L additional views of small office space.

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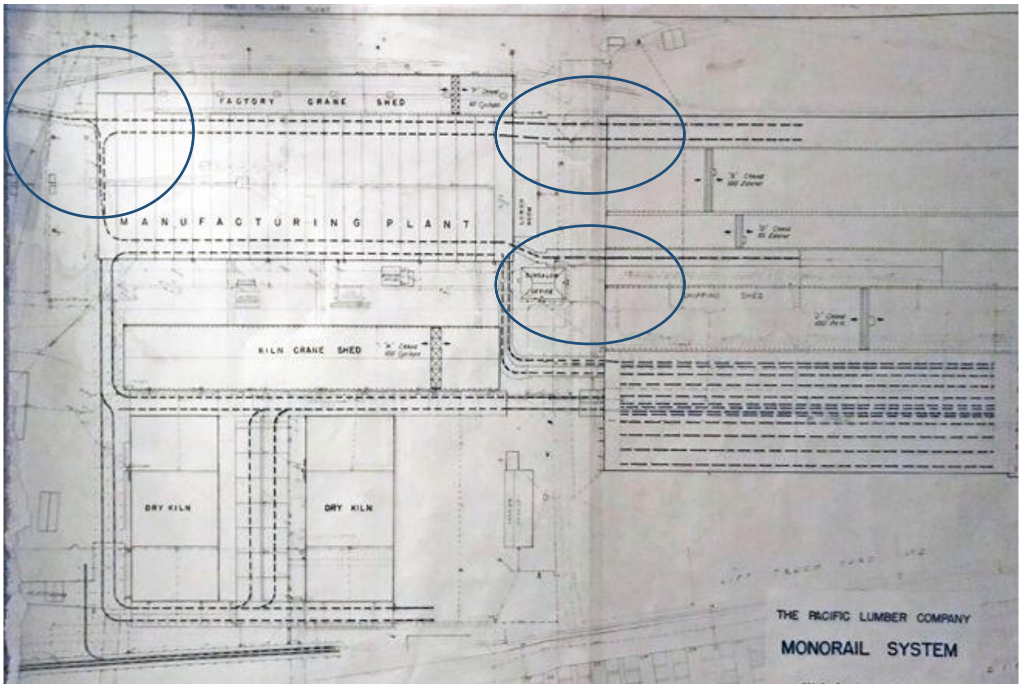
7.0 Appendices/References/Links/Terminology

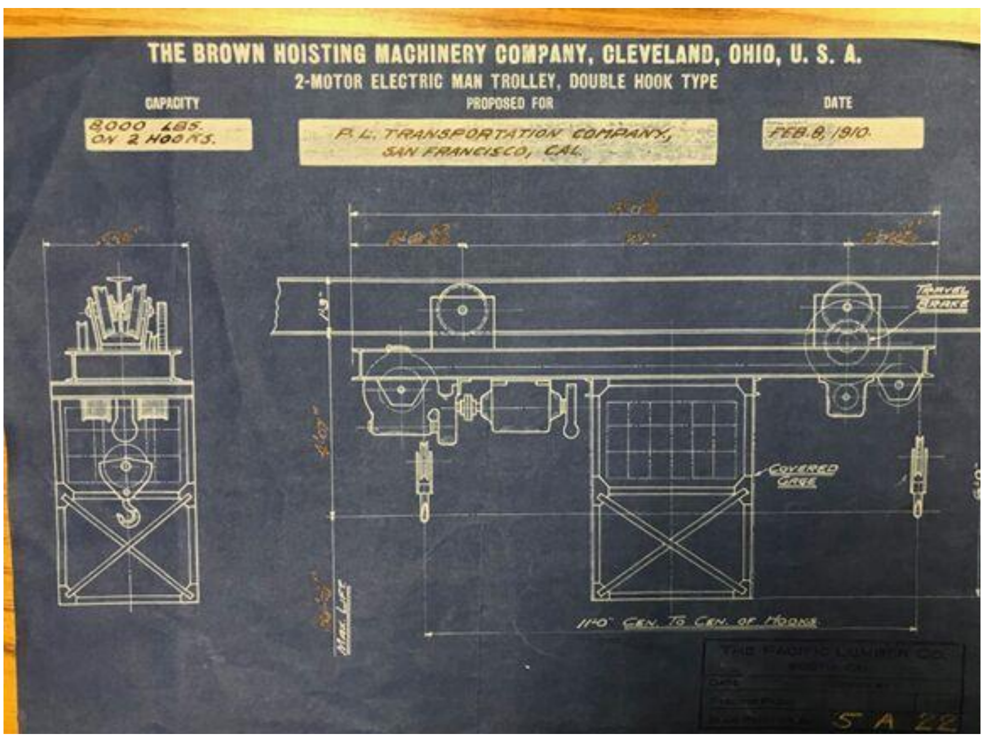
Appendices

7.1 Scotia Monorail and Crane system: Photos and drawings, documents, including plans, drawings, photographs and miscellaneous reports are located in the PALCO Town of Scotia archives and other resource locations.

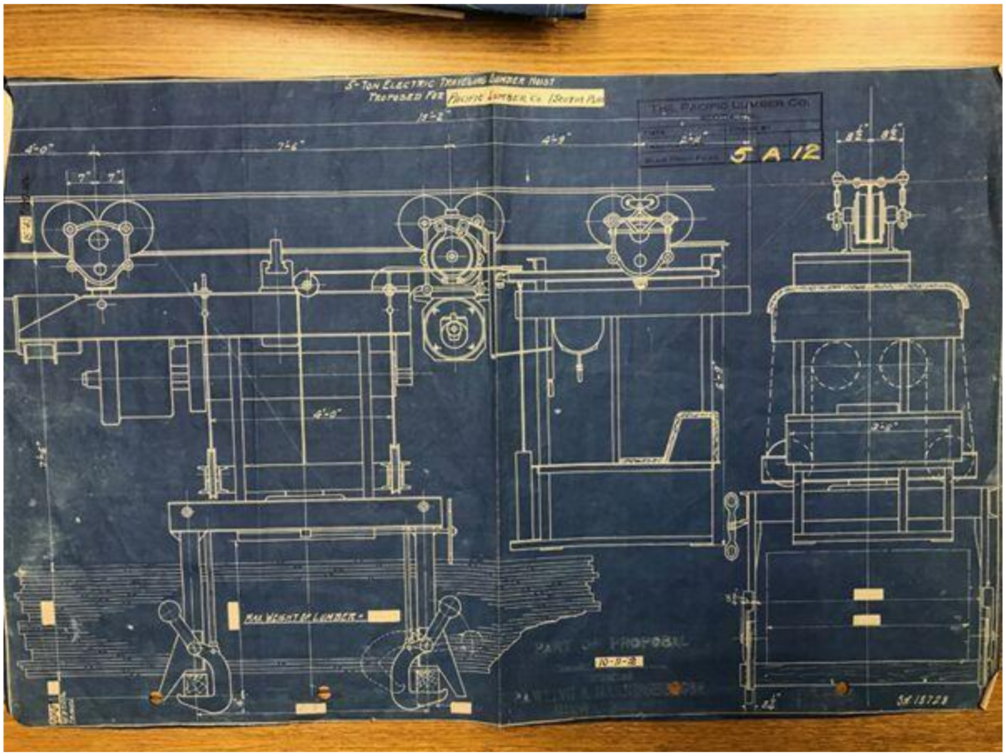
7.1.1 *Scotia PALCO operations, 1979.*



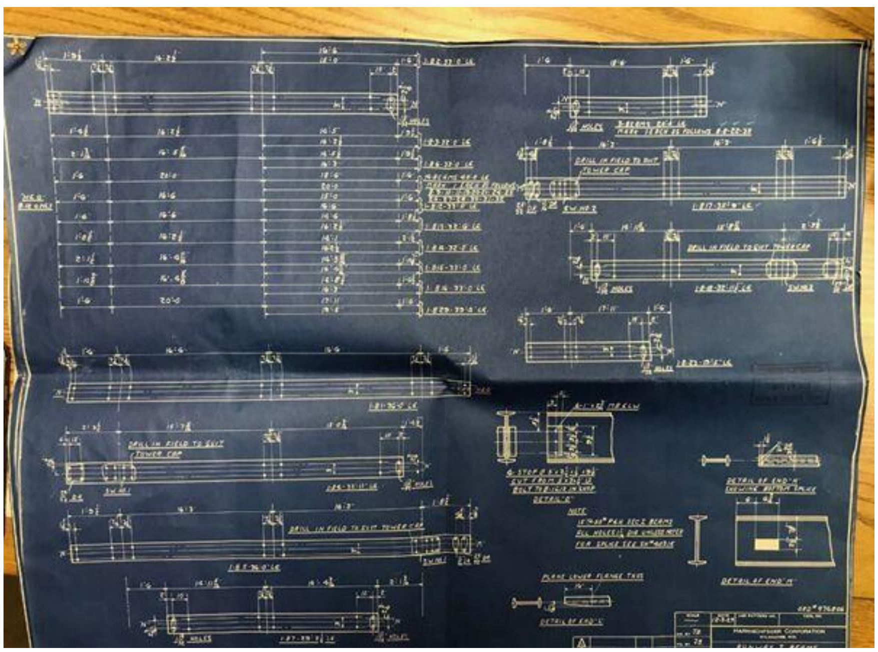
7.1.2 *location of South Monorail Tunnels #1 and 2, North Monorail Tunnel, PALCO, 1972*.



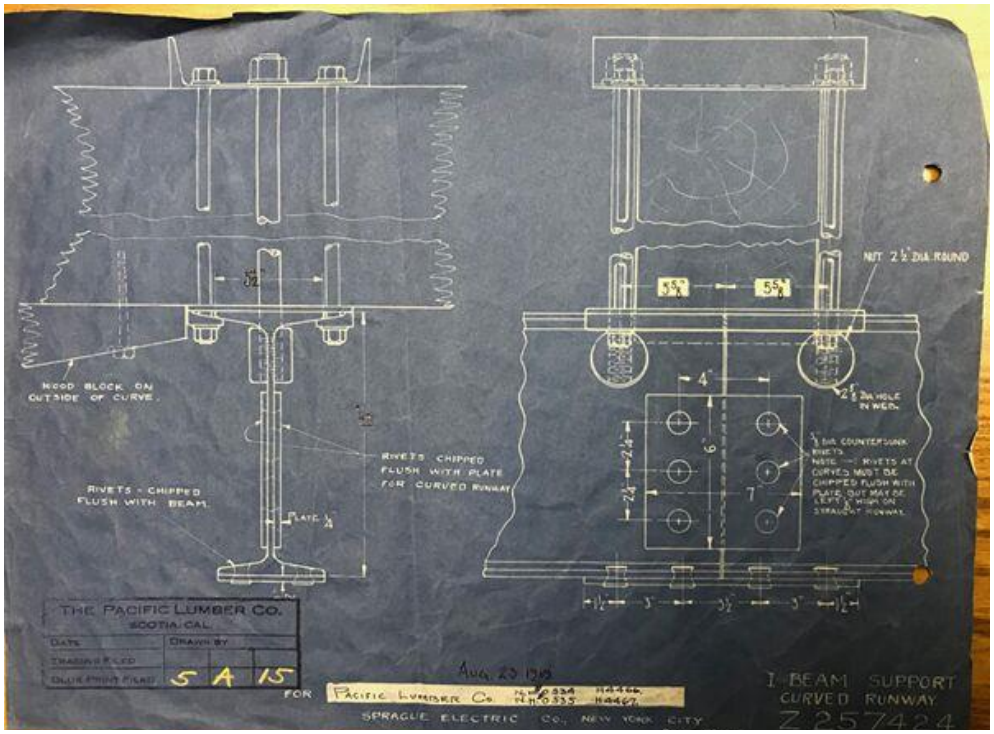
7.1.3 *PALCO early use of electric monorail trolley, 2-Motor Electric Man Trolley, Double Hook Type, The Brown Hoisting Machine Company, Cleveland, Ohio, USA, 1910*.



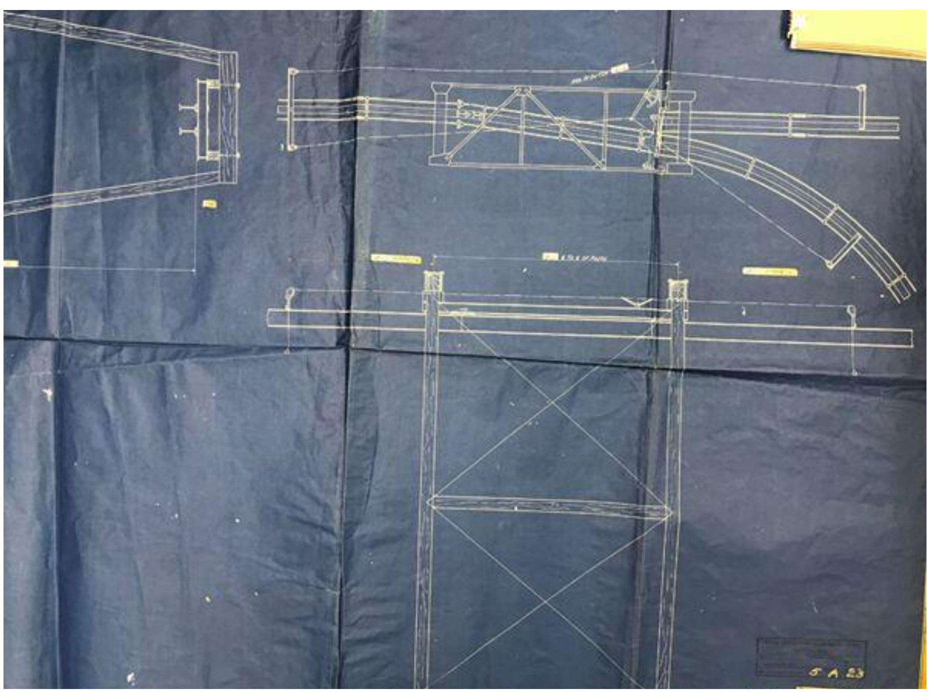
7.1.4 *PALCO early use of electric monorail trolley, 2-Motor Electric Man Trolley, Double Hook Type, The Brown Hoisting Machine Company, Cleveland, Ohio, USA, 1910*.



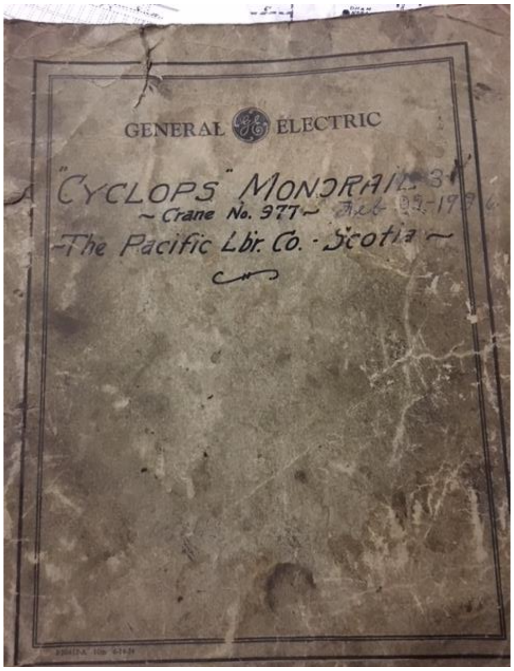
7.1.5 *PALCO runway tracks (typical), c. 1920s.*



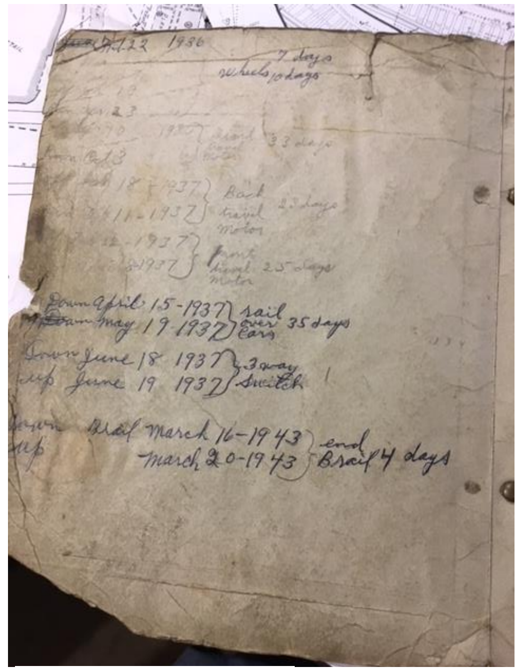
7.1.6 *PALCO runway tracks (typical), c. 1920s.*



7.1.7 *PALCO runway tracks (typical), c. 1920s.*

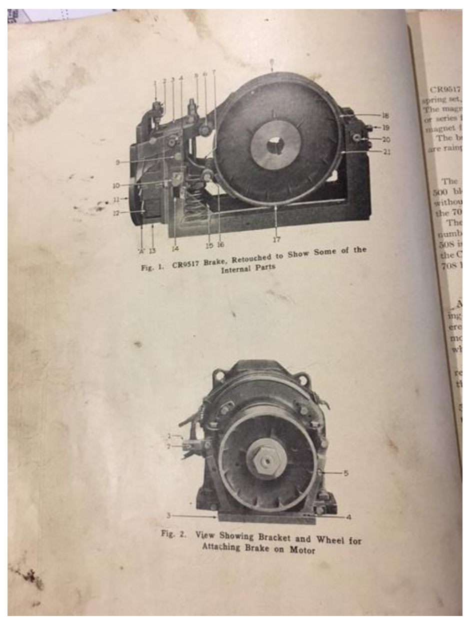


7.1.8

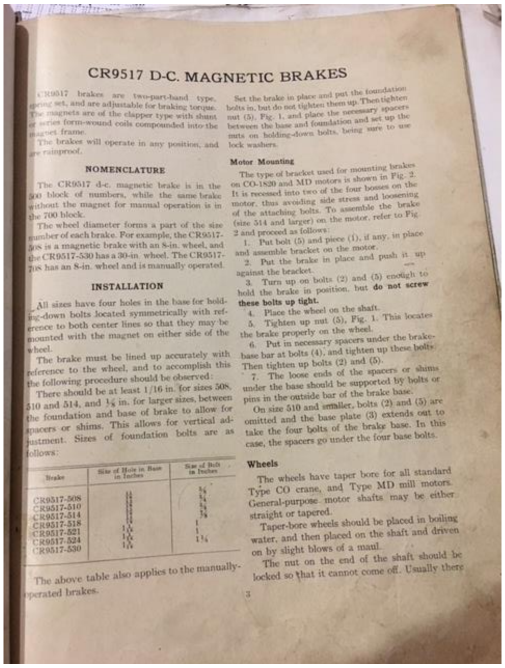


7.1.9

7.1.10



7.1.11



CR9517 D-C. MAGNETIC BRAKES

CR9517 brakes are two-part-band type, spring set, and are adjustable for braking torque. The magnets are of the clapper type with shunt or series form-wound coils compounded into the magnet frame.

The brakes will operate in any position, and are rainproof.

NOMENCLATURE

The CR9517 d-c. magnetic brake is in the 500 block of numbers, while the same brake without the magnet for manual operation is in the 700 block.

The wheel diameter forms a part of the size number of each brake. For example, the CR9517-508 is a magnetic brake with an 8-in. wheel, and the CR9517-530 has a 30-in. wheel. The CR9517-708 has an 8-in. wheel and is manually operated.

INSTALLATION

All sizes have four holes in the base for holding-down bolts located symmetrically with reference to both center lines so that they may be mounted with the magnet on either side of the wheel.

The brake must be lined up accurately with reference to the wheel, and to accomplish this the following procedure should be observed:

There should be at least 1/16 in. for sizes 508, 510 and 514, and 1/8 in. for larger sizes, between the foundation and base of brake to allow for spacers or shims. This allows for vertical adjustment. Sizes of foundation bolts are as follows:

Brake	Size of Hole in Base in Inches	Size of Bolt in Inches
CR9517-508	[illegible]	[illegible]
CR9517-510	[illegible]	[illegible]
CR9517-514	[illegible]	[illegible]
CR9517-518	[illegible]	1
CR9517-521	[illegible]	1
CR9517-524	[illegible]	1¼
CR9517-530	[illegible]	

The above table also applies to the manually-operated brakes.

Set the brake in place and put the foundation bolts in, but do not tighten them up. Then tighten nut (5), Fig. 1, and place the necessary spacers between the base and foundation and set up the nuts on holding-down bolts, being sure to use lock washers.

Motor Mounting

The type of bracket used for mounting brakes on CO-1820 and MD motors is shown in Fig. 2. It is recessed into two of the four bosses on the motor, thus avoiding side stress and loosening of the attaching bolts. To assemble the brake (size 514 and larger) on the motor, refer to Fig. 2 and proceed as follows:

1. Put bolt (5) and piece (1), if any, in place and assemble bracket on the motor.
2. Put the brake in place and push it up against the bracket.
3. Turn up on bolts (2) and (5) enough to hold the brake in position, but **do not screw these bolts up tight.**
4. Place the wheel on the shaft.
5. Tighten up nut (5), Fig. 1. This locates the brake properly on the wheel.
6. Put in necessary spacers under the brake-base bar at bolts (4), and tighten up these bolts. Then tighten up bolts (2) and (5).
7. The loose ends of the spacers or shims under the base should be supported by bolts or pins in the outside bar of the brake base.

On size 510 and smaller, bolts (2) and (5) are omitted and the base plate (3) extends out to take the four bolts of the brake base. In this case, the spacers go under the four base bolts.

Wheels

The wheels have taper bore for all standard Type CO crane, and Type MD mill motors. General-purpose motor shafts may be either straight or tapered.

Taper-bore wheels should be placed in boiling water, and then placed on the shaft and driven on by slight blows of a maul.

The nut on the end of the shaft should be locked so that it cannot come off. Usually there

3

7.1.12

GEH-[illegible]A CR9517 D-C. Magnetic Brakes

Fig. 6. Brake Mounted on Motor, Showing Bar for Hand Release

Speed of Operation

To make the brake set quicker, after current is cut off, additional brass or phosphor bronze shims from 10 mils to 30 mils thick, depending on results desired, can be put between pole piece (1), Fig. 5, and the end of the round core. This will increase the releasing current, and also the minimum dropout current.

ADJUSTMENT

When the brake bands wear, pins (6) and (16), Fig. 1, move toward each other, and (11) moves out, thus increasing the air gap "A," Fig. 1, between armature (11) and magnet (13). When this air gap gets too great to be pulled in by the magnet to release the brake, adjust at nuts (2), Fig. 1, to reduce the gap.

The following table gives the approximate minimum air gap or movement of armature (3), Fig. 6, measured at the end of strip (1) at (2).

Brake	Minimum Gap in Inches
CR9517-508	[illegible]
CR9517-510	[illegible]
CR9517-514	[illegible]
CR9517-518	[illegible]
CR9517-521	[illegible]
CR9517-524	[illegible]
CR9517-530	[illegible]

When the brake is released, set screw (19), Fig. 1, should be set so that the band ends on that side just clear the wheel.

Sometimes when the [illegible] taken out they get bent out [illegible] and do not conform accura[illegible] wheel when put back. T[illegible] properly such a band cause[illegible] air gap on the magnet. There[illegible] band should be taken out and [illegible] the correct shape.

For the three adjustments (2), (5) and (19) are the [illegible] on each brake so that only one [illegible] is necessary.

Tighten all lock nuts after [illegible] ments have been made.

Clearance for Back Shaft

If necessary to get more clearance [illegible] back shaft of geared motors on the 521, [illegible] 530 sizes adjusting bolt (2), Fig. 7, can [illegible] in hole (3), and bar (1) removed.

LUBRICATION

All bearings should be oiled periodi[illegible] the oilers provided.

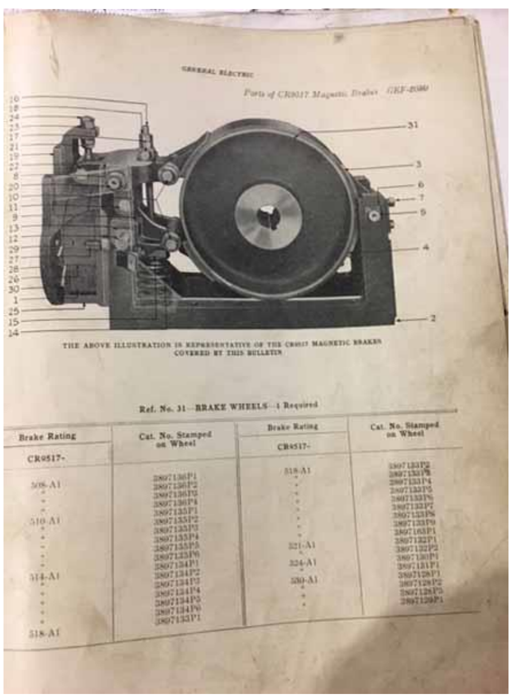
CONNECTIONS

The nameplate stamping indicates [illegible] the coil is for series or shunt connectio[illegible] series, it is connected in series with the [illegible]

Fig. 7. View Showing Parts Used for Adj[illegible] Clearance for Back Shaft

6

7.1.13



GENERAL ELECTRIC

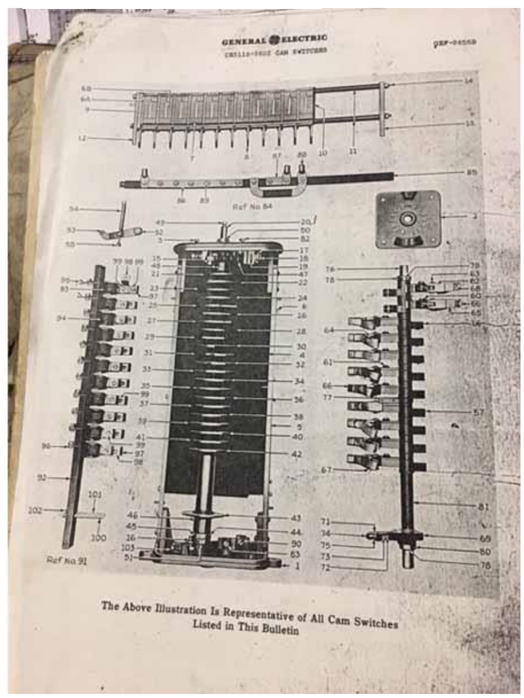
Parts of CR9517 Magnetic Brakes GEF-[illegible]

THE ABOVE ILLUSTRATION IS REPRESENTATIVE OF THE CR9517 MAGNETIC BRAKES COVERED BY THIS BULLETIN

Ref. No. 31—BRAKE WHEELS—1 Required

Brake Rating CR9517-	Cat. No. Stamped on Wheel	Brake Rating CR9517-	Cat. No. Stamped on Wheel
508-A1	[illegible]	518-A1	[illegible]
510-A1	[illegible]	521-A1	[illegible]
514-A1	[illegible]	524-A1	[illegible]
518-A1	[illegible]	530-A1	[illegible]

7.1.14



GENERAL ELECTRIC

CR[illegible] CAM SWITCHES

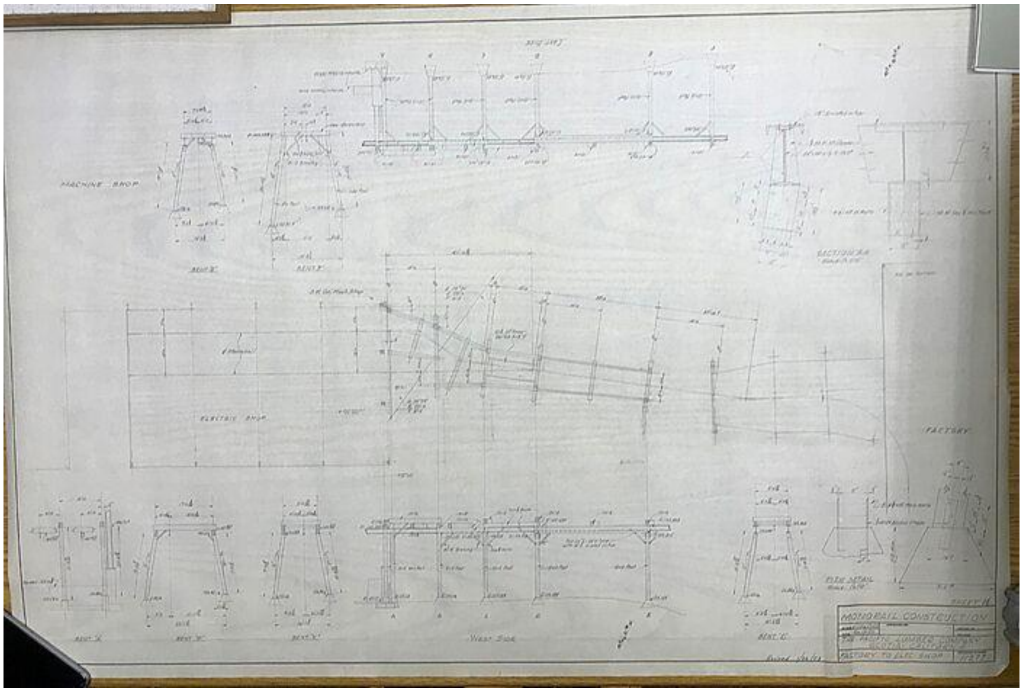
The Above Illustration Is Representative of All Cam Switches Listed in This Bulletin

7.1.15

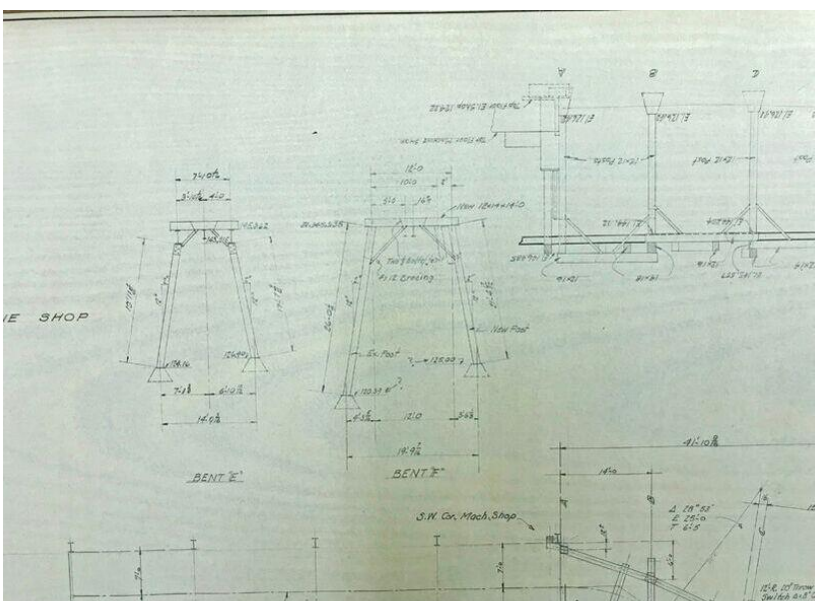
7.1.8 - 7.1.15 *General Electric Cyclops Monorail Crane no. 977, PALCO, 1930.*

7.1.16 defunct PALCO trolleys/cabs, location and date unknown.

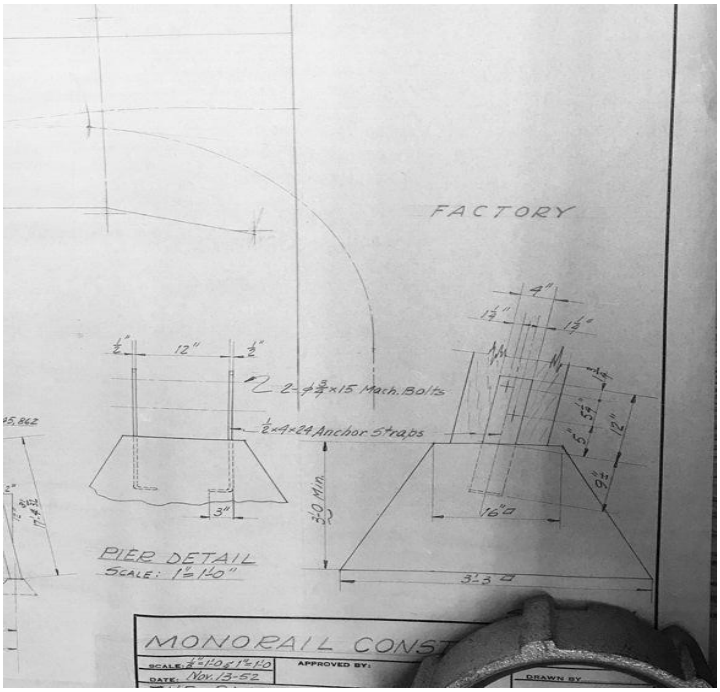
7.1.18 (right) *defunct PALCO monorail winch, location and date unknown*.



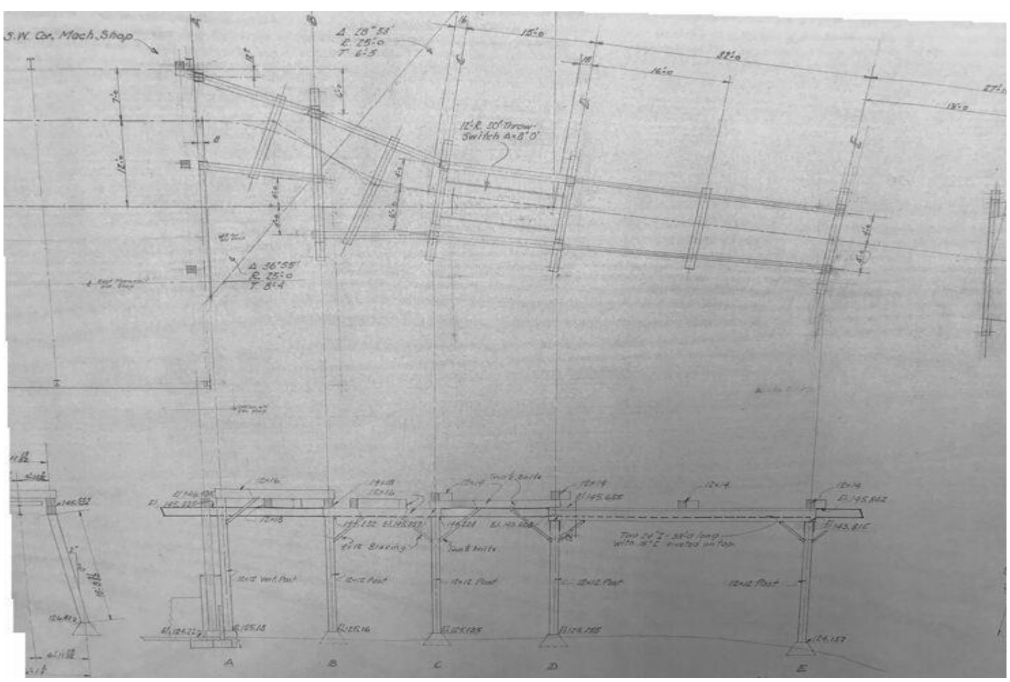
6.1.19 PALCO North Monorail Tunnel rail and monorail details, 1962 – 63..



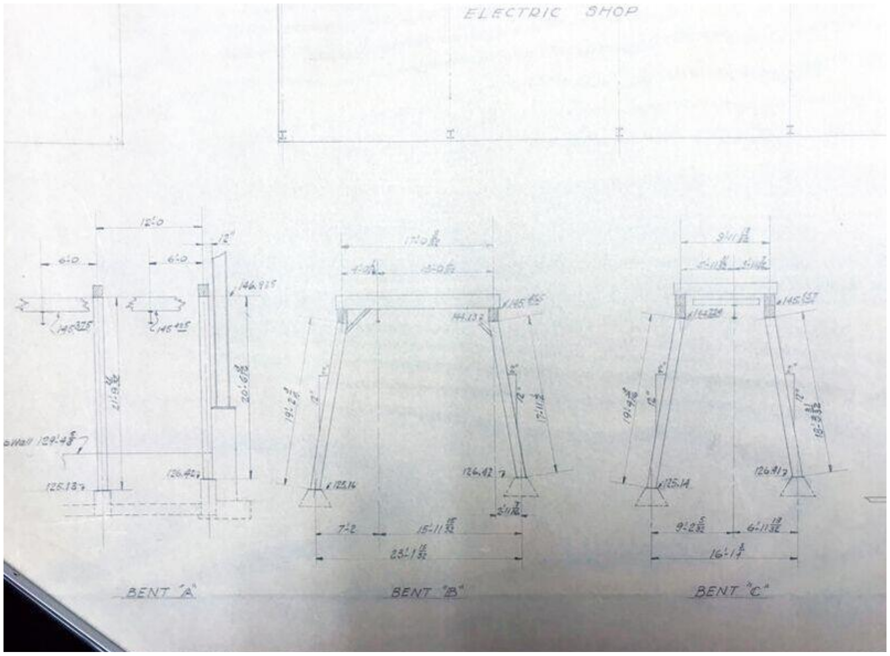
7.1.20 PALCO North Monorail Tunnel rail and monorail details, 1962 – 63.



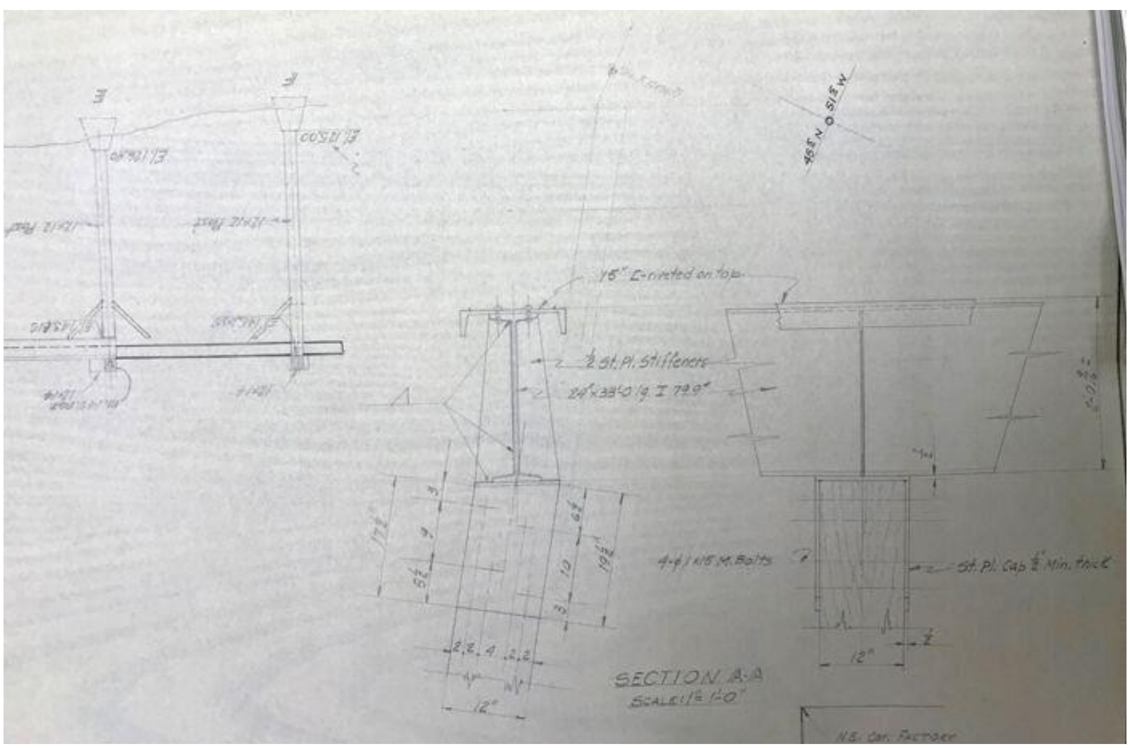
7.1.21 PALCO North Monorail Tunnel rail and monorail details, 1962 – 63.



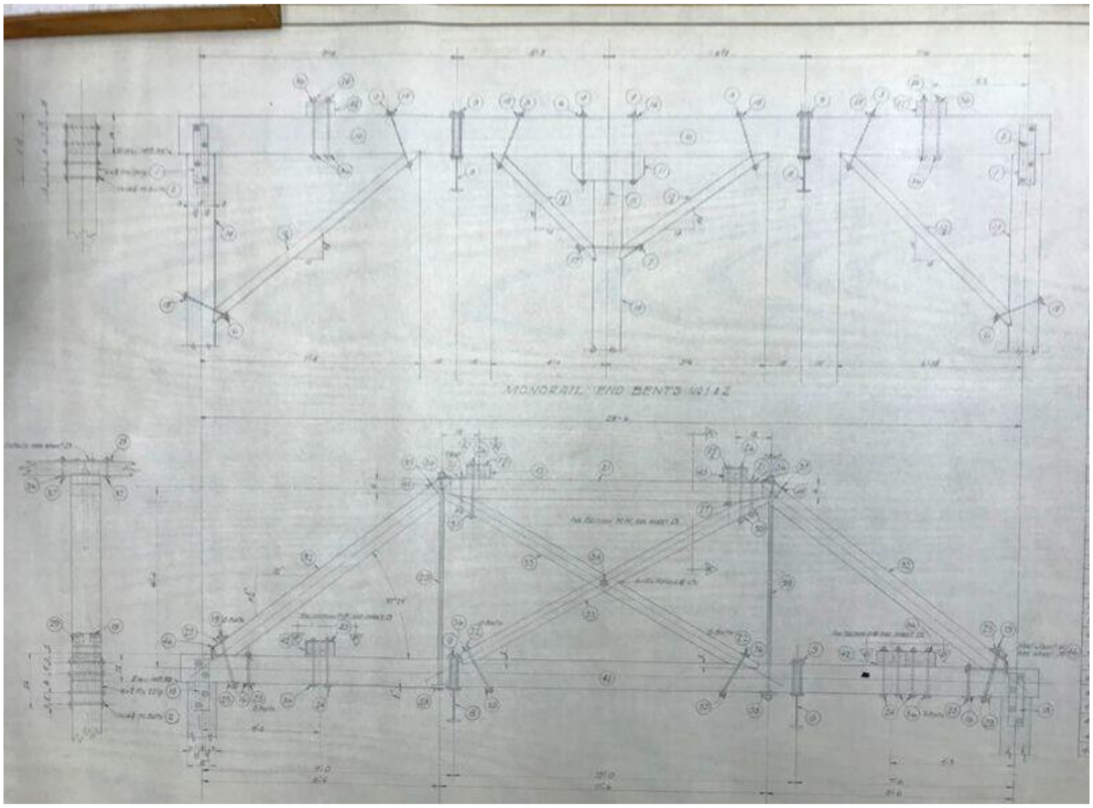
7.1.22 PALCO North Monorail Tunnel rail and monorail details, 1962 – 63.



7.1.23 PALCO North Monorail Tunnel rail and monorail details, 1962 – 63.



7.1.24 PALCO North Monorail Tunnel rail and monorail details, 1962 – 63.



7.1.25 PALCO North Monorail Tunnel rail and monorail details, 1962 – 63.

Photos and drawings, documents, including plans, drawings, photographs and miscellaneous reports are primarily located in the PALCO Town of Scotia archives and other resource locations.

7.2.0 Acronyms and selected Terminology

HRC	Humboldt Redwood Company
PALCO	Pacific Lumber Company
CSD	Community Service District (Scotia)

Monorail	A **monorail** is a railway in which the track consists of a single rail
Wood fiber (fibre)	The most important ingredient in pulp and paper; it is composed mainly of cellulose
Gable roof	Roof having a gable at one or both ends (vertical triangular portion of the end of a building having a double sloping roof, from the level of the cornice or eaves to the ridge of the roof)
Saw Mill	A mill that cuts wood logs into different sizes timber and produces lumber suitable for processing and marketing.
Bent	Framework usually designed to carry both a lateral and a vertical load which is transverse to the length of the frame structure. Types of bents at Scotia include rectangular, sloping legs, gable, gable with tie, arched, arched with tie and continuous bents
Crane	A machine for lifting and lowering a load and moving it horizontally with a hoisting integral part of the machine. Cranes can be fixed or mobile and driven manually or by power.
Gantry Cranes	An overhead crane where the bridge girder (s) are connected to “legs” on either side of the span. These legs eliminate the supporting runway and column system and connect to end trucks which run on a rail either embedded in, or laid on top of, the floor.
Cab	The operator’s compartment on a crane or trolley.

Trolley	a device that carries electric current from an overhead ire to an electrically driven vehicle. Also a wheeled carriage running on an overhead rail or track.
Truss	A structure composed of a combination of members such as chords, diagonals, web members usually in some triangular arrangement so as to constitute a rigid framework.
Trussed beam	Usually made of timber, reinforced with one or more tie rods. These beams are braced by one or more vertical posts supported by inclined rod attached to the ends of the beam.
Window frame	The fixed, non-operable frame of a window designed to receive and hold the sash or casement and all necessary hardware.
Door frame	An assembly guilt into a wall consisting of two upright members (jambs) and a head (lintel) over the doorway.
Sheathing	The covering (usually wood boards, plywood, or wallboards) placed over exterior studding or rafters on the building to provide a base for the application of wall or roof cladding.
Siding	The finish covering of an exterior wall of a frame building. Siding may be a cladding material such as wood applied vertically or horizontally.
Bolt	A metallic pin or rod having a head at one end and an external thread on the other for screwing up a nut to hold members together.
Anchor	A device such as a metal rod, wire or strap for fixing one object to another.
Steel Anchors Plates	An anchor plate or wall washer is a large plate or washer connected to a tie rod or bolt. Anchor plates are made of cast iron, sometimes wrought iron or steel.
De-barker	A machine used in sawmills or pulp mills to remove the bark from logs
Kiln	A furnace or oven for drying the lumber.
Planer and Edging	methods to make timber beams down to size and ensures flat, even finish and perfectly right-angled sections..
Pipe Insulation	Thermal, blanket, solar, acoustical, heating and other insulation systems especially for pipes.
Steam fitter	installation or repairs equipment (such as steam pipes) for heating, ventilating, or refrigerating systems.

Structural timber	Structural lumber of approximately square cross section that is 5 inches or a side or larger used primarily for posts and columns.
Steam Donkey	A donkey engine was an integrated machine consisting of a power plant and gearing that turned one or more drums or winches containing wire rope. Designed to lift, drag, and move logs from the stump to an accumulation point, donkey engines were also used to load logs on cars that transported logs to distant mill sites
Tackle	A mechanism for shifting, raising, or lowering objects or materials, such as a rope and pulley block or an assembly or ropes and pulley blocks.
Winch	A hauling or lifting device consisting of a rope, cable, or chain winding around a horizontal rotating drum, turned by a crank or by motor or other power source

Milling and Logging traditional/typical procedures

- Logs are taken by logging truck, rail or a log drive to the sawmill.
- Logs are scaled either on the way to the mill or upon arrival at the mill.
- Debarking removes bark from the logs.
- *Decking* is the process for sorting the logs by species, size and end use (lumber, plywood, chips).
- A sawyer uses a head saw (also called head rig or primary saw) to break the log into cants (unfinished logs to be further processed) and flitches (unfinished planks).
- Depending upon the species and quality of the log, the cants will either be further broken down by a resaw or a gang edger into multiple flitches and/or boards.
- *Edging* will take the flitch and trim off all irregular edges leaving four-sided lumber.
- *Trimming* squares the ends at typical lumber lengths.
- *Drying* removes naturally occurring moisture from the lumber. This can be done with kilns or air-dried.
- *Planing* smooths the surface of the lumber leaving a uniform width and thickness.
- *Shipping* transports the finished lumber to market.

7.3.0 Resources

Video overview of Scotia Mill, Scotia, California, 2014,

https://www.youtube.com/watch?v=AT-pEOo5k88

The Leaver Manufacturing Company, Oakland, California 1919

C.W. Penoyer, President from 1911-1919, essentially reshaped the Pacific Lumber Company from a lumber and logging company into an modern forest products company in less than ten years. He reconfigured the company by consolidating major critical operations at Scotia, developing a new manufacturing center, to support the logging operations and two large mills. Although he maintained the sales office in San Francisco, and branch offices in New York, Chicago, Kansas City, Saginaw, and Los Angeles, he returned the company headquarters to Scotia. As a major railhead for the North West Pacific Railroad, Pacific Lumber also became the first major lumber company in the region to shift from primarily maritime to rail shipping

Penoyer was born in Michigan in 1873 and had arrived in California with extensive experience in lumber operations in Michigan, Texas and Louisiana. In 1896 he was already a partner in Phipps, Penoyer and Co. of Bay City, Michigan. By 1902, he was Vice President of Ramsey Company of Lake Charles, Louisiana, and retired from that position when the company was sold to the Long-Bell Lumber Company. While in Michigan, he had been associated with the Avery Murphy& Eddy interests, whose members had shaped the newly incorporated Pacific Lumber Company of Maine. Penoyer had been part of the management team that was creating the new PL manufacturing center at Wilmington in San Pedro Bay in the Port of Los Angeles when he was appointed as assistant to PL President Selwyn Eddy in 1909.

There were several major incentives for centralizing operations at Scotia. One was the close ties the company had established with the developers of the North West Pacific, the Santa Fe Land and Improvement Company. Santa Fe had been an investor in PL and had sold their shares to the Murphy syndicate, headed by Frank Murphy, when PL sold their rail lines to them. In 1907, the Company contracted to clear right of way for Northwestern Pacific and to salvage all the downed lumber. .

PL maintained a group of ships nearby at Fields Landing. At their inland location in Scotia, PL lacked the direct access to Humboldt Bay and the large fleet of ocean going ships and lumber scows held by the other major Redwood companies, Carson in Eureka and Vance in Samoa. In 1912 the Company made plans with the County for a bridge across the Eel River at Scotia. Penoyer was counting on the completion of the rail line to enable them to expand production and manufacturing.

Prior to his tenure, it was clear that Scotia had been regarded by many investors as only the center of logging and lumber production. The company had recently acquired the Blinn-Robinson lumber company in Wilmington, in the port of Los Angeles, in order to establish a remanufacturing center. In 1909 a new channel to enable ships to discharge their cargo three miles from the ocean. The managers of the Port wanted to develop a major lumber distributing point to serve the booming urban centers of Southern California and the Southwest. The new Pacific Lumber Company yard at Wilmington was of one of the largest and best equipped lumber yards on the Pacific coast. Comprising 30 acres of land it had a capacity of 10.000,000 feet of lumber, with a complete monorail system and private spur tracks from all the railroads.

Penoyer continued with the original plan to develop the manufacturing center at Wilmington and at the same time he was building and upgrading the operations Scotia. He soon moved the company general offices from Los Angeles to San Francisco, where many other Redwood lumber companies had long based their sales and marketing operations, followed by the PL sales offices.

In 1911, Mill A had been shut down for the installation of new machinery while new Mill B resumed operation after repairs due to earthquake damage had been completed. While some had questioned Penoyer's decision to follow through on both of these projects at the same time, he could see that there had already been delays in construction of NWP rail line, due to weather and local geology, so could simply not afford to wait.

When the NWP was finally completed Penoyer simply dismantled and shipped the manufacturing equipment up from Wilmington, along with key personnel, but maintained the shipping center. He also brought in most of the administrative staff in SF. Consolidating operations at Scotia, from the logging operations to finished products, had always been his objective and had only lacked an equally reliable shipping network. Twenty four railroad car loads of lumber were shipped over the recently completed railroad and all shipping thereafter went directly from Scotia by rail. At this time the Pacific Lumber Company controlled 20% of the annual production of redwood.

In shaping the development of the new wood products industry he was aided by James M. Leaver, the inventor of the first dry kilns installed at Scotia. Leaver had become the designated man in charge of modernizing mechanical operations and also in the development of new products. Leaver, originally from England, had become a naturalized citizen and had settled in Bay City, Michigan where he soon began to invent devices such as building panels, doors and shutters, and corrugated packaging which utilized the products of local mills. Sometime after 1900, Leaver had relocated to Oakland, California where he established a company to manufacture and market his devices, the Leaver Manufacturing Company.

In 1911, Leaver was appointed as assistant to company president C. W. Penoyer. Dry kilns were introduced into lumber manufacturing in order to ensure a lumber product of consistent moisture, reduce warping, and prevent moisture damage Between 1911 and 1915 Leaver received five patents for dry kilns and would eventually include the 28 Leaver kilns installed in Scotia in his advertisements. Leaver was soon placed in charge of improving the mechanical operations of the plant at Scotia and charged with the development of new devices and processes to eliminate waste and speed up production.

By 1919, Company President C. W. Penoyer had seen his dream of positioning the company as a leader in the new forest products industry and the company operations consolidated in Scotia. When he resigned, for serious health reasons, he was succeeded by John H. Emmert who continued his policy of pursuing manufacturing innovations. Leaver remained on staff and worked on mechanical improvements in the milling and manufacturing operations as well as the development of new products designed to utilize the waste products of mill operations-sawdust, bark and waste wood. Leaver now focused on improving processes at Scotia. Between 1916 and 1924 he received patents for automatic bundling and tying machines, lumber sorters, and improved lumber unstacking methods and apparatus.

Although Leaver maintained his manufacturing business in Oakland, California, several patents for inventions that were developed at this time were assigned to Pacific Lumber Company. In the following decades many other inventors would receive support for their work on behalf of the lumber company, while the patents for new products and processes were assigned to the Pacific Lumber Company.

In 1923 and 1924 Leaver filed several patents for processes that would be the basis of new products such as composite woods, papers, and the creation of synthetic fibers for textiles. Other innovations that resulted from the research and development program included the processes and equipment for manufacturing fiber board, pressboard, acoustic board and tile, artificial or laminated lumber, fertilizer and soil conditioner, composite batting, insulation, well drilling muds, dyes, and composite fabrics. These became products such as Palco Wool insulation, Palco fertilizer, and automotive filters. Between 1911 and 1962, a total of 47 patents were assigned to the Company.

Leaver's research and patents for PL contributed to the transition of the lumber industry from a focus on the production of logs and lumber and the establishment of the modern wood products industry. They were also significant in the development of processes in related fields in the following decades. After PL's success in working with Leaver, the company continued a program of research and development by working with many other inventors and established a laboratory at Scotia. One advantage was that an on-site research team could accommodate changes in the technology of logging which resulted in new resources. Redwood bark, which had been peeled off in the field during the earlier period, was now collected in the mill and became the basis for a number of by-products. These collaborations appeared to have been facilitated by the Chicago office of PL, which negotiated arrangements with most of the inventors from the 1920s through 1940s. At that time, Chicago was the center of the innovation in the industrial heartland of the Midwest.

C. W. Penoyer's vison of a modern mill and manufacturing operation had been realized. Many former waste materials and what had been considered inferior grades of wood were now being integrated into new wood products. The development of new products to utilize mill waste had ushered in the modern wood products industry.

<u>Bibliographic References:</u>

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New York Lumber Trade Journal, *C.W. Penoyer*, Obituaries, Vol. 68, March 1, 1920, page 45

Petrimoulx, Jim, *Selwyn Eddy (1847-1911), Lumber businessman, owner of Eddy Bros. & Co*. in Bay City, MI, Bay Journal, Feb. 2007. http://bay-journal.com/bay/1he/writings/eddy-selwyn-1911.html Accessed February 28. 2015

Preliminary chronology of Pacific Lumber Company innovations

Based on published histories, annual reports, and patents and products assigned to Pacific Lumber Company by inventor applicants.

Source: Google Patent Search http://www.google.com/advanced_patent_search. Accessed February 26 and February 27, 2015

- Total of 28 Leaver dry kilns installed 1913-15, five patents received 1912-1915. (Replaced by Anderson Dry Kilns around 1949).
- Synthetic fibers and composite fabric, seven patents received 1923-1941;
- Artificial lumber, laminates, fiber board, composition wood products (molds), 14 patents received 1923-36.
- Other new products, apparatus and mechanical devices 1918-1962:
    - Bundling and tying machines, two patents received 1918-19.
    - Lumber sorter, patent received 1923.
    - Method and apparatus for unstacking lumber, patent received 1928.
    - Wooden battery separator, patent received 1927.
    - Pressed or filtered wood products, one patent received 1933
    - New road construction process, one patent received 1934.
    - Heat and/or sound insulating materials, three patents received 1932, 1934, 1962.
    - Shock resisting concrete, one patent received 1935
    - Summer cottage, one patent received 1936
    - Fertilizer/soil conditioner, one patent received 1937.

- Process for smoking meat, one patent received 1940
- Automatic cutoff saw, patent received 1943.
- Lumber feeding conveyer for saw trimmers, one patent received 1944
- Well drilling composition (mud), two patents received 1951, 1954.
- Process for creating dyes from redwood bark, two patents received 1954

Analysis: Sequence of Development of the Manufacturing and Shipping Zones

Based on a review of the direction of the company, from the patents received and the periods of activity which they illustrate along with the histories available.

- Mill A and Mill B were in full production of finished lumber by 1915, when the first set of dry kilns were completed and shipping by rail was inaugurated. The development of the new kilns, manufacturing building and the shipping ad processing facilities such as the crane sheds, in the area to the north of both mills was necessary in order to integrate new rail lines. Finished materials could now be loaded directly onto railcars. For this reason the core buildings and structures were probably completed by 1920.
- In terms of the manufacturing zone, PL had expanded into some new product lines. The fabrication of wooden boxes was introduced prior to WWI. Redwood lath was introduced as a new product line sometime around 1914, the success of which is also reflected in the patenting of a bundling and tying machine (1915-1916). These products alone would not justify the construction of a large manufacturing plant. However, the planned development of numerous new products, illustrated by the number of patents approved around 1923-1936, would justify expansion of the manufacturing building.
    - The period of greatest experimentation with artificial lumber and wood products was from 1923-1936. The company was concentrating on developing those products much earlier than anyone else in the redwood industry. They held the largest number of patents in this area and it is likely that the manufacturing plant was constructed in order to facilitate the fabrication of this category of wood products.
    - Experiments with fibers and chemicals required a laboratory onsite with access to raw materials, even if the inventors had other facilities for preliminary research. A laboratory facility would probably have been in place in or near the manufacturing plant during this time.

- Experiments with bark for fertilizer, for sheathing board, as fiber for paper and filters, as well as insulation appears to have followed this period, from 1934-46. This would coincide with the introduction of Palco wool and the construction of the fiber plant. The record of patents shows that few new products or processes were introduced after 1955. Postwar production focused on construction lumber and the manufacture of products such as plywoods, fiber boards and other materials used in building trades. It is unlikely that there was any further expansion into new manufacturing lines and that existing buildings were now being refitted and adaptively reused.

As the PL annual reports of the following decades illustrate, the long term emphasis in the redwood industry shifted to the manufacture of finer grade plywoods and custom woods for interiors and exteriors. Many former waste materials and what had been considered inferior grades of wood were now being integrated into new wood products

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Wood Production: Manufacturing & Kiln Drying, Ron Smith

Lumber mills turn trees into manufactured wood products. Throughout the process, the moisture content (MC) of the wood is an important factor for producer and end user alike.

The lumber manufacturing process generally follows these steps:

1. **Head Rig:** The primary saw cuts the tree into sawn pieces or boards.
2. **Edging:** Removes irregular edges and defects from sawn pieces or boards.
3. **Trimming**: The trimmer squares off the ends of lumber into uniform pieces.
4. **Rough Lumber Sorting**: Pieces are separated based on dimension and final product production, whether the finished piece will be unseasoned (known as "*green*") or dry.
5. **Stickering**: Lumber destined for kiln drying production is stacked with spacers (known as *stickers*) that allow air to circulate within the stack (green product skips this stage and the next).
6. **Drying**: Kiln drying wood speeds up the natural evaporation of the wood's MC in a controlled environment.
7. **Planing**: Smoothes the wood's surfaces and ensures that each piece has a uniform width and thickness.
8. **Grading**: Assigns a "grade" to each piece of lumber that indicates its quality level, based on a variety of characteristics, including its MC

   .

Kiln Drying Wood for Maximum Value and Usability

In order to maximize wood's value and strength, mills invest both time and money in the kiln drying processes to remove excess moisture from the lumber stack. In fact, kiln drying on some hardwood species can take up to (and beyond) a month, depending on the initial MC of the wood.

Properly dried wood has many advantages over green wood for both producers and consumers alike. It reduces waste in manufacturing and extends the service life and usefulness of wood products, giving the consumer a stable product that will last for years.

The kiln drying process can vary considerably, depending on the species and initial MC of the wood. In general, however, these are the steps in the process:

1. Lumber producers carefully stack "green" wood, using spacers or "stickers" to create gaps for air to freely circulate throughout the stack.
2. Once the wood is placed in the kiln, depending upon wood species, the kiln is heated to temperatures between 110 to 180 degrees (Fahrenheit) for conventional-temperature kilns and 230 to 280 degrees (Fahrenheit) for high-temperature kilns.
3. Operators constantly monitor kiln temperatures and relative humidity (RH), as well as the lumber's MC. The goal is dry the lumber to the correct MC for how it will be used.

The profitability of lumber manufacturing depends on the mill's ability to maximize the wood's quality throughout the entire lumber manufacturing process. If the wood in a mill's production line is too wet or too dry, the finished product may receive a lower grade and will have a lower dollar value than a piece that has been properly kiln dried.

For the post-drying lumber processing, in-line moisture content measurement systems can easily identify and mark pieces that are either too wet or too dry. These pieces can then be pulled from the production line before further processing and possibly be re-dried or re-milled as necessary to create the highest grade lumber or wood component possible for that piece, thus increasing the mill's profits and giving consumers access to better quality materials.

https://www.wagnermeters.com/forest-products-articles/kiln-drying/wood-manufacturing-kiln-drying/