NPS Form 10-900

OMB No. 10024-0018

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NAT. REGISTER OF
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United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

940

This form is for use in nominating or requesting determination for individual properties and districts. See instruction in *How to Complete the National Register of Historic Places Registration Form* (National Register Bulletin 16A). Complete each item by marking "x" in the appropriate box or by entering the information requested. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials and areas of significance, enter only categories and subcategories from the instructions. Place additional entries and narrative items on continuation sheets (NPS Form 10-900a). Use a typewriter, word processor, or computer, to complete all items.

1. Name of Property

historic name Denver Tramway Powerhouse

other names/site number Forney Historic Transportation Museum; Recreation Equipment Inc.; 5DV541

2. Location

street & number 1416 Platte Street [N/A] not for publication

city or town Denver [N/A] vicinity

state Colorado code CO county Denver code 031 zip code 80202

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended, I hereby certify that this [X] nomination [ ] request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property [X] meets [ ] does not meet the National Register criteria. I recommend that this property be considered significant [ ] nationally [ ] statewide [X] locally. ([ ] See continuation sheet for additional comments.)

Georgianna Contiguglia State Historic Preservation Officer 7/17/01
Signature of certifying official/Title Date

State Historic Preservation Office, Colorado Historical Society
State or Federal agency and bureau

In my opinion, the property [ ] meets [ ] does not meet the National Register criteria.
([ ] See continuation sheet for additional comments.)

Signature of certifying official/Title Date

State or Federal agency and bureau

4. National Park Service Certification

I hereby certify that the property is: Signature of the Keeper Date of Action

[✓] entered in the National Register Entered in the National Register 9/8/01
  [ ] See continuation sheet.
[ ] determined eligible for the National Register
  [ ] See continuation sheet.
[ ] determined not eligible for the National Register.
[ ] removed from the National Register
[ ] other, explain
  [ ] See continuation sheet.

5. Classification

Ownership of Property
(Check as many boxes as apply)

[X] private
[ ] public-local
[ ] public-State
[ ] public-Federal

Category of Property
(Check only one box)

[X] building(s)
[ ] district
[ ] site
[ ] structure
[ ] object

Number of Resources within Property
(Do not count previously listed resources.)

Contributing	Noncontributing	
1	0	buildings
0	0	sites
0	0	structures
0	0	objects
1	0	Total

Name of related multiple property listing.
(Enter "N/A" if property is not part of a multiple property listing.)

N/A

Number of contributing resources previously listed in the National Register.

0

6. Function or Use

Historic Function
(Enter categories from instructions)

Energy Facility

Current Functions
(Enter categories from instructions)

Specialty Store
Restaurant

7. Description

Architectural Classification
(Enter categories from instructions)

Late 19th and Early 20th Century
American Movements
Other: American round-arch style

Materials
(Enter categories from instructions)

foundation concrete
walls brick
concrete
steel
roof steel
other glass

Narrative Description
(Describe the historic and current condition of the property on one or more continuation sheets.)

8. Statement of Significance

Applicable National Register Criteria
(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing.)

[X] **A** Property is associated with events that have made a significant contribution to the broad patterns of our history.

[ ] **B** Property is associated with the lives of persons significant in our past.

[X] **C** Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.

[ ] **D** Property has yielded, or is likely to yield, information important in prehistory or history.

Criteria Considerations
(Mark "x" in all the boxes that apply.)

Property is:

[ ] **A** owned by a religious institution or used for religious purposes.

[ ] **B** removed from its original location.

[ ] **C** a birthplace or grave.

[ ] **D** a cemetery.

[ ] **E** a reconstructed building, object, or structure.

[ ] **F** a commemorative property.

[ ] **G** less than 50 years of age or achieved significance within the past 50 years.

Narrative Statement of Significance
(Explain the significance of the property on one or more continuation sheets.)

Areas of Significance
(Enter categories from instructions)

Transportation
Engineering

Periods of Significance
1901-1950

Significant Dates
1911
1924
1950

Significant Person(s)
(Complete if Criterion B is marked above).

N/A

Cultural Affiliation
N/A

Architect/Builder
Unknown

9. Major Bibliographical References

Bibliography
(Cite the books, articles and other sources used in preparing this form on one or more continuation sheets.)

Previous documentation on file (NPS):

[ ] preliminary determination of individual listing (36 CFR 67) has been requested
[ ] previously listed in the National Register
[X] previously determined eligible by the National Register
[ ] designated a National Historic Landmark
[ ] recorded by Historic American Buildings Survey
#
[ ] recorded by Historic American Engineering Record
#

Primary location of additional data:

[X] State Historic Preservation Office
[ ] Other State Agency
[ ] Federal Agency
[ ] Local Government
[ ] University
[ ] Other

Name of repository:
Colorado History Museum, Denver

10. Geographical Data

Acreage of Property 1.5

UTM References
(Place additional UTM references on a continuation sheet.)

	Zone	Easting	Northing
1.	13	499240	4400370
2.			
3.			
4.			

[ ] See continuation sheet

Verbal Boundary Description
(Describe the boundaries of the property on a continuation sheet.)

Boundary Justification
(Explain why the boundaries were selected on a continuation sheet.)

11. Form Prepared By

name/title Robert A. Deering / Senior Associate (additional materials by OAHP staff)

organization Mithun Architects + Designers + Planners date February 28, 2001

street & number Pier 56 – 1201 Alaskan Way, Suite 200 telephone 206-623-3344

city or town Seattle state WA zip code 98101

Additional Documentation

Submit the following items with the completed form:

Continuation Sheets

Maps
A **USGS map** (7.5 or 15 minute series) indicating the property's location.
A **Sketch map** for historic districts and properties having large acreage or numerous resources.

Photographs
Representative **black and white photographs** of the property.

Additional Items
(Check with the SHPO or FPO for any additional items)

Property Owner

(Complete this item at the request of SHPO or FPO.)

name Recreational Equipment, Inc.

street & number PO Box 1938 telephone 253-395-3780

city or town Summer state WA zip code 98390-0800

DESCRIPTION

The Denver Tramway Powerhouse is a large industrial structure located along the South Platte River adjacent to downtown Denver, Colorado.[1] The building sits at the convergence of Cherry Creek and the South Platte River. This location was advantageous for the production of electric power due to nearby rail lines, which provided access to coal for fuel, and the adjacent river, which provided cooling water and a means of discarding waste. The site was also central to other Tramway system facilities.

The orientation of the powerhouse along a northwest-southeast axis matches the diagonal compass orientation of the city's downtown street grid. The original 1901-04 building was followed by an addition in 1911 that extended the building to the northwest and increased its square footage by half.[2] A second addition in 1924 served as the battery house. The one-story over basement powerhouse is constructed of concrete foundations, red brick walls, and a steel roof, and is of generally rectangular plan, measuring approximately 108 feet by 440 feet by 55 feet high above grade. The battery house addition is an all-concrete two-story structure located in the north corner measuring approximately 24 feet by 145 feet by 34 feet above grade.

The foundations and floors are poured concrete supported on pilings extending eighteen to twenty-six feet to bedrock below. The above-grade walls are comprised of uniform size red brick laid in running bond. The standing seam metal roof is laid on wood planking supported on wood purlins and steel trusses. The roof over the 1911 addition is of nearly flat construction, gently sloping to the sides from a central mechanical platform. The roof above the original section is of more complicated design, consisting of a double-gable, or M-roof, covering the long boiler and generation bays. The roof gives the appearance of a single truncated gable when viewed from grade. Several flush skylights occupy the valley slope of the generator room gable. A large boxed skylight straddles the ridge of the generation bay. A round skylight on the boiler room gable covers the space formerly occupied by the steel smokestack.

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[1] Historical documentation refers to the building as both "Power House and "Powerhouse." In the interests of consistency, the latter spelling is used throughout the nomination.

[2] Construction dates are not certain for the original powerhouse. A building permit issued on May 23, 1901, refers to a 98 foot by 125 foot powerhouse. An additional permit issued on July 17, 1902, authorized the construction of a "brick addition to power house" at 138 feet by 105 feet. These two permits together equal the approximate plan dimensions of the original powerhouse. The sign plaque on the southeast elevation indicates a 1901 construction date, but this appears to reference the beginning rather than the completion date. This is supported by an article in the January 1, 1904, *Rocky Mountain News*. As part of its year-end summary, the newspaper ran a half-page report on the Denver Tramway Co. operations. In a reference to the new powerhouse, the article referred to it as the "nearly completed" powerhouse. Finally, the 1904 Sanborn fire insurance shows a completed powerhouse building.

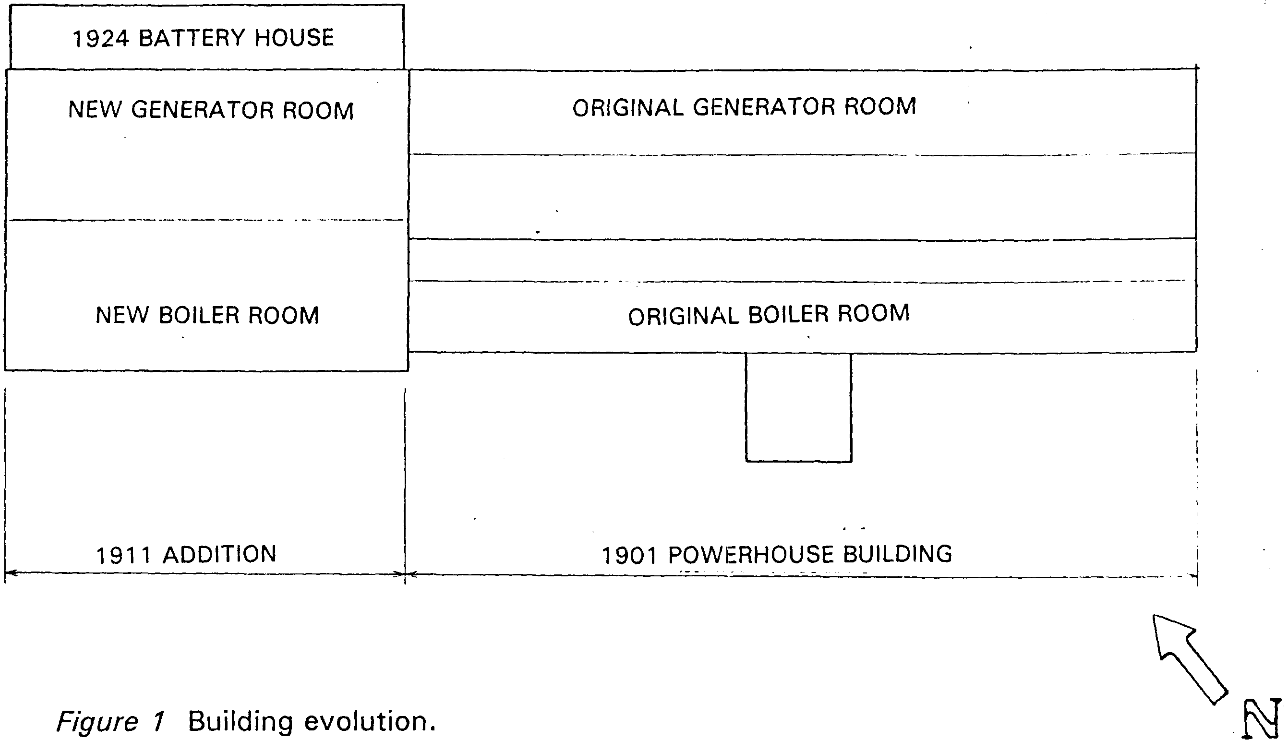

Figure 1 Building evolution.

Southeast Elevation

The southeast elevation consists of three bays delineated by pilasters surmounted by corbel arches (see photo 2). The central bay is slightly wider and the arch higher than the flanking bays. A concrete deck runs the full length of the elevation just above grade. A corbel belt course divides the elevation approximately mid-way between grade and eave. This belt course continues across all the elevations of the original building. A corbel table forms a raking cornice on the gable parapet and is integrated into the arches.

The lower portion of the center bay contains four evenly spaced, wood frame multilight double-hung windows with concrete sills and fanlight transoms. The semicircular arched windows are approximately 16 feet in height. Most of the lower level windows in the plant are of this same design, though there is some variation in height and number of lights. Doors throughout the plant are also surmounted by fanlights. A secondary corbel belt crosses the bay at the level of the transom bar and forms imposts of the projecting archivolts over each fanlight. This impost coursing repeats in each bay of the original building. The lower portions of the flanking bays contain a series of double-hung windows with fanlights, a pedestrian entry, and a large double door equipment entry.

The upper portion of each arched bay contains a circular clerestory window with radial muntins and corbel surrounds. The central bay also contains a large, concrete panel that reads, "The Denver Tramway Power Co., 1901." A lighted "Recreational Equipment Inc." sign fills the space above the corbel arches. A lighted "Starbucks Coffee" sign occupies the southwestern-most bay below the corbel belt course.

Northeast elevation

The northeast elevation of the original building is divided into fifteen evenly spaced bays by full-height brick pilasters (see photo 3). The lower portion of each bay contains a pair of tall semicircular arched multilight windows. Semicircular clerestory windows with radial muntins, corbel surrounds, and concrete sills fill each bay just below the corbeled cornice that runs the full length of the elevation below the eave. The fourth bay in from the southeast contains a pedestrian door surrounded by metal panels surmounted by a painted sign on a concrete panel stating "International Harvester Company, Warehouse No. 2." The sign dates to a period in the late 1950s after the building's use as a power plant. A concrete ramp with metal railing provides access to the entry. A metal railing along the northwestern portion of the original building protects a lightwell and stair.

The northwestern-most third of the elevation consists of the 1924 battery house addition and the 1911 powerhouse addition (see photos 4&5). The battery house is of poured concrete construction and is articulated by pilasters and recessed panels within each bay. A gabled metal roof runs the full length of the addition and is topped by four hip-roofed boxed skylights. A metal stair and railing leads to a second-story entry. The addition includes a loading dock extension recently constructed of concrete. The southeast elevation of the battery house contains two roll-up metal loading dock doors on the lower level (one in the battery house itself and one in the new extension), and two semicircular arched multilight windows. Corner pilasters frame the elevation and rise above the raked gable parapet.

The upper portion of the 1911 addition rises behind the battery house. Brick pilasters divide the elevation into seven equal bays each containing a pair of semicircular arched multilight clerestory windows with and concrete sills. A corbel belt course crosses the bay at the level of the transom bar and forms projecting archivolts over each fanlight. A corbel table runs the full length of the elevation just below the sills. Four courses of corbeling form the cornice.

Southwest elevation

The southwest elevation of the original powerhouse forms a near mirror image of the northeast elevation (see photo 2). A significant variation occurs at the center of the elevation where a full-height, 38 foot by 38 foot extension projects to the southwest (see photo 6). The extension originally contained the coal dump and water pumps. The fenestration of the main building continues on the extension, the only exception being the porte cochère to accommodate railroad gondolas.

The southwest elevation of the 1911 addition is divided into six equal bays by pairs of steel columns separating brick panels (see photo 1). Each bay contains a single semicircular arched multilight sash with concrete sill. A brick drip mold surmounts each fanlight. The regular fenestration is interrupted in one bay where the brick panel has been replaced by glazing. The brick wall terminates in a band of metal panels covering former louvered ventilators. Corporate and product signs line the panels.

Northwest elevation

The northwest elevation fronts onto Platte Street (see photo 5). Brick pilasters divide the elevation into four irregular bays. The corbel tables as well as the window and door types match those of the southeast elevation, though the northwest elevation tops out with a stepped parapet. The clerestory consists of bays of triple multilight sash alternating with bays of single circular windows. The northwest elevation of the battery house addition matches its southeast elevation with two recessed panels replacing the dock door.

Interior

Exposed steel trusses support the wood plank roof decking and are a prominent feature within the building interior (see photos 12 &14). Intermediate structural support for the original boilers and plenums are exposed built-up steel columns and beams (see photos 11 & 16). A brick and concrete horizontal plenum extended the full-length of the building and was used for smoke exhaust and coal supply. Steel structure for the plenum is all that remains. Concrete equipment foundations and brick ash pits in the basement remain indicating the locations and scale of the equipment.

New steel mezzanines with connecting stairs and two elevator shafts fill portions of the interior space. Areas have been partitioned for offices, dressing rooms, stock storage, and mechanical space (see photos 12 & 14).

Alterations

The large steel chimney which formerly extended high above the roof was dismantled prior to 1942 (see photo 25). Numerous interior alterations occurred following the closure of the powerhouse in 1955. The electric generating equipment was removed after 1955, though its final disposition is unknown.

In 1956, the Denver Tramway Corporation sold the building for use as a warehouse by the adjacent International Harvester dealer. It is likely that much of the brick window infill occurring during this warehouse period. A northeast elevation vehicular door was also added during this use. In 1967 the building was sold again and converted for use as the Forney Transportation Museum. The museum generated modest revenues which permitted only the minimum amount of building maintenance. The former powerhouse suffered from severe deterioration and was threatened with condemnation. In 1998, Jack Forney, Jr., sold the building to Recreation Equipment Inc. (REI).

Between 1998 and April of 2000 a major rehabilitation project converted the former powerhouse into the REI Denver flagship store. REI carried out the rehabilitation as a federal investment tax credit project with Mithun Partners as architects of record. As part of this project, the infilled original window locations were restored with new windows that very closely approximated the original window construction. Where possible, original windows were salvaged and rebuilt (see photos 7-9). The entire exterior of the building was cleaned and the brick was repointed. In select locations large expanses of wall were rebuilt where the structure had most seriously deteriorated. A small, non-historic building addition was demolished and the brick was salvaged to provide material for the reconstructed areas. The battery building concrete was severely deteriorated and was repaired and structurally reinforced. Foundations were stabilized where necessary to maintain structural integrity.

The wood roof deck was replaced with new wood decking in a few locations where it had deteriorated to an advanced state. A new metal roof was provided to replace the previous asphalt shingle roof. Sanborn fire insurance maps indicate that the original roof was of elaterite, a high sulfur bitumin obtained from Colorado and Utah considered valuable for roofing. The brick and steel structure was reinforced with additional steel bracing to ensure the structural integrity of the building. A small loading dock addition to the battery building was included as part of the rehabilitation work. The new dock was constructed of concrete to match the battery building but detailed in such a way so as to distinguish it as a contemporary addition.

Interior brick, wood, and steel were cleaned and brick repointed where required for structural reasons.

The original building had numerous floor levels above the basement in the boiler and generation bays. Due to severe structural deterioration, new concrete floors were built where required over existing. These raised floors also facilitated movement through the building and improved handicapped accessibility by reducing height between floor steps. Additional mezzanine levels were also created to take advantage of the significant volumes of the building and increase usable area. In the powerhouse addition where the volume was considered to be an important characteristic to the interior space, the mezzanine areas were kept to a minimum with open space left on three sides. The original steel work may be differentiated from the new mezzanine framing by its construction characteristics. The original steel framing is composed of built up columns and beams fabricated with rivets (see photo 16). The new mezzanine framing is of rolled steel with bolted joints (see photos 12 & 14).

The main retail entrance is located in the coal dump and water pump extension. As such the original building entrances have become secondary entrances, but retain their original use.

The original building grounds were primarily devoted to a network of rail lines. Surrounding buildings and the Fourteenth Street Viaduct tightly constrained the powerhouse property. Most recently the grounds housed an exhibit area for railroad cars. Like the building, the grounds have been completely rehabilitated. A parking garage located below grade is largely invisible. The amount of surface parking on the site has been minimized by use of the garage and a surface parking lot across the street. The on-site parking that is visible is obscured by a richly landscaped yard with meandering paths, indigenous plants, water elements, and pedestrian plazas. Because of the significant changes to the grounds, only the building and the immediately associated land are included in this nomination.

STATEMENT OF SIGNIFICANCE

The Denver Tramway Company Powerhouse is eligible for the National Register under Criterion A for its association with the expansion and operation of the city's electric streetcar system. The construction of the powerhouse in 1901-04 corresponded to the transformation of Denver's streetcar network to an all electric system. Following its 1911 addition, the powerhouse became the primary source of electricity for Denver's streetcars and operated until the end of the Tramway's streetcar service in 1950.

The powerhouse is also eligible for listing under Criterion C for its engineering significance. The powerhouse represents a type and method of design and construction typical of industrial architecture at the beginning of the twentieth century. Brick pilaster construction with extensive sash infill constitutes common industrial design of the period. The use of steel wall framing in the 1911 addition speaks to continued advances in structural design. On the interior, the high interior spaces with steel roof trusses, the accommodation of travelling cranes in long narrow production bays, and the use of built-up steel framing all represent advances in industrial design and materials adopted by engineers in the early twentieth century.

POWERING THE TRAMWAY SYSTEM

The transportation enterprise that eventually became the Denver Tramway Corporation (DTC) was organized in 1885 and incorporated the following year as the Denver Tramway Company. In 1890 it absorbed the Denver Tramway Extension Company and the South Denver Cable Railway Company. In 1893 the growing concern merged with the Metropolitan Railway Company to form the Denver Consolidated Tramway Company. A final merger in 1899 with the Denver City Traction Company resulted in the Denver City Tramway Company. The streetcar company resumed the Denver Tramway Company name in 1914 and in 1924 changed to the Denver Tramway Corporation. During most of its operational life the entity was known informally as the Denver Tramway Company (DTC).

Streetcar systems changed the character of Denver and many other cities during the late nineteenth and early twentieth centuries. Extension of streetcar lines allowed cities to expand outward from congested downtowns, thus speeding the development of surrounding suburbs. As people moved out from the city centers, retail business moved or expanded into downtown areas and other businesses developed along the busiest streetcar routes. Denver followed this growth pattern as the DTC extended rail lines outward to undeveloped areas.

The evolution of Denver's mass transportation includes a history of horse-drawn cars, an early but unsuccessful electric system, and a cable railway network. Horse barns provided the feed and sleeping quarters necessary for the first equine powered transit systems. The cable railway system required a more complicated infrastructure that included cable pulling powerhouses. Two cable railway facilities kept the system operating. The Denver City Cable Railway Powerhouse at 1215 Eighteenth Street (National Register listed) began operating in 1889 to power the thirty-mile network. The other powerhouse at Colfax and Broadway (demolished) occupied a prominent location just west of the State Capitol building.

In addition to the cable system, DTC also inherited electrical powerhouses from the smaller streetcar companies it absorbed. An example was the powerhouse and garage at the West End Street Railway Company (demolished). Built in 1890 at Thirty-eighth Avenue and Utica in northwest Denver, the plant continued to supply electric power after joining the DTC system.

Even in urban areas where central station power was available, manufacturers often chose to operate their own electric power plants, just as they had relied on their own steam engines to power factory millwork. In fact, industrial power plants produced nearly half of the nation's electric power before World War I.[3] By the early 1900s the Denver Gas & Electric Company provided electrical power to most Denver area homes and businesses. It remained common for the city's major industrial plants to supply their own needs with company owned powerhouses. The streetcar system required significant amounts of electricity along with a guarantee of uninterrupted service. DTC management felt most comfortable filling its generating needs with company-owned plants.

The consolidated transit system provided DTC with an opportunity for economies of scale. In 1892 DTC constructed a major new electric power generating facility at Thirty-second and Blake (extant) to provide a central power source. This powerhouse supplied a major portion of DTC's needs until 1911.

The Tramway Co. built a new $1,000,000 powerhouse at 1416 Platte Street in 1901-04 to provide additional electric power to its ever-expanding system, which by 1903 covered 155 miles. The last cable cars ran in 1900 and with the arrival of the new century DTC operated an all electric trolley system. The new powerhouse was intended to take the place of seven smaller facilities. The company managers chose the new plant's location for its easy access to railroad delivered coal, its proximity to the DTC's main terminal and downtown Denver, and its nearness to the South Platte River, which provided water to cool the powerhouse's turbines as well as a means of disposing of waste.

The Tramway Co. ran a very integrated system. Coal for its powerhouses came from the firm's own coal mine in Leyden, northwest of Arvada. The DTC used its Denver and North Western Railroad subsidiary to haul the coal to the Denver plants. The power plants themselves were organized in 1901 as the wholly owned DTC subsidiary, the Denver Tramway Power Company. The subsidiary operated until its absorption into DTC in 1912.

A major addition to the Platte Street powerhouse in 1911 increased the plant's capacity to handle a network of rail lines that extended over 200 miles. The plant expansion made the Platte Street facility the system's main source of electric power. The enlarged plant could produce up to 9,500 kilowatts. In order to distribute this electrical power throughout its operating system, DTC established a number of electrical substations throughout the Denver area. These stations

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[3] Betsy Hunter Bradley, *The Works: The industrial Architecture of the United States,* 49.

converted the high-voltage electricity from the powerhouse to a lower voltage and then distributed the electricity along the various over-street lines to power the individual cars.

The DTC's electric streetcars served as the primary form of transportation in Denver during the late nineteenth and into the early twentieth centuries. In 1908 the streetcar system transported 80 million passengers while running over 11 million miles. An average of 240 streetcars operated daily on Denver area streets. Competition from private automobiles soon began to cut into the streetcar's clientele, but ridership remained above 40 million passengers a year into the 1920s.

Rising numbers of automobiles led to traffic congestion by the 1930s. Cars increasingly competed with streetcars for space on the city streets. DTC began using buses to replace electric streetcars on selected routes. Yet, electric rail service reached its peak during World War II when gas rationing forced motorists out of their autos and into the streetcars. Ridership increased to more than 110 million passengers annually by 1945. Pre-war patterns returned in the late 1940s. The conversion to diesel-powered buses accelerated. The last electric streetcar ran in Denver on July 2, 1950. For a few years DTC used the remaining electric grid to operate trolley buses on some routes. By 1955 DTC ceased all electric bus operations.

The Platte Street powerhouse continued to operate through the end of streetcar service. The plant shut down its generating facilities on July 15, 1950. Public Service Co., the city's private electric producer, supplied power to operate the remaining trolley buses with the DTC powerhouse serving merely as a distribution facility. On the evening of Friday, June 10, 1955, the operators at the Platte St. powerhouse shut the electric power off for the last time. DTC continued its all bus operation until 1971 when the City of Denver purchased the company's holdings and formed Denver Metro Transit. Denver Metro Transit evolved into the Regional Transportation District, which manages mass transit in the Denver metropolitan area today.

The DTC and its streetcars transformed Denver and its suburbs by allowing people to exchange the congestion, crime, noise, and filth of the inner city for suburban homes. The cheap fares and easy access of the DTC's routes made it possible for people to commute to work downtown from almost anywhere in the Denver area. The move to the suburbs continued as automobiles became the dominant mode of transportation. Physical manifestations of the streetcar's influence remain in the form of a pattern of development in outlying parts of Denver along the former trolley routes.

Several elements of the former Tramway system remain, each capable of conveying part of Denver's transit history. The Tramway Building with its car barn (1100 14th Street; National Register) is directly associated with the management of the system, labor relations, and the infrastructure necessary to service both cars and crews. The Motor Coach Division Building (3500 Gilpin Street; National Register) speaks to DTC's conversion from streetcars to busses. And of course, the surviving interurban railcars, Denver & Interurban No. 25 and Denver Tramway Streetcar #.04 (both State Register listed), provide a sense of the actual travel experience. The DTC Powerhouse helps to round out the story by providing a reminder and a direct link to the extensive behind the scenes infrastructure necessary to keep an electric streetcar system in operation. As the largest and longest operating of the city's two surviving streetcar powerhouses, the DTC Powerhouse conveys an important part of the history of the consolidated streetcar system that shaped the city's growth during the early twentieth century.

ENGINEERED FOR POWER

The 1901-04 DTC powerhouse, whose designer remains undiscovered, represents a type and method of design and construction typical of industrial architecture at the beginning of the twentieth century.[4] Brick pilaster construction constitutes common industrial engineering of the period. This form of construction allowed the use of thinner wall panels than required for load-bearing masonry and permitted the expansive use of sash. The steel wall framing with brick infill in portions of the 1911 powerhouse addition speaks to continued advances in structural design. The high interior spaces spanned by steel roof trusses, the accommodation of travelling cranes in long narrow production bays, and the use of built-up steel framing all represent advances in industrial design and materials utilized in the early twentieth century.

Architectural historian Betsy Hunter Bradley has traced the development of industrial architecture in the United States. She suggests that powerhouses and steam-electric power plants were engineered for efficiency in operation and maintenance. Fireproof construction was a matter of necessity. Noncombustible materials, usually stone or brick, and later of reinforced concrete, were used in the construction. Powerhouses were two-part facilities with separate rooms for boilers and engines, and perhaps a third for coal storage. The boiler and generator rooms, of similar size and side by side in plan, were separated by brick fire walls. This division of space kept coal dust produced by stoking of boiler fires away from the machinery and gauges in the engine room. Trussed roofs spanned each area to eliminate interior columns. The size of the structure was governed by the number of boilers and engines housed and the space needed for stoking the boilers, maintaining the equipment, and replacing boiler tubes. Large exterior doors and overhead traveling cranes facilitated the handling of large pieces of equipment. Expansive windows with operable sash were recommended, as were skylights or monitors. In some large powerhouses, coal bunkers were positioned above the boilers, and conveyor systems both delivered coal and removed ashes. This arrangement often made the boiler house taller than the adjacent engine room.[5]

The DTC Powerhouse utilized this basic structural plan. A brick firewall separates the former boiler room from the generator room. The removal of the boilers themselves left large openings in the firewall. The boiler room and generator room run side by side parallel to the long axis of the building. Coal bunkers supported on steel framework once supplied the bank of boilers. A 1908 *Rocky Mountain News* article praised the plant's coal delivery and ash elimination system. Human hands never touched the coal after leaving the Leyden Mine. The coal was automatically dumped into waiting coal cars that dropped their loads into a coal dump at the plant (see photo 23). Conveyors distributed the coal to bins above the boilers from which automatic stokers feed the fires

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[4] Building permits for the powerhouse do not indicate an architect or a builder.

[5] Bradley, 50-51.

(see photos 19 and 20). Conveyors also removed ash from the boilers and carried it to a waiting rail car for shipment to the dump.[6] The conveyors and bunkers have been removed but the supporting steel framing remains.

Bradley demonstrates that a number of engineering elements and materials further define the early-twentieth century powerhouse. The discussion below relates these items to the DTC Powerhouse.

Structure

Wood-framed structures offered technological and economic advantages that were exploited in industrial building construction. Wood was valued for its high tinsel strength and elasticity. Compared to stone and iron, wood was easier to work. Wood posts were utilized instead of masonry interior bearing walls because they were more efficient in resisting loads and allowed for greater flexibility in the use of space. Skeletal wood frames lent themselves to rational design and the use of engineered curtain walls. These advantages were offset by wood's limited strength and combustibility. By 1910, the use of wood in industrial building construction had become more limited, primarily because wood had become difficult to procure in longer lengths.[7]

Masonry construction materials – stone, brick, and tile – were utilized in factory construction because of their strength and fire resistance. The popularity of stone construction reflected regional resources and traditions. Locally available granite, schist, sandstone, and limestone were noncombustible and inexpensive building materials. The strength and hardness of granite recommended the material for industrial use, particularly for foundations.[8]

Brick pressed by machine became the masonry material of choice for fire-resistant construction around 1860 because it was denser than hand-molded brick and had a greater resistance to high temperatures. Brick and other clay products – ornamental terra cotta and hollow tile – remained the most fire-resistant building material available prior to the widespread use of concrete.[9] Builders began to use hollow terra-cotta tile during the 1870s for the construction of partition walls and floor arches and as a protective covering for iron and steel elements.[10]

Iron and steel framing in industrial buildings allowed for increases in both span and strength. In fact, these considerations far outweighed the risk of exposing iron and steel frames to fire. The forms developed to take advantage of these materials evolved jointly with consolidated, open plans for manufacturing works. Iron was incorporated into industrial buildings in an incremental manner. It was used first as the tie-rods that braced brick structures and as discrete elements in timber roof trusses. The next steps included the use of iron roof trusses and cast-iron bearing

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[6] *Rocky Mountain News*, January 1, 1908, Section 2, p 3.
[7] Bradley, 133.
[8] Ibid., 135.
[9] Ibid., 135-36.
[10] Ibid., 137.

plates and columns to support the heavier loads of machinery in multistory lofts. Combination framing systems of cast-iron columns (in compression) and wood (in tension) in beams and rafters capitalized on the properties of both materials.[11]

Wrought, or rolled, iron was utilized in beams and also as an alternative for cast-iron columns because of its greater tensile strength. Machine-fabricated wrought-iron plates, channels, and angles could be joined into various configurations of built-up shapes that could be easily inspected for flaws and checked for proper thickness.[12]

During the last two decades of the nineteenth century, cast iron, wrought iron, and steel were all used in industrial building construction. The practice of forming built-up shapes in machine-fabricated iron and steel and their superior strength led to the more limited use of cast iron. Wrought iron and steel had almost identical material properties in tension and compression; but steel had an elastic nature when stressed almost to the breaking point that made it the superior building material.[13]

Steel's tensile and compressive strength provided the stability and spans desired in industrial buildings, and its ductile and elastic nature gave it the ability to withstand the pounding and jarring of machinery without fracturing. The ability of steel to endure strain when approaching its elastic limit diminished the immediate seriousness of errors made in the design of framing and bracing. The speed with which steel-framed buildings could be erected from factory-fabricated members also recommended its use. In comparison to those of wood and iron, steel framing members could be smaller in section; therefore they were lighter in weight, took up less room, and did not obstruct as much daylight from skylights, monitors, and windows. Steel did not shrink or rot, and when properly protected with paint or treated to produce a protective oxide coating, it required little maintenance.[14]

The exterior walls of the original portion of the DTC Powerhouse are of brick pilaster construction. The thick pilasters carry the load of the roof, interior floors, and in the case of the generating rooms, the traveling cranes. The brick panels between the pilasters form curtain walls supporting only their own weight. Such masonry construction typifies industrial construction in early twentieth-century Denver.

The southwest elevation of the 1911 addition reflects advances in the use of steel frame construction (see photo 1). Exposed steel columns replace the masonry pilasters. As in brick pilaster construction, the brick panels between the steel columns function as curtain walls.

On the powerhouse interior, extensive steel framing was used to support the coal delivery system and the chimney flues in the boiler bay (see photos 11 & 16). Built-up columns and girders

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[11] Ibid., 138.
[12] Ibid., 140.
[13] Ibid., 144.
[14] Ibid., 144-45.

provided strong support for the elevated coal bins above the brick boilers. The steel frame kept the corridor clear for operation and maintenance in front of the boilers.

Though the boilers and associated coal bins have been removed, the steel framing remains. The framing conveys the design and application of steel in a twentieth century industrial structure.

Windows

Common wisdom throughout the nineteenth century was that good lighting could not be achieved in a factory building over 60 feet in width. Wall construction determined the maximum size of windows and hence the quality of the interior lighting. Load-bearing masonry walls supported a portion of the floor-load in addition to their own weight, and the width of the window openings in them was limited by the strength demanded of the wall. The concentration of the strength of the wall in pilasters permitted larger openings. This was one reason for the popularity of pilaster and panel wall construction.[15]

Regularity in the size and placement of window openings in industrial buildings was a function of the identical dimensions of the interior bays and the need for even interior lighting. Uniform fenestration was also a means of providing a sense of organization and dignity for the factory exterior. In most cases, a range of windows was broken only by hoistway doors and vehicle passageways, or perhaps by areas of more extensive glazing. For aesthetic and programmatic reasons, regular fenestration prevailed even when the demand for good lighting was not a dominant consideration.

During the mid-nineteenth century, standard units of multilight wood sash, either double-hung or fixed, were placed in industrial buildings. Counterbalanced double-hung sash allowed large windows to be opened with ease. The lowering of the top sash in unison with the raising of the lower one facilitated the movement of air by providing an outlet for hot air near the ceiling.

Around the turn of the twentieth century, the use of metal window frames and sash became more common, though by no means universal. Sheet metal was pressed into service in metal-clad and hollow metal window frames.[16]

The DTC Powerhouse employs extensive glazing in the brick panels between its pilasters (see photos 2 & 3). The two longest elevations of the original powerhouse section feature rhythmic bays of pairs of multilight double-hung sash with fan light transoms. The vast majority of these windows are 16-feet tall. Abundant natural light enters to illuminate the boiler and generation bays. Each bay also includes a semicircular clerestory window which provides additional interior illumination. The fenestration in the 1911 addition varies, in particular on the southwest elevation where the number of windows is significantly less. The shorter southeast and northwest elevations are more irregular due to a number of pedestrian and equipment doors, but

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[15] Ibid., 162.
[16] Ibid., 165.

again, large expanses of glazing fill the spaces between the pilasters (see photos 2 & 5). The southeast gable and upper level of the northwest elevation each contain clerestory windows to enhance illumination.

Traveling Cranes

Electric-powered cranes, along with electric drive and steel framing, revolutionized the physical setting of heavy manufacturing. The elimination of overhead millwork, in fact, made possible the use of traveling cranes in machine shops and other areas previously filled with shafting. New types of spaces – crane-served bays and craneways – became essential components of industrial building design.[17] Powerhouses did not engage in manufacturing, but the need to install and maintain heavy electric generating equipment lent itself well to the use of traveling cranes.

The traveling crane consisted of a trolley incorporated into a bridge, or girder, that spanned a pair of elevated tracks (see photos 21 & 24). It had two motions in a horizontal plane: The trolley moved transversely on the bridge and the bridge traveled longitudinally along the rails. It appears that traveling cranes were not commonly used in the United States until the last quarter of the nineteenth century. Traveling cranes were not cost-effective labor-saving devices for American manufactures during the mid-nineteenth century for several reasons. Because they could not be used in mechanized operations where headroom was filled with millwork, the jib crane continued to be the most commonly used industrial crane. Timber-framed travelers were limited in capacity and span. They were also primitive in design and difficult to operate effectively. Traveling cranes worked well only when they were well balanced, absolutely stable, and free from vibration.[18]

Early traveling cranes were difficult to power. Line shafting was driven by a stationary steam engine or by a steam engine attached directly to the crane. Compressed air-driven (pneumatic) traveling cranes suffered from dragging air hoses, and rope-driven models were quite slow. None of these methods of operation was very satisfactory. By 1890 electric-powered travelers were available from several crane manufactures.[19]

The long double bays of the traditional powerhouse may appear to have been designed specifically to accommodate a traveling crane. While the crane eased installation and maintenance of electric generating equipment, the need for fire resistance, efficiency in operating and considerations of lighting and ventilation significantly influenced powerhouse design.

The DTC Powerhouse contained traveling cranes which operated the full length of the 1901-04 and 1911 generating bays. Though the cranes and the rail supports have been removed, the location of the rails along the side walls and across the pilasters remains visible (see photo 14).

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[17] Ibid., 98-99.
[18] Ibid., 99-100.
[19] Ibid., 100.

Roof

The industrial roof was engineered to serve the manufacturing process – to provide ventilation and light, resist fire, span large areas, and support equipment. During the nineteenth century, many factories had gable roofs. Initially, the scale of industrial operations was well matched with the limitations of the span of roof rafters, and a 25- to 30-foot width for factories prevailed. During the mid-century, industry began to require larger spaces, and two methods of spanning somewhat wider industrial buildings with gable roofs became standard practice. Traditional rafters and purlins could be used to support the roof of a wide building if two rows of columns were used to divide the interior into thirds. Alternatively, roofs supported by trusses eliminated the need (or limited the number of) interior columns as they spanned wider structures.[20]

The pitch of a gabled factory roof was a compromise between the rise needed to keep wind from driving rain under roofing materials and the flatness that minimized the wind load and limited the area of the roof. Such roofs were covered with a variety of roofing materials, the choice of which depended on cost, degree of fire-resistance required and the pitch of the roof. The use of wood shingles on industrial buildings was avoided, although wood sheathing was often laid under more fire-resistant sheathing. Slate shingles and sheet metal were the fire-resistant roofing materials of industry until the 1890s, when concrete roofing tiles, slabs, and shingles became available. By the time asphalt shingles were introduced in 1916, few new factories had gabled roofs, though many older ones were still in use.[21]

The elimination of spaces that easily caught fire and the stability gained from a roof of mill construction led to the use of nearly flat roofs on industrial loft buildings during the mid-nineteenth century. This change was made possible by built-up roofing, developed during the 1840s, that could be used on flat and very low-pitched roofs. In the following decades flat roofs became standard for urban industrial and commercial buildings. Tar and gravel roofing, another common type of fire-resistant covering, could be used only on a flat or very low-pitched roof with a rise of not more than one inch per foot.[22]

Most trusses used in American industrial buildings were simple ones, and many were constructed with both timber and iron elements. Even after the introduction of iron trusses, timber trusses remained in common use because many builders knew how to erect them and the small pieces of lumber that comprised trusses were inexpensive. During the mid-1850s iron trusses appeared in large production sheds. The use of iron trusses spread, and during the 1880s the demand for them increased further due to the scarcity of good timber and the vulnerability of wood buildings and roofs to fire. [23] Iron eventually yielded to steel trusses as the latter material grew in availability.

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[20] Ibid., 178.
[21] Ibid., 178.
[22] Ibid., 179.
[23] Ibid., 181.

The form of the roof truss was determined by the length of the span and the number of supporting columns. The bracing of the roof monitors and the accommodation of wind and snow loads were taken into account, as were the slope of the roof and type of covering to be used. For narrow roofs of 20 to 30 feet, a king-post or king-rod-and-queen-rod truss was recommended. Two truss types were commonly used for the wider gable roofs of industrial buildings. Variations of the Fink and fan trusses, including their compound versions with subdivided panels, worked well for spans up to 100 feet. The Fink truss was preferred because of its simplicity and low cost. Arched roof trusses could support spans of more than 100 feet. For nearly flat roofs, flat Pratt, flat Warren, and flat Howe trusses – which could be used for spans of various lengths up to 80 feet by varying the number of panels – were favored.[24]

The spacing of roof trusses was a matter of preference and changed over time, even though bay width and truss dimensioning were interrelated. The wider the spacing, the heavier the trusses had to be. Positioning trusses 10 to 16 feet on center was considered most economical for spans up to 50 feet. For longer spans, a distance of from one-fourth to one-eighth of the span length was suggested. If trusses were only 8 to 10 feet apart, planking could be placed across them, eliminating the need for rafters and purlins. During the early twentieth century it became common practice to place trusses 20 to 30 feet apart. In addition to carrying its covering, roof framing supported shafting, hoists, tramways, and cranes.[25]

The DTC Powerhouse utilizes two basic truss types. In the gable roofed original section, the roof follows the standard practice of using Fink trusses (see photo 12). The trusses in the generator bay are of standard design. The trusses in the boiler bay are unusual in that the peak is off-center. This results in one upper chord being both longer and of gentler slop than the other. The off-centered peak allows it to match the height of the peak of the generator-room trusses.

The nearly flat roof of the powerhouse addition results in the use of a different truss type – a flat Howe truss (see photo 14). Again, this represents an accepted industry standard.

Skylights

Skylights were the most common means of lighting the top story of industrial lofts during the nineteenth century and were also used extensively on production sheds. The shape of skylights, as well as their form, varied over time, culminating in large expanses of continuous skylights.[26]

Skylights placed flush with surfaces of pitched roofs gained acceptance and popularity by the second-third of the nineteenth century. The form of flush skylights were expanded to glazed roofing. Heavy plate glass was installed to form part of the roof structure in large manufacturing

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[24] Ibid.

[25] Ibid.

[26] Ibid., 186.

plants and train sheds. Low, boxed-skylights with hipped or single-pitch roofs were also common. The early standard boxed skylight of the early 1900s was 12 by 6 feet.[27]

The DTC Powerhouse included a series of flush mounted skylights. The skylights were located along the valley side of the boiler room and generator room gables. In these positions the skylights provided natural light sources opposite to the side wall sash. An additional six 4 by 5 foot wire glass skylights illuminated the boiler room in the 1911 addition. Only the skylights in the original generator room remain.

Chimneys

The industrial power plant produced a draft that facilitated the combustion of coal (which heated the water in the boilers to produce steam) and carried off gasses that resulted from combustion. The first consideration largely dictated the chimney's height, since the intensity of a draft depended on the difference in weight of the column of air within it and the surrounding atmosphere, not on the diameter of the shaft. The height of the chimney was also influenced by the type of coal burned and generally ranged from 75 to 100 feet. Engineering criteria favored a cylindrical chimney to a square one because a rounded structure was less exposed to wind pressure. Also, a cylindrical interior flue offered less resistance to gases than a square one and had no corners that could fill with eddy currents. Octagonal chimneys offered only a little more exposure to wind than round ones and took less material to construct than square chimneys.[28]

Chimneys built of brick were most common throughout the nineteenth century. Around 1900 radial brick chimneys began to appear in the United States. Radial bricks, made from refractory clay, had curved faces 4 inches by 6 inches. Their angled ends were part of the radius of the chimney's circular plan. Because of the larger sizes of the units, a chimney of radial brick incorporated less mortar and was stronger and less expensive to construct than a chimney of standard brick.[29]

A short chimney, particularly a self-supporting one made of sheet metal, was considered a stack. Iron stacks were in common use by the 1870s in areas where sheet-metal-working shops could provide them as an inexpensive alternative to brick chimneys. An iron or steel stack was more efficient than a brick chimney because there was less air infiltrating through the walls of the structure and because it took up less space than its brick counterpart. A number of small steel stacks, held in position by guy ropes, could be used instead of one tall brick chimney as a cost-saving measure. The guy wires, though, betrayed the weakness of metal stacks, and the short life of the steel chimney was an argument against its use. [30]

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[27] Ibid., 186-87.
[28] Ibid., 52.
[29] Ibid., 52.
[30] Ibid., 52.

Reinforced concrete was a third alternative for chimney construction. Though reinforced concrete chimneys could have thinner walls than brick ones, they were even more expensive to construct due to the cost of the formwork. Another disadvantage of this type of chimney was that concrete was not as impervious to weathering as the highest-quality brick.[31]

The DTC Powerhouse utilized several short metal stacks as well as a single, approximately 130-foot tall, metal chimney (see photo 17). Metal stacks of this size were unusual for Denver, a city dominated by brick chimneys. The design of the plant's flue system was the subject of comment by the local newspaper. The *Rocky Mountain News* reported that gases from the boilers were recirculated to burn again and that as a result "the combustion is so perfect that a silk handkerchief might be held over the smokestack without being soiled in the least."[32] Though photographs of the powerhouse in operation indicate that the "silk handkerchief" test might not always work, the plant did appear to produce minimal smoke for such a large coal-burning facility (see photo 22).

The powerhouse stacks were removed sometime prior to 1942 (see photo 25). The location of the main stack may still be read by the existence of the interior framing and the large circular skylight which fills the stack's roof penetration.

Industrial Aesthetics

Architectural historian Betsy Hunter Bradley suggests that an understanding of the industrial aesthetic as related to factory design must be grounded in the programmatic and progressive fields of engineering and industry. The styles used for other types of buildings have not formed the basis of industrial architecture. An engineering-derived aesthetic engendered a dynamic approach to design that incorporated new material, building techniques, and forms that could meet the functional demands of engineered factory buildings.[33]

The aesthetic basis of American industrial building design was an ideal of beauty based on function, utility, and process held by engineers, not the formality or picturesqueness associated with recognized architectural styles. There was an accepted correct "feel" or tone for industrial architecture that expressed strength, stability, and function and avoided the use of lavish or extensive decoration.[34] Of course, industrialists and business owners also had a real interest in the appearance of their buildings, which represented considerable financial investment and hopes for continued economic success.[35]

While engineers have considered an emphasis on decoration inappropriate, they have not avoided the use of ornamental architectural elements in industrial architecture. They have often employed

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[31] Ibid., 52.
[32] *Rocky Mountain News*, January 1, 1908, Section 2, p 3.
[33] Ibid., 201.
[34] Ibid., 202.
[35] Ibid., 203.

a limited number of such elements to stand in for, or evoke, architectural style and thereby relate industrial buildings to the preferred expression of the day.[36]

In 1929 civil engineer Charles Evan Fowler noted four fundamental principles that guided the work of the engineer in designing bridges and other structures: simplicity, symmetry, harmony and propriety. Though symmetry was a fundamental aspect of bridge forms, balance was often substituted in other types of structures designed by engineers.[37]

The standardization of factory design depended on the building blocks of industrial buildings – the bay area between interior columns. Repetition of bays of uniform size resulted in the regular, rectangular forms of industrial buildings. The placement of bays to form relatively narrow, but long, structures was based on the need for light. The regularity in the size and placement of window openings was a response to the identical dimensions of the bays within and the need for even illumination.[38]

Framed structural systems predominate in industrial building construction. A structural frame was more efficient than load-bearing masonry in meeting the demands of industry. Factories could be detailed to convey strength and stability when framing was expressed and accentuated on the building exterior. On the other hand, framed structures could be entirely hidden from view by engineered curtain walls. In such cases, it was obvious that the enclosing wall was carried by the frame.[39]

Both engineers and architects recognized that they could capitalize on the intrinsic characteristic of brickwork to create an appropriate utilitarian appearance for industrial buildings. This approach also provided an alternative to the architect's reliance on expensive terra-cotta and stone ornamentation. Brick bearing walls were made skeletal in form, as much like a framed system as possible, through the concentration of loads in thick piers, or pilasters. When both vertical pilasters and horizontal spandrels and stringcourses were emphasized, facades appeared as articulated grids and often featured a lively interplay of elements.[40]

Some designers of industrial buildings sought to create a brick aesthetic based on the expressive use of new brick products. Mortar was colored to blend or contrast with brick. The use of extra-wide mortar joints or narrow "butter" joints also influenced the character with little additional expense. Patterned brick and splayed (angled) and rounded units were incorporated into factory buildings as a relatively economical and rational means of relieving plain brickwork.[41]

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[36] Ibid., 202.
[37] Ibid., 225.
[38] Ibid., 229.
[39] Ibid., 230.
[40] Ibid., 230.
[41] Ibid., 234.

Arched door and window openings in brick industrial buildings represented structural elements that added to aesthetic character. The segmentally arched shape for window openings dominated in brick structures because of practical and economical considerations. This shape was most often laid as a "rough-arch" of standard brick with wedge-shaped mortar joints. In a gauged arch, bricks, rather than the mortar joints, assumed the wedge form. Because bricks that could be shaped as wedges were softer (and weaker) than other bricks, gauged arches were not as strong as rough ones. Indeed, when gauged arches – often round-headed in shape – framed window openings, interior or unseen rough arches usually formed much of the openings and supported the wall above. Consequently, round-headed windows were often limited to the top story of industrial and commercial lofts, where the strength of the arched openings was not as critical. Segmental and round arches were sometimes laid as rowlock arches, formed of small bricks laid in concentric rings. Rowlock arches were not as strong as bonded arches but were easier to lay and sufficiently strong for many applications.[42]

The American Round-Arched Style of Industrial Buildings

The American round-arch style, an interpretation of an idiom developed in Germany by progressive architects during the 1830s and 1840s, forms the artistic basis of much building in brick for industry and commerce. The *Rundbogenstil*, as the style was known in Germany, synthesized classical and medieval styles – and relied on brick and locally available stone. Characteristic of the style were pilasters and horizontal bands forming grids; elaborate brick corbelling, especially corbel tables; and molded surrounds emphasizing arched door and window openings. During the 1850s and 1860s the vocabulary of this mode was expanded to include windows set off by projecting archivolts enriched with dentils, segmentally arched windows, and polychrome patterned brick.[43]

The *Rundbogenstil* was brought to the United States by German immigrant architects and builders and was pictured in pattern books and architectural periodicals. Round arches appeared in American religious architecture by the mid-1840s and soon thereafter in public buildings. American designers and builders tended to incorporate the style into exterior forms and detailing but rarely used it in their interiors. The term *Rundbogenstil* was seldom used in the United States. The stylistic characteristics were most often denoted by the terms *Byzantine, Romanesque, Norman, Lombard, Anglo-Norman, modern Italian*, or *Lombard-Venetian*. Architectural historian Kathleen Curran, an authority on its adaptation, suggests the term "American round-arched style."[44]

The American round-arched style provided an appropriate architectural character for utilitarian commercial and industrial buildings and expressed many of the ideals of the engineering aesthetic. The forms were familiar to masons and were easy and economical to build because no additional materials or trades were necessary for their execution. The practical reasons for using

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[42] Ibid., 234.
[43] Ibid., 235.
[44] Ibid., 235.

segmentally arched openings meant that round-arched openings did not predominate, even in this style of building. Most important, the round-arched style was generated by – not applied to – a building's structure.[45]

In the hands of builders, engineers, and architects who were adept at combining the familiar elements of the round-arched style, factories readily acquired inherent architectural effect. Corbeled brickwork, the incremental increasing in the thickness of the wall, provided a means of modeling the wall while accenting structure and providing patterned relief. Horizontal corbel tables spanned panel walls to join pilasters where additional wall thickness was needed.[46]

The American round-arched style offered a means of minimizing the box-like nature of flat-roofed industrial building. Brick cornices were built up from corbel tables and projecting courses and might incorporate panels, geometric forms, or bricks set at angles as "dogs' teeth." Corbel tables also eliminated the need for cornices of combustible wood or more expensive sheet metal. The extension of a brick cornice as a pedimented parapet above the flat roofline suggested a three-dimensional roof form to observers on the street. These brick pediments were often detailed with a central medallion and surrounding panels rather than with classical forms.[47]

The DTC Powerhouse is one of Denver's finest examples of the American round-arched style and is certainly the largest extant example. The only better example in respect to its extensive and extraordinarily well-executed brick corbelling is the Cable Railway Powerhouse (National Register). The Cable Railway Powerhouse is truly a brick mason's tour de force. The DTC Powerhouse, though more restrained in its masonry detail, exhibits most of the defining characteristics of the American round-arched style and is more typical of Denver's industrial architecture.

The DTC Powerhouse makes exclusive use of round-arch window openings to the exclusion of segmental arches. Rowlock arches are used in the brick panels between the pilasters. The corbeled belt course which divides the lower lights from the clerestory is not merely a decorative touch. The belt defines the level of the interior traveling crane and provides additional strength and stability as needed between the load-bearing pilasters.

The southeast gable end demonstrates import industrial aesthetics of the round-arch style (see fig. 2). The design provides balance to the asymmetrical structure behind. The differing interior bay widths are effectively masked on the long elevations by the truss treatment. The equal height peaks allows the twin gables to appear from grade as a single truncated gable. In the gable end, the visual awkwardness of the off-center valley is mitigated by the brick treatment and fenestration. The triple corbel arch, with its larger and taller center span, and the skillful placement of the clerestory windows and sign plaque, all meet engineer Charles Fowler's call for simplicity, balance, harmony, and propriety.

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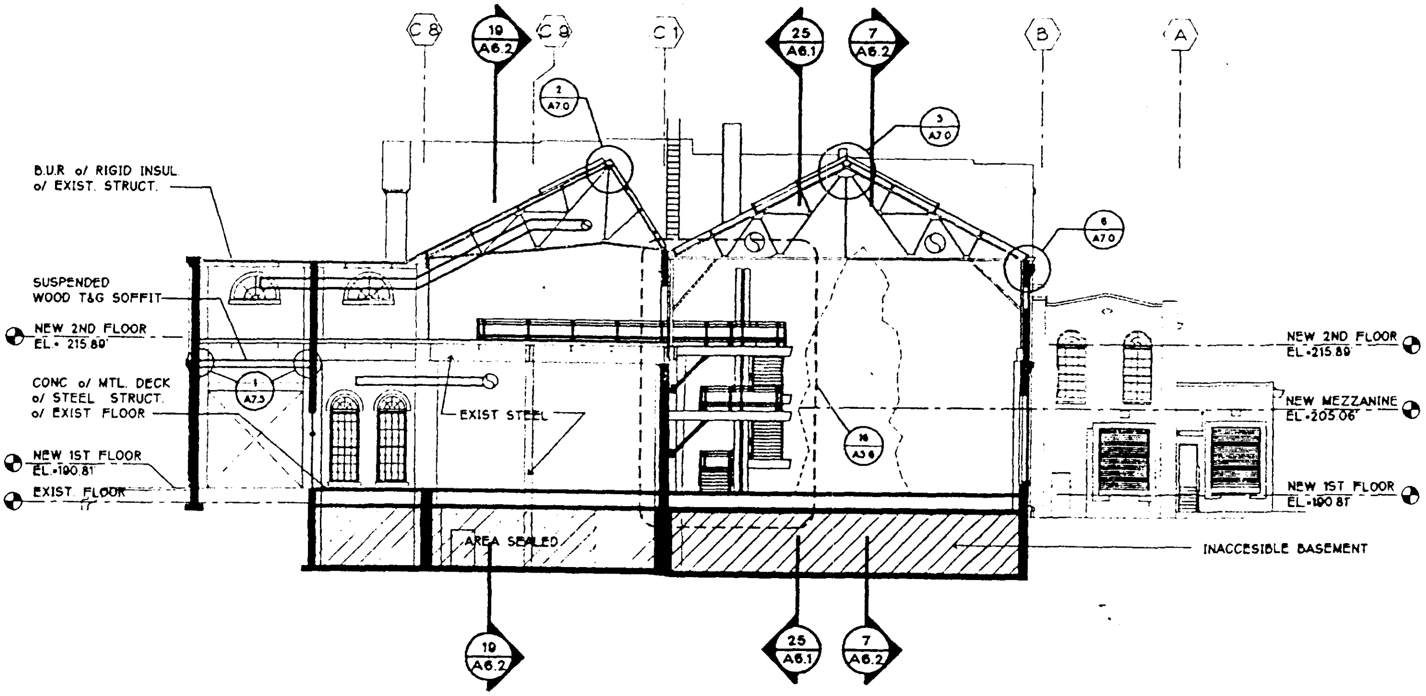
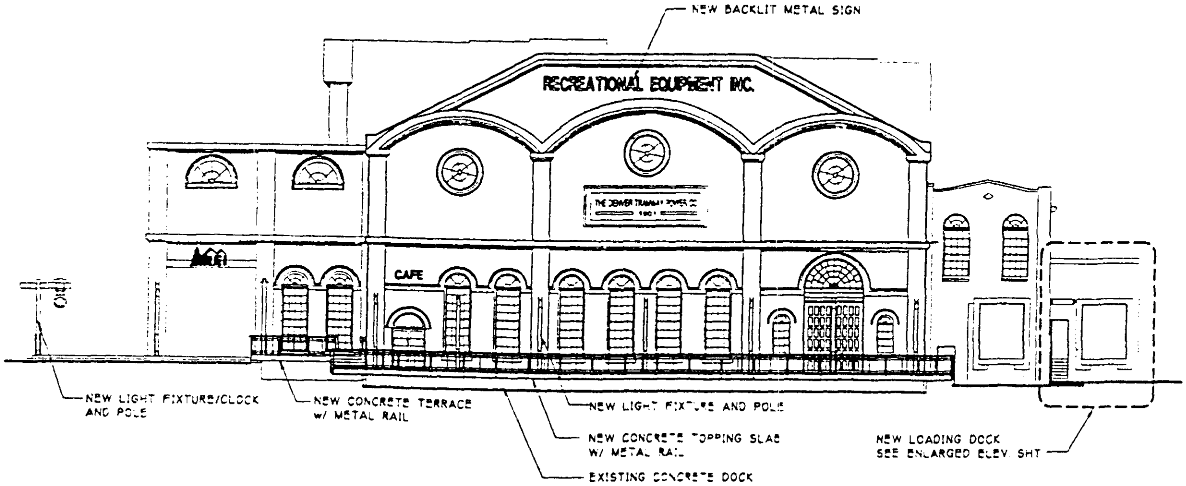
[45] Ibid., 237.
[46] Ibid., 237.
[47] Ibid., 237.

Figure 2 External Expression of Interior Bays



Cross section through the original boiler and generation bays



Southeast elevation

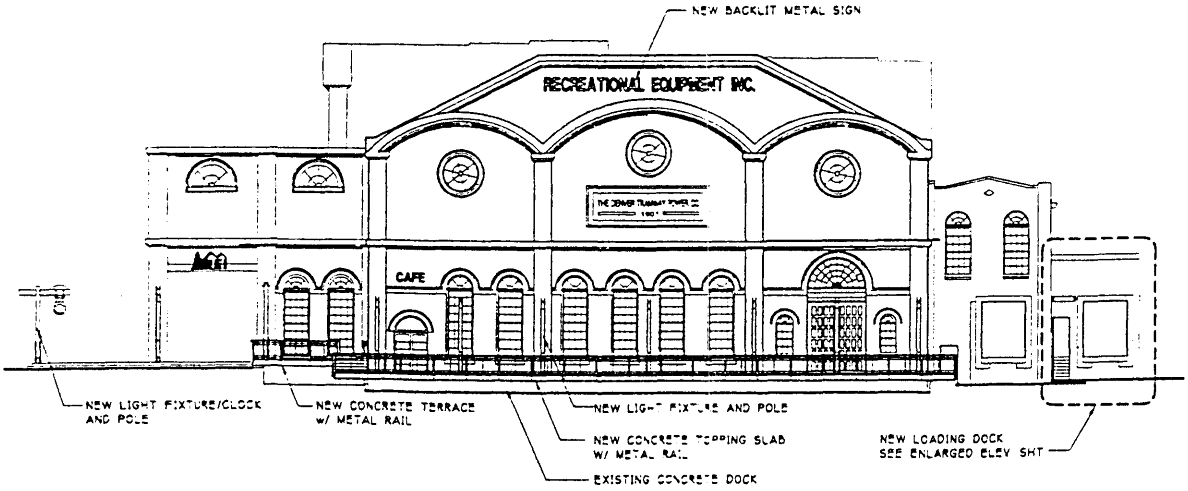
The sense of balance extends to the coal dump/water pump extension off the southwest elevation. The extension is placed in the exact center of the original powerhouse. The extension is visually united to the main building by its matching height and by the continuation of the fenestration, even to the use of identical clerestory windows and corbel treatments.

The 1911 addition is less successful aesthetically. The addition repeats the use of brick pilasters and round-arched windows, but the attention to aesthetics so clear in the original construction is lacking. The northeast elevation was the most pleasing with the rhythmic use of paired round-arched windows between each brick pilaster. The lower level originally repeated the paired window pattern on the original section. The 1924 addition of the battery house obscured the elevation's lower half. The southwest elevation repeats the use of the round-arched windows. However, the designers failed to avail themselves of the opportunity for additional glazing afforded by the use of steel columns. In fact, the bays here only contain a single round-arch window and the clerestory is unglazed. This elevation also lacks the horizontal corbel table and cornice.

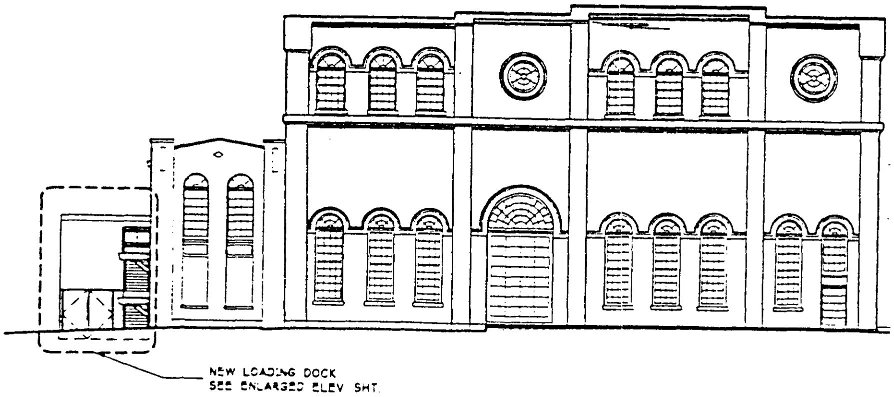
A comparison of the northwest elevation of the addition and the southeast elevation of the original powerhouse best illustrates the variation possible within the American round-arch style (see fig. 3). Where as the southeast elevation successfully balances the asymmetrical interior structure, the northwest elevation is decidedly unbalanced. The elevation is divided into four bays of unequal widths in a wide-narrow-wide-narrow pattern. The varying bay widths are accentuated by the clerestory fenestration. The wide bays each contain three arched windows and the narrow bays each contain a single circular window. The stepped parapet reaches its high point on only one of the interior bays and steps down on successive bays toward the eaves. The use of the round-arch windows, the circular windows and the corbel tables helps to visually unite the elevation with the older portion of the building. However, the newer elevation fails to achieve the sense of balance and aesthetics achieve by the older southeast elevation.

Taken in total, the DTC Powerhouse represents a successful utilization of the American round-arch style of industrial architecture. Increasingly fewer good examples of the style exist, in any state of preservation. The recent powerhouse rehabilitation presented significant challenges to the building's owner and architect. The successful results demonstrate the possibilities that may be achieved with imagination and sensitivity. The powerhouse now has a new life in the community while retaining those engineering qualities that allow it to convey its important historical associations and design excellence.

Figure 3 Comparison of Southeast and Northwest Elevations



Southeast elevation



Northwest elevation

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Rocky Mountain News, January 1, 1908, section 2, p. 3

Rocky Mountain News, December 31, 1908, p. 3.

Rocky Mountain News, January 1, 1910, section 2, p. 3

Rohe, Alice. "Tramway's Part in Wonderful Development of this Beautiful City of Denver," *Rocky Mountain News*, January 1, 1911, section 2, p. 6.

GEOGRAPHICAL DATA

Verbal Boundary Description

The boundary consists of a line 10 feet out from the footprint of the building, except for the northwest elevation where the line follows the building footprint.

Boundary Justification

The boundary includes all the land historically associated with the powerhouse which retains its integrity from the 1901-1950 period of significance.

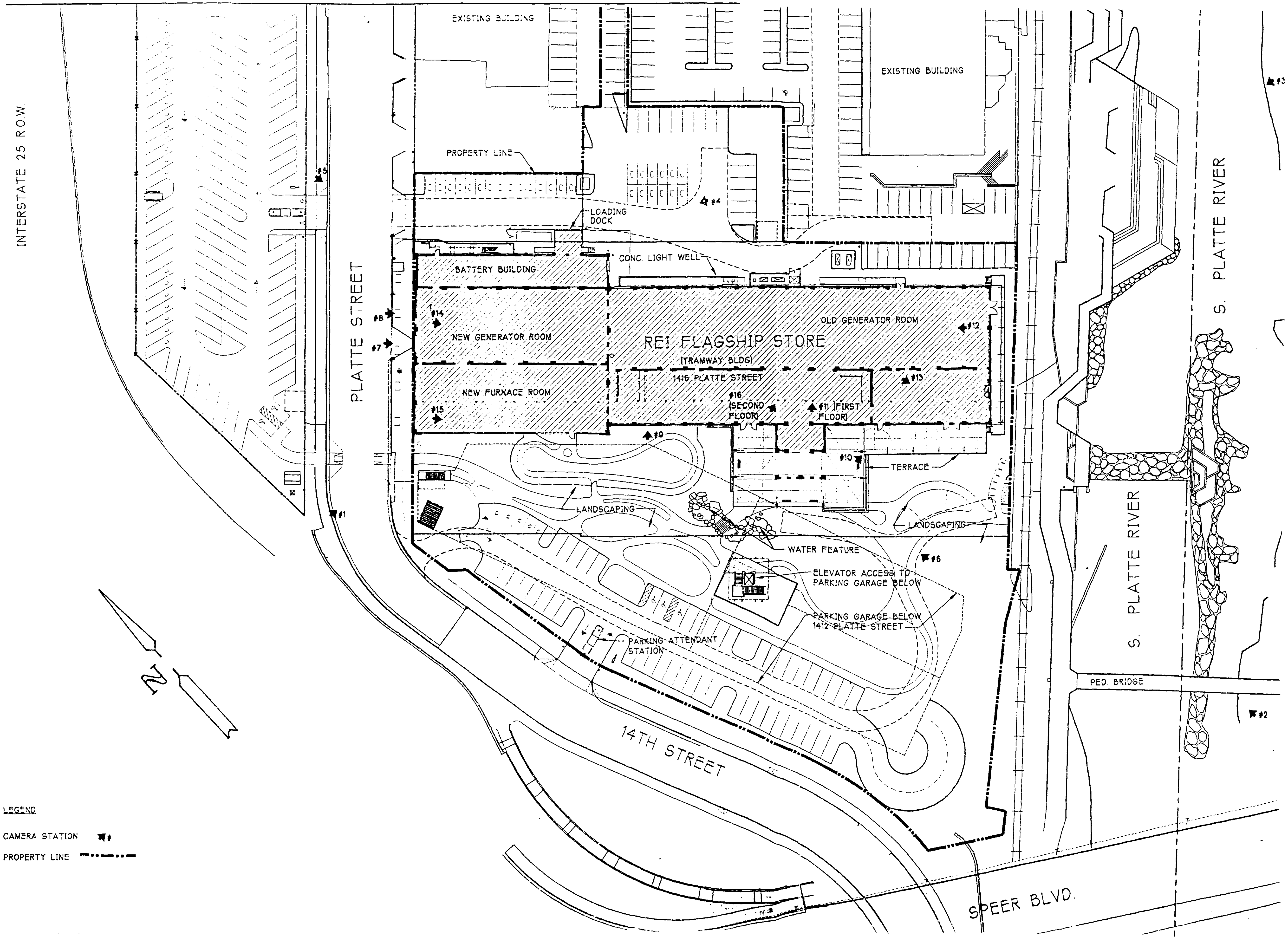
PHOTOGRAPH LOG

The following information pertains to photograph numbers 1-25, except as noted:

Name of Property: Denver Tramway Powerhouse
Location: Denver County, Colorado
Photographer: Scott Dressel-Martin
Date of Photographs: February 14, 2001
Negatives: Possession of photographer

Photo No.	Photographic Information
1	Northwest and southwest elevations; view to the east.
2	Southwest and southeast elevations; view to the north.
3	Southeast and northeast elevations; view to the northwest.
4	Battery house, southeast elevation; view to the northwest.
5	Northeast and northwest elevation; view to the south.
6	Southwest elevation, view to the north.
7	Northwest elevation, original doors with restored fanlight; view to the southeast.
8	Northwest elevation, restored door and windows; view to the southeast.
9	Southwest elevation, replacement windows; view to the southeast.
10	Southwest elevation, replacement windows on first and clerestory levels; view to the southeast.
11	Interior at entry, view to the northeast.

Photo No.	Photographic Information
12	Interior of old generating room; view to the northwest.
13	Interior of café showing coal bunker and stairs; view to the south.
14	Interior of new generating room; view to the southeast.
15	Interior of new boiler room; view to the southeast.
16	Interior of old boiler room; upper level showing plenum; view to the east.
17	Southeast and northeast elevations; view to the west. Photographer: unknown; date: 1906; Colorado Railroad Museum, Golden.
18	Northwest and northeast elevations; office (demolished); view to the southeast. Photographer: unknown; date: ca. 1905; negative location unknown.
19	Interior of original boiler room; view to the northwest. Photographer: L.C. McClure; date: 1906; Colorado Railroad Museum, Golden.
20	Interior of new boiler room; view to the southeast. Photographer: unknown; date: after 1911; Colorado Railroad Museum, Golden.
21	Interior of original generating room; view to the southeast. Photographer: Charles S. Price; date: 1911; Colorado Railroad Museum, Golden.
22	Northwest elevation and surrounding neighborhood; view to the southeast. Photographer: L.C. McClure; date: 1911; Western History Department, Denver Public Library.
23	Southwest and southeast elevations; view to the north. Photographer: Charles S. Price; date: 1911; Colorado Railroad Museum, Golden.
24	Interior of new generating room; view to the east. Photographer: Charles S. Price; date: 1927; Colorado Railroad Museum, Golden.
25	Northwest and southwest elevations; view to the east. Photographer: unknown; date: 1942; Colorado Railroad Museum, Golden.


INTERSTATE 25 ROW
PLATTE STREET
EXISTING BUILDING
PROPERTY LINE
LOADING DOCK
CONC LIGHT WELL
EXISTING BUILDING
#4
#5
#8
#7
#1
BATTERY BUILDING
#14
NEW GENERATOR ROOM
NEW FURNACE ROOM
#15
REI FLAGSHIP STORE
(TRAMWAY BLDG)
1416 PLATTE STREET
OLD GENERATOR ROOM
#12
#13
#16 (SECOND FLOOR)
#11 (FIRST FLOOR)
#9
#10
TERRACE
LANDSCAPING
LANDSCAPING
WATER FEATURE
#6
ELEVATOR ACCESS TO PARKING GARAGE BELOW
PARKING GARAGE BELOW 1412 PLATTE STREET
PARKING ATTENDANT STATION
14TH STREET
SPEER BLVD.
N
S. PLATTE RIVER
S. PLATTE RIVER
PED. BRIDGE
#2
#3
LEGEND
CAMERA STATION
PROPERTY LINE

USGS TOPOGRAPHIC MAP
Arvada Quadrangle, Colorado
7.5 Minute Series
1965, Revised 1994

HISTORIC PHOTOGRAPHS

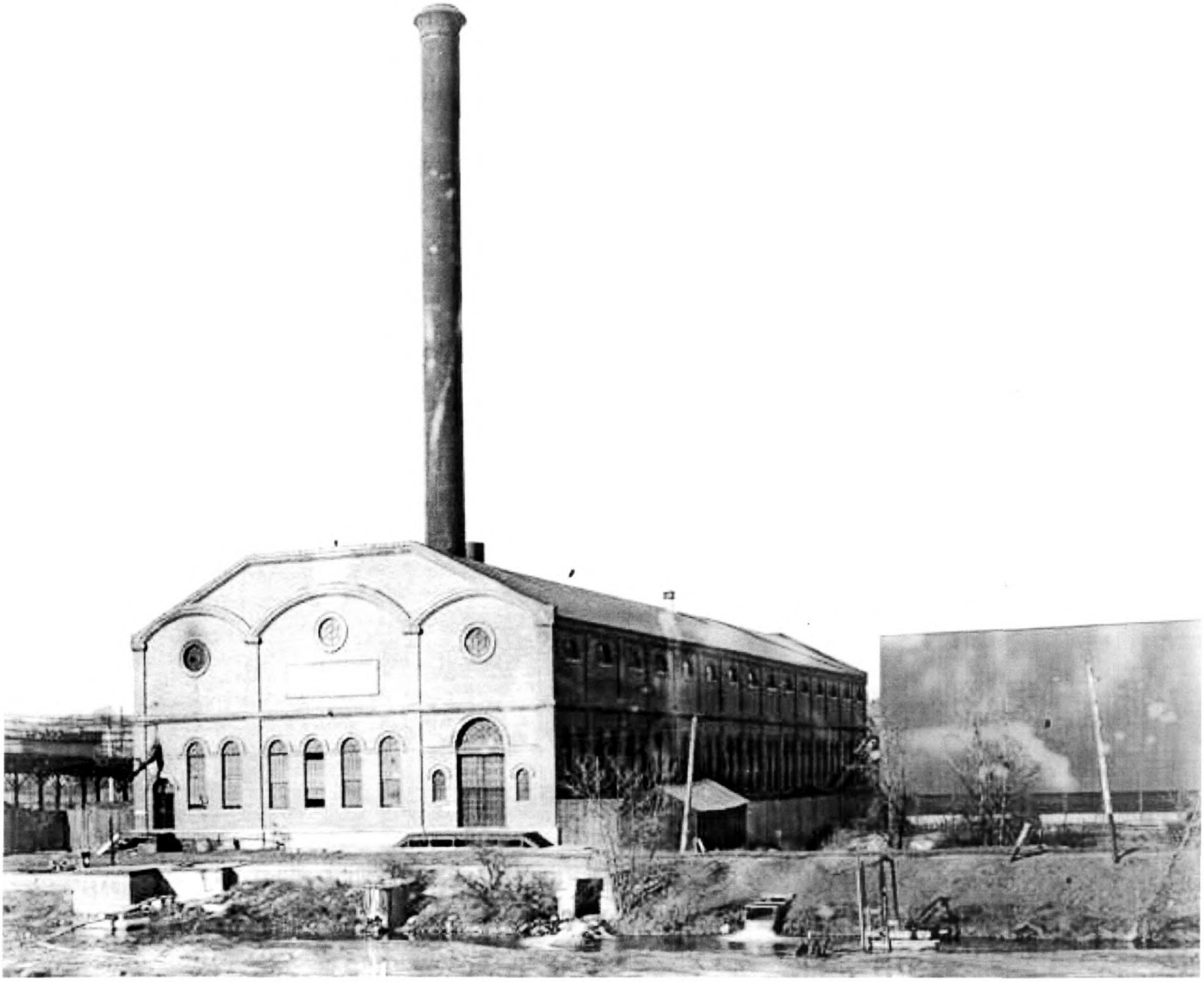


Photo 17 Southeast and northeast elevations; view to the west.
Photographer: unknown; date: 1906; Colorado Railroad Museum, Golden.

HISTORIC PHOTOGRAPHS

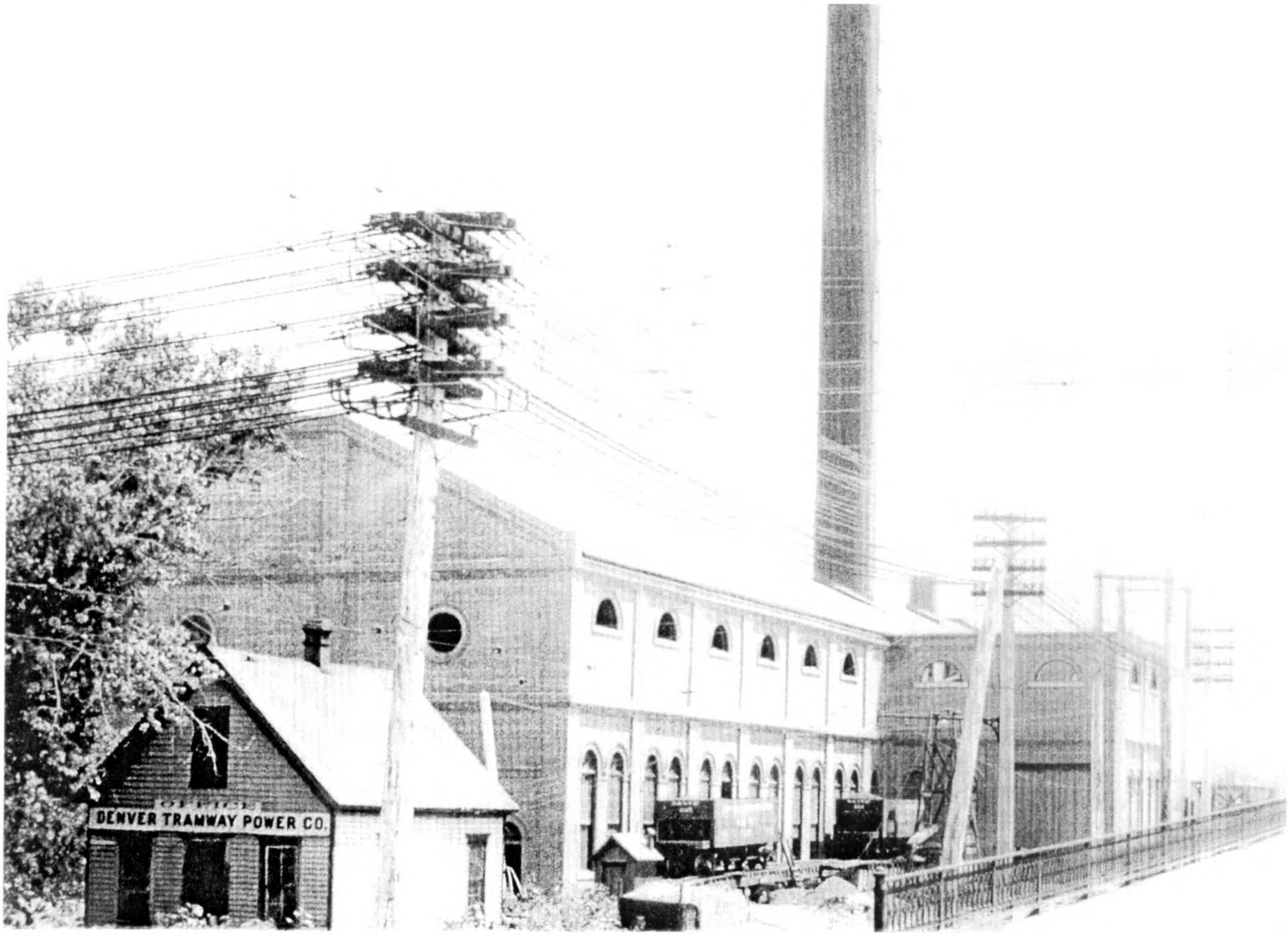


Photo 18 Northwest and northeast elevations; office (demolished); view to the southeast. Photographer: unknown; date: ca. 1905; negative location unknown.

HISTORIC PHOTOGRAPHS

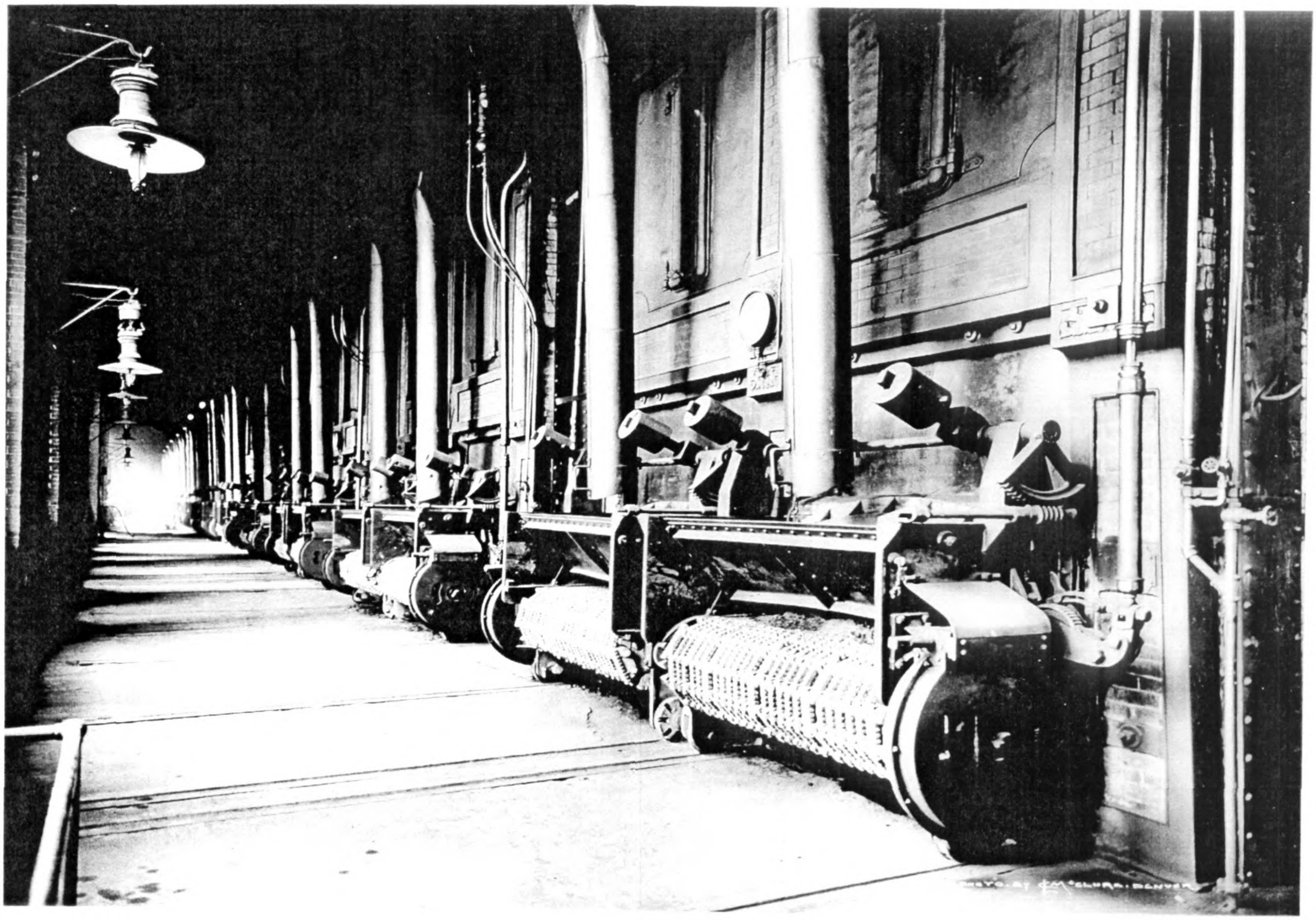


Photo 19 Interior of original boiler room; view to the northwest.
Photographer: L.C. McClure; date: 1906; Colorado Railroad Museum, Golden.

HISTORIC PHOTOGRAPHS

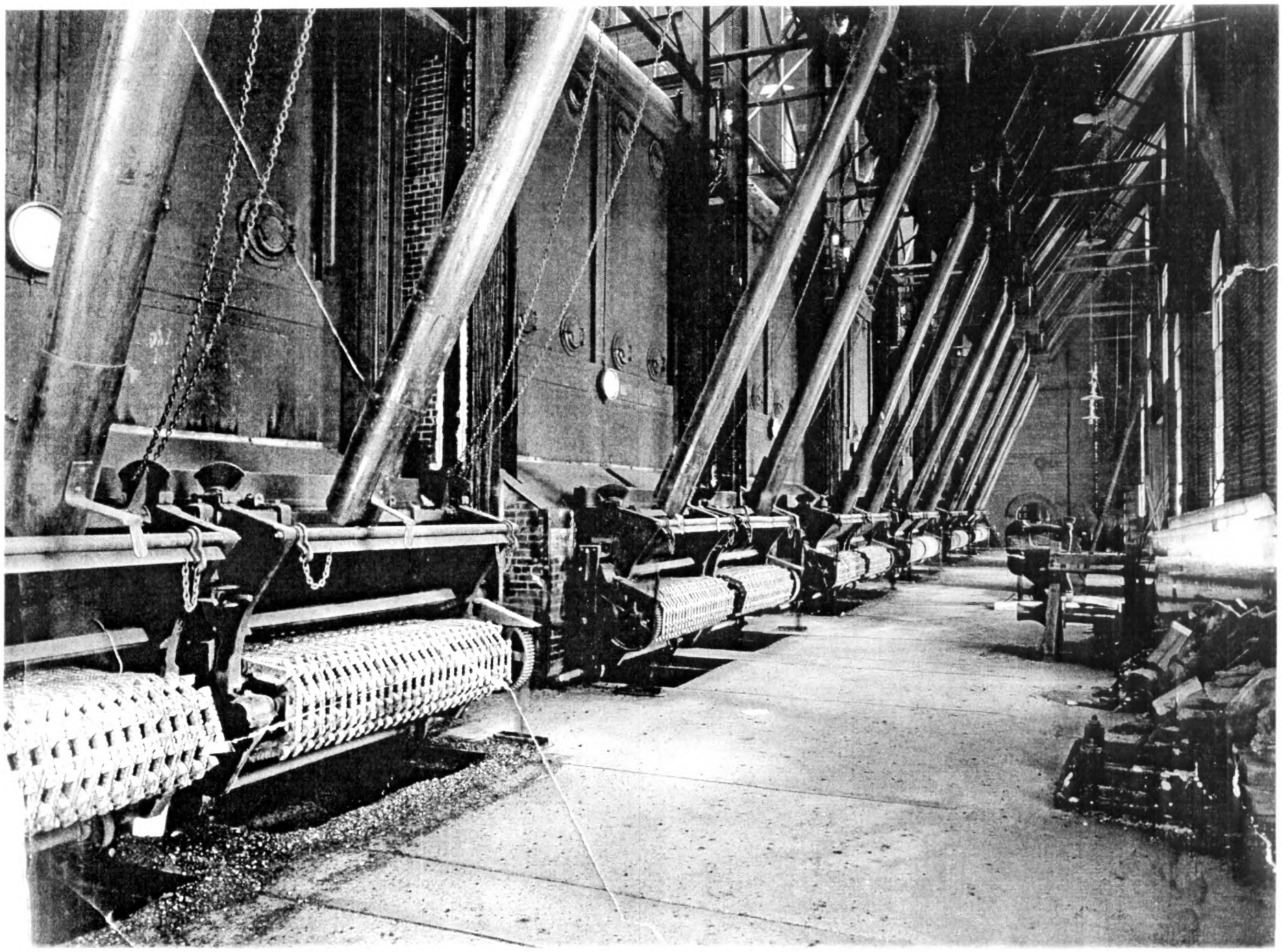


Photo 20 Interior of new boiler room; view to the southeast.
Photographer: unknown; date: after 1911; Colorado Railroad Museum, Golden.

HISTORIC PHOTOGRAPHS

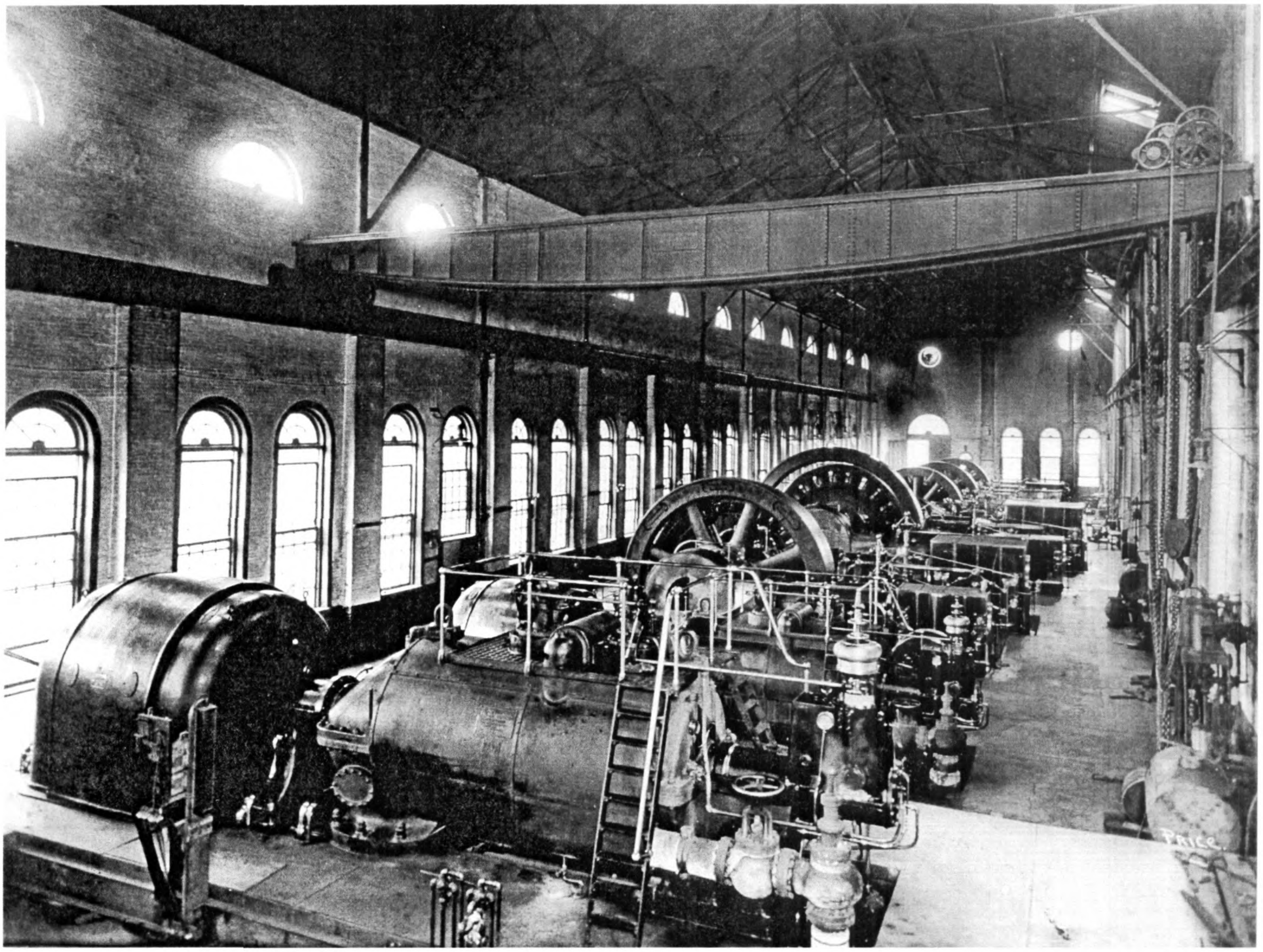


Photo 21 Interior of original generating room; view to the southeast.
Photographer: Charles S. Price; date: 1911; Colorado Railroad Museum, Golden.

HISTORIC PHOTOGRAPHS

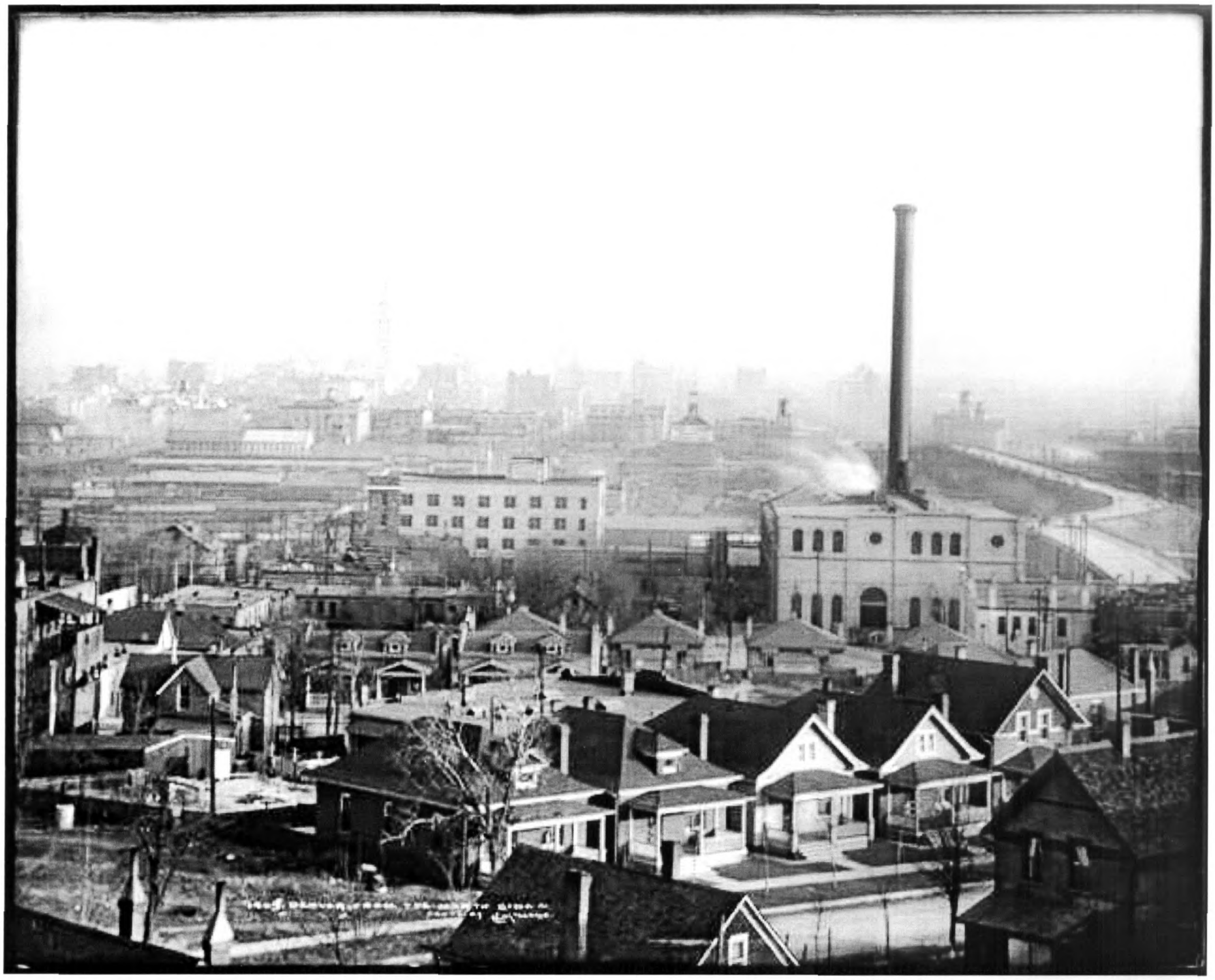


Photo 22 Northwest elevation and surrounding neighborhood; view to the southeast. Photographer: L.C. McClure; date: 1911; Western History Department, Denver Public Library.

HISTORIC PHOTOGRAPHS

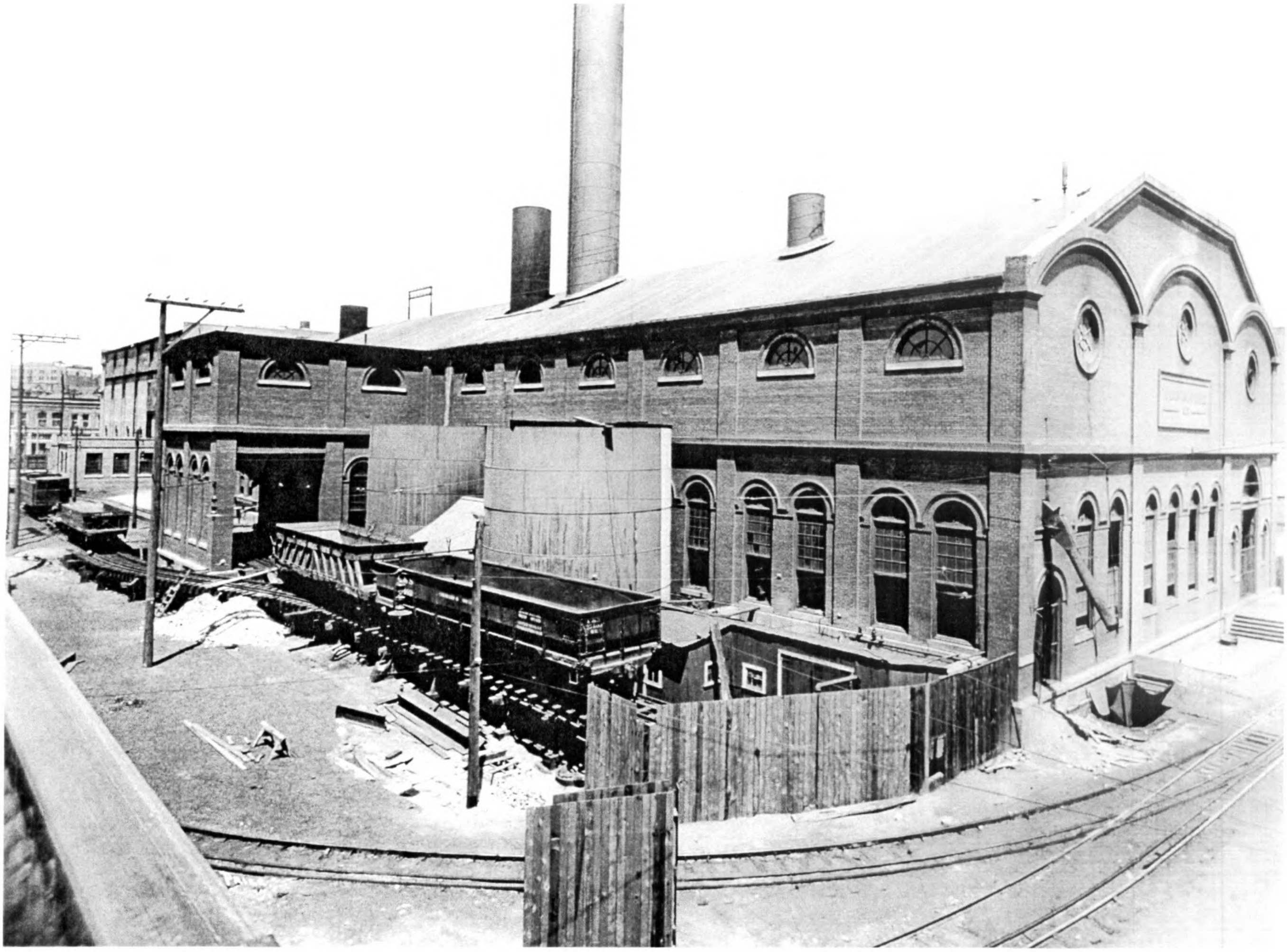


Photo 23 Southwest and southeast elevations; view to the north.
Photographer: Charles S. Price; date: 1911; Colorado Railroad Museum, Golden.

HISTORIC PHOTOGRAPHS

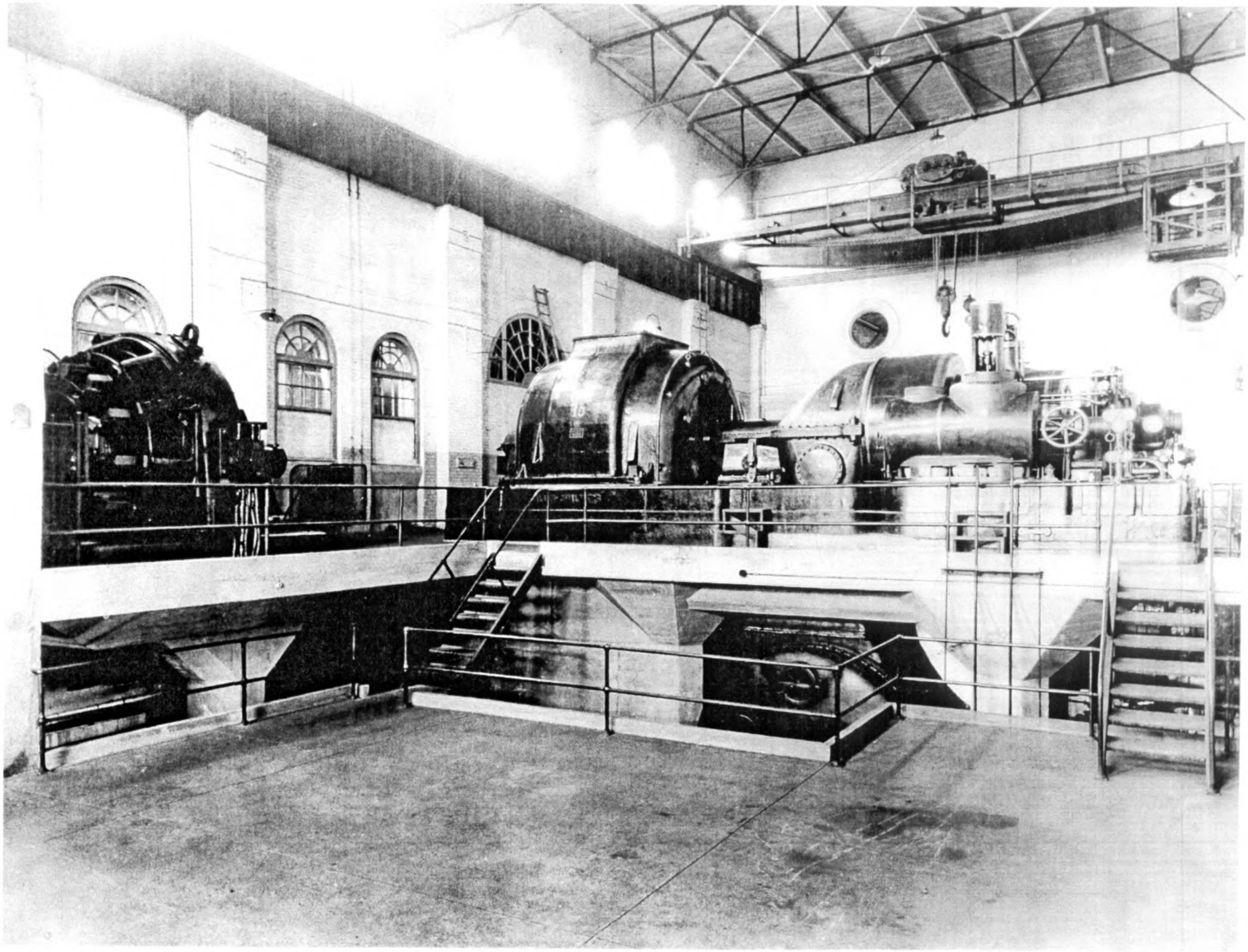


Photo 24 Interior of new generating room; view to the east.
Photographer: Charles S. Price; date: 1927; Colorado Railroad Museum, Golden.

HISTORIC PHOTOGRAPHS

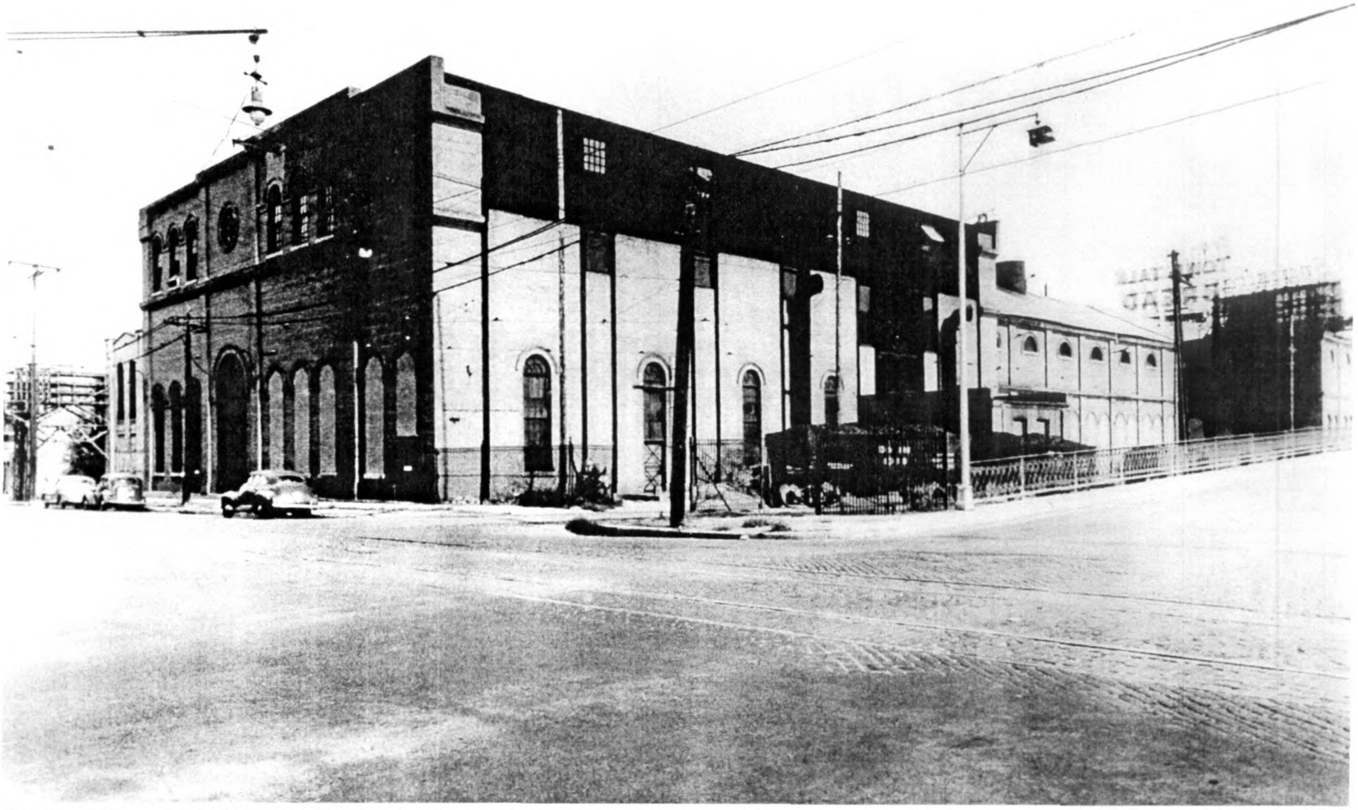


Photo 25 Northwest and southwest elevations; view to the east.
Photographer: unknown; date: 1942; Colorado Railroad Museum, Golden.