# HISTORIC AMERICAN ENGINEERING RECORD

## BURNSIDE BRIDGE — HAER No. OR-101

| | |
|---|---|
| Location: | Spanning the Willamette River at Burnside Street, Portland, Multnomah County, Oregon<br><br>UTM: 10/526080/5040915<br>Quad: Portland, Oregon |
| Date opened: | 28 May 1926 |
| Structural Type: | Double-leaf Strauss riveted steel bascule with Double-Intersection (lattice) Warren (with sub-vertical) side span deck trusses. |
| Engineers: | Ira G. Hedrick, Kansas City, and Robert C. Kremers, Portland. Additional engineering by Gustav Lindenthal, New York City, with entire bridge construction supervised by Lindenthal. Bascule design, Joseph B. Strauss Co., Chicago. |
| Architect: | Houghtaling and Dougan, Portland, Oregon |
| Prime Contractors: | Pacific Bridge (main span), Lindstrom & Feigenson (approach end ramps), NePage McKenny (lighting). |
| Subcontractors: | Lindstrom & Feigenson (concrete approaches and concrete encasement of steel girders, east end), Booth & Pomeroy (steel erection), Jaggar Sroufe (bascule span electrical). |
| Steel Fabricator: Electrical | U.S. Steel |
| Machinery: | Westinghouse Electric Company |
| Owner: | County of Multnomah, Portland, Oregon |
| Present Use: | Vehicular, pedestrian and bicycle traffic |
| Significance: | Burnside Bridge is one in an ensemble of twelve monumental highway bridges across the lower Willamette River, and one of five Portland span bridges (with Ross Island Bridge, Sellwood Bridge, Lovejoy Viaduct, and the Broadway Bridge) associated with Gustav Lindenthal during the period 1924-1928. The Portland bridges were the last of this master engineer's career, and remain rare examples of Lindenthal- |

designed highway-only deck trusses. The Burnside Bridge proper was designed by Ira G. Hedrick , a former partner of J.A.L. Waddell of Kansas City, Missouri, while Lindenthal oversaw the Burnside Bridge's entire construction. The Burnside Bridge bascule system was designed by the Strauss Bascule Bridge Co., Joseph Strauss, most famous for the Golden Gate Bridge in San Francisco. Of the Underneath Counterweight type, Burnside is one of the three main bascule span types patented by the Strauss Co., and is similar in proportions and operation to the Arlington Memorial Bridge, Washington, D.C., another large Strauss bascule. When the Burnside Bridge opened in 1926, it was the first large-scale bascule bridge in the U.S. designed with a concrete floor on its lift span roadway deck, and was further distinguished by being the largest double leaf deck bascule bridge constructed at that time. Both the bridge's side spans are riveted steel Double-Intersection (lattice) Warren trusses (with sub-verticals). The Warren truss dates to 1848, with the Burnside Bridge's Double-Intersection Warren truss configuration unique in Oregon.

Historian: Researched and written by Sharon Wood Wortman, July, 2000

Project Information: Documentation of the Burnside Bridge is part of the Willamette River Bridges Recording Project, conducted during the summer of 1999 under the co-sponsorship of Historic American Engineering Record and the Oregon Department of Transportation in cooperation with Multnomah County. It extends preliminary work conducted under the Oregon Historic Bridge Recording Project with the same co-sponsors in the summer of 1990.

## Geographic Site - Portland Profile

The Burnside Bridge is one of three bascule bridges in a collection of 14 large extant highway and railroad bridges located across the lower 26 miles of the Willamette River near Portland, Oregon.[1] Portland, the largest city in Oregon, is the seat of Multnomah County, the most populated of Oregon's thirty-six counties. In addition to five Historic American Engineering Record (HAER) study bridges, the county owns and maintains twenty other bridges located throughout greater Multnomah County, with the Willamette River bridges its largest bridge structures.[2] The Burnside Bridge opened 28 May 1926, replacing another bridge at this same location dating to 1894. The 1926 bridge was designed under the supervision of one three-member board of Multnomah County commissioners. Construction of the bridge, however, was supervised by a second three-member board, due to illegally awarded contracts that caused the first board of commissioners to be replaced. The other thirteen lower trans-Willamette River bridges include six highway bridges owned by the Oregon Department of Transportation (ODOT); three other movable highway bridges and one fixed span highway bridge also owned by Multnomah County; and three railroad bridges, one owned by the Burlington Northern-Santa Fe Railway Co., and two owned by the Union Pacific-Southern Pacific Railway Co. One of the U.P.-S.P. bridges also serves as a highway bridge, for a total of twelve lower Willamette River highway spans. None of the bridges across the Willamette are owned by the City of Portland.

The Willamette River travels 310 miles northward from its farther-most reach in the high Cascades through the northwestern part of Oregon. This is the nineteenth largest river in the U.S. by volume of flow at its mouth and is the most predominant natural feature in Portland.[3] With a thalweg of between 30' and 40' through Portland, the Willamette is navigable for about 100 miles upstream from Portland, south to Eugene.[4] Willamette River mile 0, or the mouth of

---

[1] *Bascule* comes from the French and means "seesaw."

[2] Multnomah County also built Sellwood Bridge, Histroic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Sellwood Bridge," HAER No. OR-103, opened 15 December 1925; Ross Island Bridge, Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Ross Island Bridge," HAER No. OR-102, opened 21 December 1926; and St. Johns Bridge, Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "St. Johns Bridge," HAER No. OR-40, opened 13 June 1931.

[3] The Willamette River has more runoff per square mile than any other major river in the United States. *Oregon Blue Book 1999-2000*, Office of the Secretary of State (Salem, Oregon: 1999), 195; "Willamette River Recreation Guide," Oregon State Marine Board and Oregon Parks and Recreation Department (Salem, Oregon: 1998), 1; Frits Vanderleeden, *The Water Encyclopedia* (Michigan: Lewis Publishers, 1990), 126.

[4] Eugene is the second largest city in Oregon. Vessels traveling above Willamette Falls, located south of Portland at Willamette River mile 26, are limited by the Willamette Falls Navigational Locks and Canal to six-foot drafts and may not be longer than 175', nor wider than 37'. Installed in 1873, the locks have been operated since 1915 by the U.S. Army Corps of Engineers. "Columbia River Channel Improvement Study," U.S. Army Corps of Engineers (Portland District, August 1999, see section, "2.2 Historic Channel Development."

the river, is located at the confluence with the Columbia River, about twelve miles north, or downriver, of Portland Central City Waterfront. The Willamette-Columbia rivers' junction is located between Sauvies Island and Kelley Point Park, in close proximity to Vancouver, Washington. This area upstream to the Broadway Bridge, near Willamette River mile 11, is known as Portland-Vancouver harbor. This harbor is about 110 river miles east of the Pacific Ocean, where the Columbia River ends near Fort Stevens, at Astoria, Oregon, designated Columbia River mile 0.[5] Portland shares such an inland deep-water port geography with only a few U.S. cities, among them Baton Rouge, Baltimore, Houston, Savannah, Sacramento, New Orleans and Wilmington, Delaware.[6] In Portland's case, such conditions resulted in the erection of 21 movable or high-span bridges across the Willamette River, all built or rebuilt between 1887 and 1989, when in the latter year the draw span of a railroad swing bridge located at river mile 6.9 was replaced with a vertical lift draw span.

About the time of the extant Burnside Bridge's construction, prior to the completion of the Portland Harbor Wall on the west bank in 1929, and the completion of Interstate-5 freeway on the east bank in 1968, the width of the Willamette River at Burnside Bridge's location was 850'.[7] Within the city core, the Willamette River is divided into five segments (from north to south, or upriver): North Portland, Central City Waterfront, Ross Island/Oaks Bottom, Johns Landing and Sellwood. Just in the area of the Central City Waterfront there are five bridges, four of them with large movable spans, all about 1/3 mile apart.[8]

---

[5] Portland is around and about the center of a watery three-way intersection: Traveling north down the Willamette, turning left from Portland harbor takes one down the Columbia River and to the Pacific Ocean; turning right from Portland harbor takes one up the Columbia River along the northern border of Oregon; traveling south from Portland harbor takes one into the Willamette Valley.

[6] Portland, with Sacramento (Sacramento River), Stockton (San Joaquin River), and Longview (Columbia River) are the four major inland deep-water port river cities on the West Coast of the United States.

[7] Records of the Proceedings of the Board of County Commissioners, Commissioners Journals, "Burnside and Ross Island Bridges," 11 July 1924. Events, reports, correspondence, contracts, and bid documents specific to the building and construction of Willamette River and Columbia River bridges were recorded verbatim, and in date order, by the Clerk of the Multnomah County Board of Commissioners during the funding, planning, design and construction of the Burnside, Ross Island, Sellwood, Broadway, Interstate, St. Johns bridges, and approaches, between 1920 and 1959. Several leather volumes are stored at Multnomah County's Ford Building Archives, 2505 S.E. 11th, Portland. They are referred to hereafter as "Commissioners Journals."

[8] "Portland Quadrangle Oregon-Washington 7.5-Minute Series (Topographic) Map (United States Geodetic Survey, 1990). In addition to the Portland quadrangle, there are five others that display the Willamette River and the 14 Willamette River bridges located between river mile 0 to 26: Sauvies Island, Linnton, Lake Oswego, Gladstone and Oregon City quadrangles.

**Location of Burnside Bridge**

At 26 miles, Burnside Street is one of the longest and busiest streets in Portland. It terminates on the east side where it meets with Powell Boulevard in mid-Multnomah County in the City of Gresham, and on the west side where it meets with Barnes Road, between Mt. Calvary Cemetery and the north side of Sunset Hills Memorial Park, located in Washington County.

Along with the Willamette River, the Burnside Bridge forms the city's primary intersection: The Willamette divides Portland east from west, while Burnside street divides the city north from south. Depending on which corner a traveler is situated on the bridge, he or she is either in northeast, southeast, northwest or southwest Portland. (A fifth section, called the Peninsula, is located in North Portland.)

Historically, Burnside Street, with the Burnside Bridge, has been Portland's Bowery, or "skid road." "Lower Burnside Street," on the northwest side of the Burnside Bridge, was also once referred to as "the North End."[9] Since its first dock was built in 1852, the Burnside/waterfront area has provided a range of functions that continues into the 21st century. On the east side of the river, the bridge approach structure spans three city blocks, crossing the main line tracks of the Union Pacific Railroad Co. (formerly the Spokane, Portland & Seattle Railway), Interstate-5 and the Central Eastside Industrial District, landing at the intersection of N.E. and S.E. Martin Luther King, Jr. Boulevard (formerly Union Avenue), a major north-south connector.[10] Directly beneath the bridge's east end at Ankeny Street is a nationally famous public open-air skateboard ramp, opened in 1993. A 120'-long steel cantilever truss pedestrian bridge and elevator pad were put in place on Burnside's southeast side on 12 April 2000 connecting the bridge to Eastbank Riverfront Park.[11] On the west side of the river, the bridge

---

[9] Eugene Snyder, *Portland Names and Neighborhoods* (Portland: Thomas Binford, 1979). In 1935 Burnside had a reputation such that some property owners petitioned to have the name changed. Slum housing has given way to an influx of art galleries and other gentrification, with the street and the stairs leading to the Burnside Bridge shared more often by people from all walks of life.

[10] Portland has renamed some of its streets and other sites. Extant names are used throughout Burnside Bridge. See Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Burnside Bridge," HAER No. OR-101, with historic names provided in parentheses.

[11] This section of Eastbank Riverfront opened in October 2000. The entire 1-1/3 mile-long linear park runs between the Willamette River and Interstate-5, from the Marquam Bridge to the Steel Bridge. The park is being built in three phases. As part of Phase 1, construction to put a pedestrian and bicycle walkway on the bottom deck (south side) of the Steel Bridge began 11 April 2000. The Steel Bridge walkway connects Eastbank Riverfront Park, to the east, and Tom McCall Waterfront Park, to the west, at their north ends. The Steel Bridge walkway also connects with another "bridge" structure and link to the Rose Quarter, the latter being constructed above the river's eastern bank. The Burnside connector bridge (part of Phase 2, which extends from the floating walkway north of the

approach structure spans two blocks and crosses the Portland Harbor Wall, Tom McCall Waterfront Park, S.W. Naito Parkway (formerly Front Street); and the Metropolitan Area Express (MAX) light rail tracks, laid in 1986. Directly beneath the bridge's west end is Saturday Market, an open-air craft market operating seasonally since 1974. The bridge lands on the west side at the intersection of N.W. and S.W. Second Avenue, on the perimeter of the Portland New Chinatown-Japantown Historic District, and the Skidmore/Old Town Historic District.[12]
At the heart of several contemporary central city Portland urban renewal or "vision" projects, the bridge and street link seven nearly contiguous districts and plans. These seven, reflecting an effort to link the "new" Burnside with the "old," include the Lower Burnside Redevelopment Area, located on the east side of the Willamette between Second Avenue and N.E. Sandy Boulevard at 12th Avenue and, continuing west from the bridge's west end, six more plans: Old Town/Chinatown Development Plan; Midtown Blocks; West End Plan; Bridge the Divide and Cap I-405; Goose Hollow/Civic Stadium; and Goose Hollow District Design and Goose Hollow Station Community Plan, the latter project terminating at 24th Avenue.[13]

In the mid-1990s, Burnside Street was declared a "Regional Emergency Transportation Route," which makes the Burnside Bridge the one non-freeway bridge in Portland designated for public agencies to route emergency vehicles, equipment and supplies across the Willamette

---

Burnside Bridge to the Hawthorne Bridge) gives people a means to enter or exit Eastbank Riverfront Park from the elevation of Burnside Street (ascending 45' to the bridge street level). Phase 3, set to begin construction in 2001, extends the park south of Hawthorne Bridge, to the Oregon Museum of Science and Industry. Craig Totten, structural engineer, KPFF Engineering, interview with Sharon Wood Wortman, 25 January 2000, and Fred Locht, Senior Inspector, Capital Project Consultants, interview with Sharon Wood Wortman, 2 July 2000. It is an incongruous pairing, the shiny 109,000 pound steel truss, with the Italianate-style Burnside, and not one that ODOT's Environmental Section, or the State Historic Preservation Office found compatible with the classic design of the Burnside. Several paint colors were originally proposed for the connector, among them red, yellow and green. The connector bridge's final coat resembles unpainted aluminum. Linda Dodds, ODOT Environmental Section, telephone conversation with Sharon Wood Wortman, 12 April and 18 May 2000.

[12] The Portland Skidmore/Old Town Historic District was listed on the National Register of Historic Places in 1975, and the Portland New Chinatown-Japantown Historic District was listed in 1989. "National Register of Historic Places," GPO: 1994.

[13] "Summary of Existing Plans for Burnside and Environs-Burnside Transportation and Urban Design Plan Map," City of Portland, Office of Transportation, 27 June 2000. The map, as part of the city's "Burnside Transportation and Design Plan," charts unrelated efforts changing the face of Burnside one section at a time. The city felt it important to develop a comprehensive plan to balance the needs of the constituencies and uses along the street. Burnside Street is rapidly changing, with the Brewery Blocks now under reconstruction in one of the largest urban renewal projects in the city's history. When complete, the Burnside Transportation and Urban Design Plan, scheduled to be approved and published the end of 2001, will contain recommendations for transportation and urban design improvements along Burnside Street and the Burnside Bridge from 24th Avenue on the west to 13th Avenue on the east. Also see *Burnside, A Community*, by Kathleen Ryan (Portland: 1979).

River in case of earthquake or other disasters.[14] In 1999, an average of 1,000 bicyclists and pedestrians and 41,000 vehicles used the Burnside Bridge each day.[15] Each June, the Rose Festival Grand Floral Parade closes Burnside Street and the bridge for a few hours while floats cross from east to west for the largest single day spectator event in Oregon.

**Central City Waterfront**

The flat east bank along the Central City Waterfront owes its appearance to the rupture of ice dams in a glacial lake, now named Montana, between 16,000 and 12,000 years ago. Referred to as the Missoula Floods, water and rocks exploded westward down the Columbia River, scouring and depositing loads of rock, gravel and sand in the Willamette River basin. The river bottom in the Central City Waterfront bears testimony to the sweep of the carrying force of these floods. Tom McCall Park and Eastbank Riverfront Park, as well as all the bridge approach piers in the Central City Waterfront area, are constructed on man-made fill in an "alluvial bog," with few bridges enjoying the geologic security of bedrock. Such conditions drove the foundation designs of all the lower Willamette River bridges. As the city grew, marshes, creeks, gullies and lakes were drained, dredged and filled in.[16] Hills were sluiced, and other changes were made so that not many of the early physical landmarks can be recognized today, except the Tualatin Mountains (referred to as the West Hills), the river and east side volcanoes. Because of gentrification along the Central City Waterfront, few structures in the built environment except the Willamette River bridges remain as reminders of the early twentieth century.

**Namesake**

In the plat laid out by Captain John Couch, streets in the northwest section of town were designated only by the letters of the alphabet. In 1891, the streets were renamed, with "B" Street

---

[14] Regional Emergency Transportation Routes, Portland Metropolitan Area," a report of Metro Regional Emergency Routes Task Force, 19 March 1996, files, Multnomah County, Bridge Section.

[15] "Traffic Flow Map," City of Portland, Office of Traffic Management, 1998; Multnomah County, Bridge Section, 1403 S.E. Water Ave., 9 March 2000.

[16] At the onset of European settlement, the Willamette River meandered to and beyond Water Avenue on the east bank. On the west, the harbor line was once nearer Naito Parkway (formerly Front Street); "Historic Vegetation of the Willamette Valley," compiled and published by the Nature Conservancy of Oregon, Natural Heritage Program (2000); Elizabeth L. Orr and William N. Orr, *Geology of the Pacific Northwest* (New York: McGraw-Hill, 1990), 329-339; Matthew A. Mabey and others, "RLIS Relative Earthquake Hazard Map, Portland, Oregon 7-1/2 Minute Quadrangle" (Portland: Oregon Department of Geology and Mineral Industries, and Metro, 1990 and 1997).

becoming Burnside Street to honor Vermont native Dan Wyman Burnside (1825-1887).[17] Burnside migrated to Portland via the California gold fields, arriving in 1852. He prospered in the flour business, served on the Portland City Council, volunteered as a firefighter and died at age 62 in 1887.[18]

## Description of Burnside Bridge

Bridges were opened, under construction, or being planned in every decade of the twentieth century in Portland. However, the largest-scale public bridge building era occurred in the 1920s, with the Burnside Bridge making the leap in Portland from the era of lightweight through-truss spans of the late nineteenth and early twentieth century, to the modern automobile era that demanded wide bridge decks with uncluttered, truss-free views. Beginning with Sellwood, three "modern era" bridges opened within six months of each other, one after the other:

| | |
|---|---|
| Sellwood Bridge | 15 December 1925 |
| Burnside Bridge | 28 May 1926 |
| Ross Island Bridge | 21 December 1926 |

Inextricably linked, these three 1920s bridges were not only built by Multnomah County, they shared some of the same design engineers, architects, contractors and sub-contractors. They also shared similar engineering technology, as they were the first steel deck truss highway bridges across the Willamette River near Portland.

Several newspaper stories reported on the opening ceremonies held 28 May1926, listing events of the day for everything from a City Club luncheon at the Benson Hotel, to three parades, to a regatta.[19]

Mayor Baker felicitated the county commissioners, the engineers, and contractors, on behalf of the city, for the great bridge achievement. Raymond B. Wilcox, president of

---

[17] "D. Burnside" is shown in the 1878 Portland City Directory as "agent Imperial Flouring Mills, Front Street," *1878 Portland City Directory* (Portland: R.L. Polk, 1878), 71; Wood Wortman, *The Portland Bridge Book*, 2nd ed. The namesake has been referred to as "David Burnside" in various publications, including the first edition of *The Portland Bridge Book*. The error was noted by Dr. Steven Dow Beckham during research conducted in 2000 for interpretation of the Burnside Bridge on panels to be erected in Eastbank Riverfront Park.

[18] Snyder, *Portland Names and Neighborhoods*. Burnside is buried in Section 3, Lot 8 of River View Cemetery in Southwest Portland. Wood Wortman, *The Portland Bridge Book*, 2nd ed.

[19] "Burnside Bridge to be Open Today," *The Portland Oregonian*, 28 May 1926, 1.

the Portland Chamber of Commerce, expressed the appreciation of the business and industrial interests. Dan J. Malarkey, representing the Pacific Bridge company, builders of the bridge, recalled that the same company built the old Morrison street bridge, the first span across the river, only 38 years ago. Hans H. Rode, resident engineer, spoke of the cooperation of all in the completion of the structure, and formally presented the bridge to Commissioner Smith, who accepted it on behalf of the county. Rev. E.H. Pence, pastor of the Westminster Presbyterian church, asked the benediction, and then little Miss Myers gave the bridge its christening bath.[20]

The Burnside Bridge was the last new movable bridge to be built on the Willamette until the Morrison Bridge opened 32 years later in 1958. It is a riveted steel double-leaf bascule draw span bridge, with two steel deck truss side spans, each 268' long. The side span trusses are double-intersection Warren trusses, also called lattice trusses. The trusses are sub-divided by vertical posts that run from the top chords to the diagonal intersections, making them sub-verticals. This is an extremely rare truss type in Oregon.[21] The bridge has 34 approach spans: 19 concrete spans on the west side and seven concrete and eight steel spans on the east side. These approach spans link the bridge to surface streets located on the east and west banks of the Willamette River. Its main span or bascule draw span is 252' long (trunnion to trunnion) and has a solid concrete deck, constructed with concrete 4-3/4" thick on the bascule leaves. Burnside is said to be the first bascule span in the U.S. built with a concrete deck. "This material was used because of the minimum wear, thereby eliminating trouble and repair expense, and because the factor of safety to motor travel is high."[22]

[20] "Burnside Bridge has Gay Opening," *The Oregonian*, 29 May 1926, 1. The names of the crew of the new Burnside Bridge were reported in "Parade Full of Color," ibid., 29 May 1926, 8: A.W. Graham, foreman; W.J. Kiernan, George Press, A.J. Hollingsworth, R.J. Ryan, Frank Hanser, Henry VanAuken, gatemen; E. B. Hayden, C.E. Gast, F.F. Gates, D.L. Leonard, operators; M.J. Larue, relief operator.

[21] For a list of truss types in Oregon, see Dwight A. Smith, James B. Norman and Peter T. Dykman, *Historic Highway Bridges of Oregon* (Portland: reprinted by Oregon Historical Society Press, 1989), 22. The source for "Common Historic Truss Designs in Oregon" is the Historic American Engineering Record, National Park Service, United States Department of the Interior, Washington, D.C. Also see Historic American Engineering Record (HAER), National Park Service, U. S. Department of the Interior, "Ross Island Bridge," HAER No. OR-102 and Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Sellwood Bridge," HAER No. OR-103. Both bridges sub-divided Warren deck trusses designed by Gustav Lindenthal.

[22] A.B. Reeve, Research Engineer, "The Story of Strauss Bridges," The Strauss Bascule Bridge Co. (Chicago, June 1925), 54. Melville E. Reed, "The New Burnside Bridge, Portland, Oregon," *Western Construction News*, 10 July 1926, 21. At the time, the other deck option was wood. According to *Engineering News Record*, "Open-Mesh Steel Deck for Seattle Bascule," (24 Nov. 1932, 624), open steel deck grating did not become popular on the West Coast until 1931, and not in Eastern states until after 1928. Also see "The New Burnside Bridge at Portland, Oregon," *The American City Magazine*, October 1926, 474; "Portland's Three New Bridges and Water-Front Development," *Western Construction News*, 10 January 1926, 33.

A Strauss publication of the day said:

> A recent far-reaching departure in bascule bridge design just introduced by the Strauss Company is the provision of a concrete floor on the moving leaf. This has been successfully accomplished for the first time under Strauss patents, in the Burnside Street Bridge at Portland, Oregon, which is further distinguished by being the largest double leaf deck bascule yet built.[23]

The Burnside Bridge would remain one of the heaviest lift bridges in the U.S. throughout the twentieth century. Each leaf weighs 930 tons and is balanced by a counterweight weighing 1,700 tons, with the total weight on each trunnion pin 1,315 tons. The pins are 28" diameter by 7'-11" long.[24] Massive unreinforced concrete piers, or abutment piers, are located at the west and east ends of the deck truss spans. Concrete bascule piers house the counterweights and bascule machinery. Each bascule pier includes unreinforced concrete walls from the pit floor down to the top of the pile cap, wall heights vary from 35' to 44'. Each pier sits on pile foundations.

Beneath the bridge, the west bank consists of a concrete retaining wall (part of the harbor wall system) with a level fill surface at about elevation 35' behind the wall.[25] The east river bank slopes up between 2 and 2-1/2 horizontal to 1 vertical to an elevation of about 30', east of which the land has a gentle uphill slope. Geologic maps prepared since the construction of the bridge indicate that both the west and east banks have been built up with fill. The extent of the mapped fill along the east bank is significantly larger, extending 600' east of the river.[26]
Electrical/Mechanical: The Burnside's extant electrical system is comprised of seven sub-systems: power distribution, main span drive controls, main span drive motors, centerlock drive, traffic control system, navigational aids and roadway illumination. A description of Burnside's contemporary mechanical system, still in use as originally built, is found in a 1985 report:

> The mechanical system of the Burnside is a span drive driven by two motors. The motors have double extended shafts. A spur pinion is mounted on one shaft extension and a motor brake on the second extension. The four brakes included in each drive are

---

[23] Reeve, "The Story of Strauss Bridges," 41.

[24] "Machinery for Strauss Trunnion, Double Leaf Bascule Span," by U.S. Steel Products Co., American Bridge Co., drawing rev. 3-18-1925, Sheet No. 11, Multnomah County, Bridge Section.

[25] Burnside Bridge No. 0511 Seismic Evaluation Report," letter dated 15 November 1995, Shannon & Wilson, Inc., to Sverdrup Civil, Inc., November 1995, 2, 3, Files, Multnomah County, Bridge Section.

[26] Burnside Bridge No. 0511 Seismic Evaluation Report, letter dated 15 November 1995, Shannon & Wilson, Inc., to Sverdrup Civil, Inc., November 1995, 2, 3, Files, Multnomah County, Bridge Section.

all solenoid actuated shoe brakes. This type of brake sets almost instantaneously developing heavy shock loads in the entire span driven systems and in the structural steel supporting the drive. Each drive includes five open spur gear reductions, including the rack and pinion sets. Each span drive also includes a differential to equalize the loads in the gear trains leading to the two rack and pinion sets. The racks and pinions in the span drives are cast tooth gearing. All other gears are cut tooth gearing. Cast tooth gears wear rapidly, initially. The area of contact increases as the teeth 'wear in.' The wear rate reduces as the area in contact increases. The machinery bearings used in the span drive are plain sleeve bearings with bronze bushings in split housings. The bearings are grease lubricated.[27]

On 21 May 1926, a week before the bridge opened for traffic, and about 16 months after its construction first started, Rode, the resident engineer acting for Engineer-in-Chief Gustav Lindenthal, submitted a concise construction history and description of the bridge to the Board of Multnomah County Commissioners. The report, a copy reprinted verbatim, best describes the bridge as it stood that date[28]:

> Dear Sir: At your request I have in the following compiled some information of a general nature in regard to the Burnside Bridge. Some of the figures are only approximate, particularly those pertaining to the cost of the bridge, inasmuch as the work has not yet been completed. A number of bills are still outstanding.

**General Description of the Bridge**

The bridge proper extends from west of First Street to east of East Third Street, the total distance being 2807.365 feet between faces of abutment walls. But the approaches extend down to Third Street on the West Side and to Union Avenue on the East Side, thus making the total length of the bridge, including approaches, 2925.130 feet.

The river spans include two fixed truss spans of 266'-5-1/4" and one double leaf bascule span of 252 feet between trunnions.[29]

---

[27] "Burnside 1925," a report by Sverdrup & Parcel and Associates, Inc., 9 April 1985, Files, Multnomah County, Yeon facilities, 1620 S.E. 190th.

[28] Rode's report, reprinted in the Commissioners Journals, "Burnside and Ross Island Bridges," exists also as a two-page typed carbon copy document bearing Rode's initials, dated 21 May 1926, Files, Multnomah County, Yeon facilities.

[29] It is not known why Rode reports the length of two fixed truss spans as 266'-5-1/4". Both the design and shop drawings show dimensions of 268' from bearing to bearing on the slope of the bridge, and 267'-10-1/2" center to center of pins on the horizontal.

The various section lengths are as follows:

East line of Third Street to face of west abutment wall, 429.201 feet; Face of west abutment wall to centerline of Pier 1, 602.186 feet; River spans, centerline of Pier 1 to centerline of Pier 4, 855.875 feet; East Approach Steel Viaduct, centerline of Pier 4 to Bent 28, 680.590 feet; Bent 28 to face of east abutment wall, 168.714 feet; Face of east abutment wall to west line Union Ave., 188.564 feet, total 2925.130 feet.

The width of the navigation channel is 213 feet between the bascule piers. The maximum vertical clearance of the bascule span is 70.37 feet above city datum or 67.27 feet above government datum, which is considered identical with "Low Water." In order to obtain this clearance it was necessary to raise the roadway at the center of the bascule span to Elevation 77.650 above city datum, which in turn necessitated using a 3.84% grade on the West Approach.

The width of the roadway between curbs is ordinarily 68 feet, giving sufficient space for six lanes of traffic, i.e. two streetcar tracks and four additional lanes. The sidewalks are ordinarily about 7 feet wide.[30]

On the approaches west of Front Street and east of East Second Street the roadway is widened to 90 feet, thus giving space for two additional lanes of traffic, and the sidewalks to about 8 feet clear width.

Staircases lead to the bridge at Front Street and at East Third Street. At Front Street there is also direct access, without crossing traffic to safety islands along the car tracks. At Second Street all four street corners and two safety islands are connected by a subway 4-1/2 feet wide and 7-1/2 feet high. A similar subway crosses Burnside Street at East Third Street.[31]

---

[30] The bridge now has two seven foot pedestrian sidewalks on the main span, one on each side of the bridge, as well as five lanes of vehicular traffic: two lanes for west bound vehicular traffic, and three lanes for east bound vehicle traffic. There are also two dedicated bicycle lanes, one on each side of the bridge between the pedestrian sidewalk and the outside traffic lane.

[31] "Due to the width of Burnside Street and the expected volume of traffic, this precaution was deemed necessary." "The New Burnside Bridge, Portland, Oregon," Reed, *Western Construction News*, 10 July 1926, 20. Photographs showing the islands in large detail can be found at the Oregon Historical Society in the Maps and Photo Library, File, "Burnside Bridge."

## Type of Construction

The river spans have steel trusses carrying a concrete deck. The West Approach is a reinforced concrete structure, except west of First Street where the pavement rests on a sand and gravel fill. The East Approach across the railroad yard is of steel plate girder and steel column construction with a concrete deck, but all the steel is encased in concrete. [See **Plate 1**, photograph showing concrete encasement of east approach steel girders.[32]] From the railroad yard to east of East Third Street a reinforced concrete structure is used. For the remaining part of the East Approach up to Union Avenue the pavement rests on a fill.[33]

The river piers as well as the more important approach footings rest on pile foundations. For the two bascule piers the piles are driven down to an average elevation of 95 feet below city datum. The bascule pier seals poured on top of the piles are of unusual size measuring 68 x 78 feet and being 37 feet high, extending from Elevation -70 to -33.

### Bascule Span

The two bascule leaves, together measuring 252 feet between trunnions, travel when raised into their extreme position, through an opening angle of 73-1/2-degrees. The bascule span is of the Strauss type.

---

[32] The photograph shows equipment for placing concrete on the east approaches. Apparently the steel girders were encased to protect them from fire caused by the movements of trains through the rail yard located beneath the bridge's east end. The original design drawings show railroad tracks on East First and Second Street and in the block between, and another in the block east of Second Street. Burnside Bridge design drawing T-2 (AB-1/3), ca. 1925, Files, Multnomah County, Bridge Section. This encasement was no small feat. The girders weighed 85 tons and were nearly 104' long. A photograph with descriptive paragraph labeled, "Photograph of Steel Girders, East End of Burnside Bridge, with Kurt Siecke, Engineer," was enclosed with a report titled, "Experience Record, Kurt H. Siecke Engineer, May-1954," Files, Multnomah County, Yeon facilities. Siecke writes: "The designing engineer [he takes the credit here] of the 102'-7-1/2" 85-ton steel girder spans for the east approach to the Burnside Bridge is seen viewing the product of his calculations. These heavy steel girders are encased in concrete and support the roadway. These girders have been received by rail and were unloaded on timber blocking in the railway yards. The steel plates are 132 inches high and 5/8 inches thick. They are supported by 6 inch x 3-1/2 inch x ½ inch stiffener angles spaced five feet apart which also help carry the concrete encasement and served as connections for the floor beams. Seventeen structural steel girders in all were used."

[33] The approach fills were made of river gravel hauled in by trucks and consolidated by a water jet. "This resulted in a fill so compact that there was no settlement of the concrete paving and sidewalks, although they were placed about a month after the fill was made." Melville Reed, "The New Burnside Bridge, Portland, Oregon, *Western Construction News*, 10 July 1926, 21. The Spokane, Portland & Seattle Railway Co. had to move its track six feet west to make room for Burnside Bent No. 28, located on the east bank. Several buildings were razed to make room for the bridge approach, both on the east and west banks. See Appendix 1, "Selected Time Line of Events," 31 May 1925.

Each bascule leaf weighs about 930 tons and is balanced by a counterweight weighing approximately 1700 tons. The total weight of leaf and counterweight, 2630 tons, rests on the two main trunnion pins on each bascule pier giving a maximum reaction of 1315 tons per pin. The whole bascule leaf turns when the bridge is being opened or closed around those trunnion pins which have a diameter of 27 to 28 inches and are 7 feet 11 inches long; they are steel forgings and rest in cast steel bearings with phosphor bronze bushings.

When closed the two bascule leaves are connected by means of a centerlock preventing any movement of the leaves against each other.

The bascule leaves are operated by means of four main motors of 70 H.P. each, two motors for each leaf. These motors receive D.C. current, 550-Volts, and normally make 560 revolutions per minute. The normal torque per motor is then 670 pounds at 1-foot radius but the specified starting torque is 1425 pounds at 1 foot radius.

The motors act through a series of gears on a circular rack attached to the main trusses, the angular velocity of the motors thereby being reduced 3638 times. Or in other words, instead of the 560 revolutions per minute for the motors, the bascule leaves make only 0.154 revolutions per minute, which corresponds to an opening time of 67.9 seconds for the full angle of 73-1/2 degrees. Allowing for acceleration and retardation the actual opening or closing time will be about 70 seconds.

In addition to the main motors there are a number of smaller motors for operating the centerlocks and roadway gates, also emergency brakes, etc. The various motors are interlocks so as to secure the correct sequence of operations. For instance, when the bridge is being opened the gate motors cannot be operated unless the automatic flagmen and warning signals have been put in operation. Again, the centerlock cannot be opened unless the gates are closed, and the main motors operating upon the bascule leaves cannot be started until the centerlock is released. When the bridge is being closed all of these operations must be performed in the reversed order.

Each bascule leaf can be operated from its own bascule pier. But ordinarily both leaves will be operated from the operator's house on the west bascule pier, thus requiring only one operator.

By means of a submarine cable that connects the two bascule piers, current can be transferred from one side to the other. Therefore, the bridge can be operated even if the current supply from the West Side, or from the East Side, breaks down.

**Quantities of Materials**

The amounts of main materials entering into the bridge, including approaches, are as follows:

| | |
|---|---|
| Structural and Miscellaneous Steel | 5078 tons |
| Cast Steel | 37 tons |
| Bascule Machinery | 190 tons |
| Street Car Rails | 120 tons |
| Total Steel, exclusive of Reinforcing Steel | 5425 tons |
| Reinforcing Steel | 1615 tons |
| Concrete | 58,000 c.y. |
| Cement | 76,000 bbls. |
| Wooden Piling | 118,000 lin. ft. |
| Fill Material | 15,000 c.y. |

**Construction Contracts and Estimate of Costs**

| | | | |
|---|---|---|---|
| 21 July 1924 - Contract let to Pacific Bridge Co: | | | |
| Bridge except Bascule Superstructure | | | $1,784,000.00 |
| Bascule Substructure | | | 556,173.00 |
| Take down Old Draw Span | | | 10,000.00 |
| Remove Old Piers, etc. | | | 40,000.00 |
| | | | $2,390,173.00 |
| 9 November 1925 - Contract let to Lindstrom and Feigenson for Completing Approaches | | | $93,976.00 |
| 21 September 1925 - Contract let to NePage-McKenny Co. for Lighting System for $11,853.00, but in letter of 29 September 1925, modified so as to make the contract sum | | | $14,865.50 |
| Total of Main Contract Sums | | | $2,499,014.50 |
| **Engineering:** | | | |
| G. Lindenthal, Prel. Report | $ 3,636.36 | | |
| G. Lindenthal, 50% Max. Fee | 79,000.00 | | |
| Other Engineering | 147,044.81 | | |
| Architects | 6,521.74 | | $236,202.91 |
| Testing of Cement | | | 2,278.29 |
| Preliminary Expenses, Bonds, Adv. etc. | | $11,949.80 | |
| Relocating Tracks and Sewers | | 3,421.43 | |
| Bates Building | | 9,750.00 | |

| | | | |
|---|---|---|---|
| Storing of Old Burnside Steel | | 6,766.34 | |
| Premium on bond for Strauss Bascule Bridge Company | | 250.00 | $32,137.57 |
| | Forward | | $2,769,633.27 |

**Extra Work and Additions or Deductions, to Date:**

| | | |
|---|---|---|
| Pacific Bridge Co. Contract | $33,675.00 | |
| Lindstrom & Feigenson Contract | 11,833.35 | |
| NePage-McKenny Co. Contract | 3,744.72 | $49,253.07 |
| Change of Bascule Handrail, Manganese Steel Joints, etc. | | 3,580.28 |
| Pacific Bridge Co. Construction of Starlings | | 27,500.00 |
| Pacific Bridge Co., Piling for future Harbor Wall | | 4,891.33 |
| Rock for Riprapping, Pacific Br.Co. $2500.00 | | |
| Port Commission 22738.75 | | 25,238.75 |
| Pacific Bridge Co., submitted and approved bills, not yet included in any estimate (Group "A") | $14,669.04 | |
| Additional bills to be approved, less credits, will hardly exceed any | 4,330.96 | |
| | $19,000.00 | |
| Lindstrom & Feigenson bills, not yet submitted, for extra work, including Depression of First Street, paving on Burnside, etc. may be as high as | $15,000.00 | |
| NePage-McKenny C. bills, not yet submitted, may be say | 4,000.00 | $38,000.00 |
| | | $2,918.096.70 |

Claims presented by Pacific Bridge Company
but not approved, are as follows:

| | |
|---|---|
| Group A | $ 7,333.03 |
| Group B | 9,942.07 |
| Group C | 40,351.88 |

and in addition thereto 1-1/2% bond premium for all extra work. If part of Group C is allowed the Contractor in the final settlement, then the total bridge cost, not including the right of way, may be about $2,940,000.00.

This does not include any damages for change of grade, for cracks in walls and settlement of Columbia Digger Co.'s warehouse, nor similar expenses.

**Subcontracts**

The Pacific Bridge Company sublet parts of the work as follows:
15 August 1924, to United States Steel Products Company for furnishing the Structural and Cast Steel and Bascule Machinery $733,459.00

21 August 1924, to Lindstrom & Feigenson for constructing the West Approach, except piling and lighting system $174,418.00

the East Approach, except structural and cast steel, piling and lighting system $239,776.00 $414,194.00

above sums not including Handrail, Lamp Posts and Trolley Poles at certain unit prices.

6 September 1924, to Jaggar Sroufe Company for furnishing and installing all electrical operating equipment for the bascule span $ 39,000.00
10 December 1924, to Booth & Pomeroy, Inc. for handling, erecting and painting all structural and cast steel, also installing all bascule machinery, at unit prices estimated to aggregate $151.371.00

| | |
|---|---|
| Total for subcontracts, not including extra work, additions and deductions, nor work performed at unit prices in Lindstrom & Feigenson subcontract | $1,338,024.00 |

Of all the materials entering into the bridge only the following were not supplied from the state of Oregon:

| | |
|---|---|
| Structural and Cast Steel, Bascule Machinery and Rails, about | $750,000.00 |
| Reinforcing Steel, about | 105,000.00 |
| Electrical Equipment, about | 30,000.00 |
| | Total $885,000.00 |

which is very nearly 30% of the total cost of the bridge.

For the Burnside Bridge we therefore find similarly as for the Sellwood Bridge that although the river spans, and for the Burnside Bridge also the greater part of the East Approach, are built of steel, still 70% of the entire construction cost is paid out within the state.

Multnomah County estimated a replacement cost for Burnside Bridge in 1997, including right-of-way acquisition, of $143,333,750.[34] For a description of the bridge's architecture, see "Architectural/Aesthetic Details and Operator Towers" section.

**Foundation Construction**

The main contract for constructing the bridge was let to Pacific Bridge Co. on 21 July 1924, in the amount of $2,390,173.[35] The "Record of Borings" drawing in the design set shows that a total of seven soil borings were taken in June 1923.[36] The deepest borings extended to –162' under Pier 4, near the east side of the river. As noted in the Hedrick & Kremers report of 19 June, that same year, and as shown on the borings drawing, the river pier borings were put down by a standard Star well drilling rig, with on-shore borings made with dirt augers operated

---

[34] "Willamette River Replacement Cost Summary," printed 1/10/97, file name BR-RPL97.WK1, Files, Multnomah County, Bridge Section.

[35] "Specifications, Proposal and Contract for the Burnside Bridge across the Willamette River at Portland, Oregon, Design No. 2, Trunnion Bascule Draw Span with Riveted Steel Truss Fixed Spans," signed 21 July 1924 Files Multnomah County, Bridge Section.

[36] "Record of Borings," Burnside Bridge, Multnomah County, Oregon," Sheet No. 5, Hedrick & Kremers, 13 June 1923 initials L.G. Frost, W.D. Smith and E.H., Files, Multnomah County, Bridge Section.

by hand. The borings produced silt, sand, clay, quick sand, fine sand, hard sand, sandy gravel, coarse red sand, hard sand and shale, and hard sand and clay cemented. The settlement test, a 4" pipe placed to the bottom of a hole with sandbags on top of the pipe and left for 12-17 hours, produced ¼" maximum settlement.[37]

Construction of the river piers was a challenge due to their size and the nature of the foundations, with about 550 timber piles placed under each pier. The piles had to be cut off ten feet above the river bottom, or about 65' below the surface of the water. A 13,100 pound subaqueous hammer drove the piles.[38] Such an underwater hammer made possible the use of piles only 50' long instead of 120'. "As exact location of each pile was desired, an underwater section of stationary driver leads was fastened to the underside of the drive scow and the drop leads were thus as accurately held in place and guided below water level as they were above."[39] Excavation at the site of each pier was made with a clamshell before pile driving began. The ten foot pile projection above the bottom of the excavation allowed this much of the piles to extend into the concrete base of the pier, which was later poured around the tops of the piles by the open caisson method. The underwater pile driving method was chosen to save money on timber, and because it was thought it would give better results for the hard driving expected. "This belief was based on the fact that the subaqueous hammer would deliver the entire force of the blow directly to the piles which were put down in the 40' lengths required plus a slight additional length that would make it possible to cut them all off to the same level."

The four timber cribs (caissons) required for the Burnside Bridge river piers were built nearby on the river, and then towed into place and sunk. The two largest cribs were placed near mid-channel for the bascule piers, with the two smaller cribs located near the river banks for the abutment piers. As noted in Rode's report, the two larger cribs are 78' long by 68' wide and 80' high and the smaller ones are 68' long by 36' wide and 55' high. After being sunk in place, a concrete seal was poured by the tremie method to elevation –33', ". . . with care being taken that the pour was continuous without construction seams. After setting for 28 days the cribs were pumped out and the remainder of the pier was built in the dry."[40]

The bridge was erected on the site of the old Burnside Bridge and the old timber draw

---

[37] "Record of Borings," Burnside Bridge, Multnomah County, Oregon," Sheet No. 5, Hedrick and Kremers,13 June 1923 initials L. G. Frost, W.D. Smith and E.H., Files, Multnomah County, Bridge Section.

[38] "Subaqueous Pile Driving at Portland, Oregon," *Engineering News-Record*, 9 July 1925, 53.

[39] "Subaqueous Pile Driving at Portland, Oregon," 53.

[40] Reed, "The New Burnside Bridge," 22.

rest located mid-channel was used by the contractors in building the new bridge. "The two large timber cribs were built up at moorings alongside this draw rest which also served as a convenient location for compressor plant and stored materials."[41] About two days were required for the complete sinking of a crib. The work was rushed during the fall months, in order to have the bases sealed on the two bascule piers before the winter high water began. About 440,000 board feet of Douglas fir timber was used and 44,000 pounds of hardware were used in the construction of each of the large cribs. Philip Hart, an engineer with Pacific Bridge Co., devised the crib construction method. "Within six months of the contract being let, the old bridge was removed, the excavation for all but one of the smaller piers had been completed, all four cribs had been built, piles had been driven in the two bascule piers, both of the large cribs had been successfully sunk and sealed, and one of them had been pumped out and the forms for the concrete pier at this crib had been placed."[42] The journal articles do not mention that Crib No. 4 collapsed during the morning of 11 April 1925, when the struts connecting the opposite walls of the crib suddenly buckled, or that an error was discovered in the design of Burnside's superstructure at Piers No. 2 and No. 3. As a result, work on those piers stopped for a week in November 1925 while the plans were corrected.[43]

For reasons unknown, just before the bridge opened, A.E. Doyle, Portland's premier architect, inquired about the piling for the foundations on the east side of the river. In response, Rode prepared an extract from the pile records for all foundations of the bridge on the east side of the river. Rode's accompanying letter provides further clues to the soil conditions encountered during Burnside's construction:

> In the attached table will you find all the important data in regard to the piles. You will notice that the driving was rather irregular within any one foundation, which is partly due to a gradual tightening up as the number of piles increased, and partly to the presence of boulders or other obstructions. But the average penetrations for the various foundations run rather uniformly. Nearly all piles were driven to practically refusal. For all the bent foundations the piles went down very easily for quite a distance, through an upper layer of silt and, farther down, sand. Underneath is a layer of coarse gravel on which the pile foundations are resting.[44]

---

[41] "Timber Cribs Floated to Place for Bridge Piers," *Engineering News-Record*, 8 October 1925, Vol. 95, 584.

[42] "Timber Cribs Floated to Place for Bridge Piers," *Engineering News-Record*,584.

[43] "Timber Cribs Floated to Place for Bridge Piers," 584..

[44] "Extract From Pile Records For East Approach," by Hans Rode, 5 May 1926, with unsigned letter of the same date. Files, Multnomah County, Bridge Section.

Another engineering oversight later led to a furious last-minute letter writing exchange about navigation clearance under the bridge. After the U.S. Army Engineers had completed its final inspection of the Burnside Bridge some time in late 1926, it found all clearances satisfactory, "except the vertical clearance at the center of the bascule span, which is found to be only 64.8' instead of 67.27' as called for in the permit."[45] About the 3.1 foot miscalculation, Rode reported to the County Commissioners on 8 November 1926:

> On the approval drawing, Sheet No. 1, submitted to the District Engineer on 16 November 1923, and on the revised sheet No. 1-A submitted 7 May 1924, the clearance is actually given as 67.27 feet whereas it should have been given as 64.17 feet. The discrepancy of 3.1 feet is the difference between City of Portland datum and the U.S. Engineers datum—City of Portland datum is used on all bridge plans except those submitted to the War Department where U.S. Engineers datum must be used. By mistake the one clearance figure at the center of the bascule span referred to City datum on the approval plans.[46]

The U.S. Engineers finally approved Burnside, but not until February 1927, and then the approval took an act of Congress, as a bill had to be introduced in Congress legalizing the bridge as actually built.[47]

**Strauss Bascule**

Prior to 1893, there was one popular choice for movable bridges, the swing span bridge. In the late 1800s, the modern-day vertical lift and bascule bridges arrived, the latter with the

---

45 Commissioners Journals, "Burnside and Ross Island Bridges," 8 November 1926. Files, Multnomah County Ford Facilities.

46 Commissioners Journals, "Burnside and Ross Island Bridges," 8 November 1926.

47 Commissioners Journals, "Burnside and Ross Island Bridges," 8 November 1926. Also 9 February 1927. In the 1920s, prior to the time dams were being built on the Willamette's tributaries, stage level was influenced in the Portland-Vancouver harbor by natural stream flows on the Columbia River, Willamette River and local tributaries and tidal effects, especially for stages below 12'. Water level in the Willamette at Portland has been historically tracked by several datums for measuring elevation. This is because various agencies have established datums noting zero water level at different spots along the waterfront to keep track of river elevation according to their individual needs. Since each agency had its own reason for establishing its datum, few match. For example, zero for the City of Portland datum is 2.92' lower than the zero for the National Weather Service (NWS) datum. Similarly, the National Geodetic Vertical Datum (NGVD) is 1.55' below the NWS datum. Thus, when the river's elevation is seven feet above zero (7.00) on the NWS gage located on the Morrison Bridge, the City of Portland's gage would read 9.92, and river stage according to the NGVD would be 8.55. Multnomah County, owner of four of the five Central City Waterfront movable bridges, has historically operated from more than one agency's datum, using the NWS datum plane for boat operations, but the City of Portland plane for building and repairing bridges. "Datum Chart," n.d., Files, Multnomah County, Bridge Section

opening of the Van Buren Street Bridge in Chicago, and the London Tower Bridge in London.[48] The modern bascule bridge afforded quick openings, machinery that could be hidden out of sight, and deck trusses with wide views. By the 1920s, the city of Portland wanted an automobile bridge that would be such "a wide and capacious structure."[49] They also wanted a Burnside Bridge with enough clearance "so that all river boats can pass under the bridge without raising the bascule."[50]

Selecting a movable bridge type is usually based on the components of economics: first cost, maintenance and operation.[51] By the 1920s, bascules had developed so that two main types were being offered. One was the rolling bascule. Varieties of the rolling bascule included the Scherzer, made by the Scherzer Co. and the Rall, patented by Theodor Rall, and marketed by the Strobel Engineering Co. Strobel and Scherzer both were Chicago firms.[52] The other main bascule type was the trunnion-style bascule, offered by the Chicago Bascule Bridge Co. and by the Strauss Bascule Bridge Co., also of Chicago.[53] In mechanics, a bascule is an apparatus in which one end is counterbalanced by the other end, on the principle of the seesaw.
A Strauss company publication defines this type:

---

[48] *Movable and Long-Span Steel Bridges*, eds. George A. Hool and W.S. Kinne (New York: McGraw-Hill, 1943), 1. For an excellent description of the London Tower Bridge, see Otis Ellis Hovey, *Movable Bridges*, (Wiley & Sons: New York, 1926), 81-87.

[49] Commissioners Journals, "Burnside and Ross Island Bridges," 20 June 1923, Hedrick and Kremers report.

[50] Commissioners Journals, "Burnside and Ross Island Bridges," 20 June 1923, Hedrick and Kremers report. 19 June 1923. By "river boats," Hedrick & Kremers, no doubt, meant river boats, i.e., steam boats, as opposed to ocean-going ships.

[51] *Movable and Long-Span Steel Bridge*, 5. Historically, esthetics have been given minor consideration by cash-strapped public agencies.

[52] The Broadway Bridges, opened in Portland in 1913, is a Rall type bascule bridge.

[53] About Chicago being a hot bed of bascule bridge companies and bridge building activity, Ed Wortman says, "This is what happens when you have tall boats, a lot of people and a skinny river." (The Chicago River is only about 200' wide—so narrow it can be dyed green for St. Patrick's Day). For more about the variety of bascules, see John A. Schultz, Jr., S.E., Hazelet & Erdal, "Remember the Past to Inspire the Future, Historic Development of Movable Bridges," a paper prepared for the 5th Biennial Symposium of Heavy Movable Structures, Inc., American Consulting Engineers Council's Affiliate, 2-4 November 1994, Clearwater Beach, FL.; Schultz, "The Selection and Evolution of the Chicago Type Trunnion Bascule Bridge, Historical Development of Movable Bridges, Part III, a paper presented at the Sixth Biennial Symposium of the Heavy Movable Structures Convention, 30 October-1 November 1996, Clearwater Beach; Donald N. Becker, "Development of the Chicago Type Bascule Bridge," *American Society of Civil Engineers*, 1943 Feb., 263; Hovey, *Movable Bridges*; J.A.L. Waddell, *Bridge Engineering* (New York: Wiley, 1916), Vol. 1, "Bascule Bridges," 700; and J.B. Strauss, "Bascule Bridges," paper presented in Washington, D.C., 29 December 1915, for the Proceedings of the Second Pan American Scientific Congress (Vol. VI, Washington: GPO, 1917).

> Bascule Bridge signifies a movable bridge which is balanced about a horizontal fulcrum, and which may be raised or lowered by rotation about this fulcrum. This fulcrum, in the Strauss type of bascule bridge is a fixed shaft termed a "trunnion", and is provided with phosphor bronze bushings. This has proven to be an ideal operating mechanism in every respect.[54]

By 1925, the Strauss Co. had patented five types of trunnion-style bascule bridges: Underneath Counterweight, Vertical Overhead Counterweight, Heel Trunnion, Double Leaf Simple Span Heel Trunnion and Double Leaf Arch. Of these, the three that gained widespread use were the Heel Trunnion, Vertical Overhead Counterweight, and Underneath Counterweight. The latter was chosen to be the type used for the Burnside Bridge.

In a report to the Board of Multnomah County Commissioners of 19 June 1923, regarding their recommendations for the 1920s bridges, Hedrick & Kremers commented on the Burnside Bridge's location and general description, width of roadways and sidewalks, requirements of the U.S. Engineers, borings, estimates of quantities and costs, relative merits of steel and concrete, live loads, lists of drawings, traffic during construction, and "Types of Bascule Span":

> There are several types of bascule spans in use but for a deck bridge, such as is proposed for this structure, a double leaf trunnion bascule is the proper type to use. Of this type of structure the two principal ones are what are known as the Strauss pivoted counterweight trunnion and the Chicago type with fixed counterweight. There has been considerable controversy over royalties and patent rights in connection with the construction of bascule spans, as in Chicago and Seattle.[55] There have been ten bridges or more of the Chicago type built in the City of Chicago, two at Detroit, and several at Seattle. The Strauss Bascule Bridge Company has designed a good many of the Strauss type. The

---

[54] Strauss, J.B "Bascule Bridges," 29. The U.S. Steel Co. shop drawings for Burnside's trunnion show cast steel trunnion bearings and phosphor bronze bushings, Sheet No. 9, Files, Multnomah County Bridge offices.

[55] "Eight Years of Litigation Over Seattle Bascule Bridges," *Engineering News-Record*, vol. 103, 19 December 1929, 968-969. Also see Reeve, "The Story of Strauss Bridges," 54. This Strauss Co. publication devotes nearly three pages to "A Brief Word on Bridge Patents," and describes its eight-year-long infringement proceedings against the City of Chicago in litigation for ten city-built bascule bridges. Strauss won in both Chicago and Seattle, collecting $348,500 from the former city and $50,000 from the latter for bridges built in the 1920s. (By June 1925, Strauss had 50 patents covering various types of bascule and lift bridges, a cantilever-suspension bridge, and other types of fixed bridges, as well as the patent for a concrete bridge floor.) At issue was the cross-girder principle, and whether anyone but Strauss had the rights to transverse cross-girder type bascule bridges, similar to the girder type found in Portland's Morrison Bridge, opened in 1958, see Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Morrison Bridge," HAER No. OR-102. According to the article in *Engineering New-Record*, Strauss patent 995,813, covering the trunnion design, expired 11 June 1928.

Strauss Bascule Bridge Company of Chicago handle the Strauss type and the Chicago Bascule Bridge Company, the Chicago type. It is but natural that both of these concerns claim advantages for their respective types over the other. We believe that either one of these bascules properly designed and built will give you a first class structure. In so far as we can see, there is not a material difference in either the costs nor the merits of the two designs."[56]

Regardless of "no material difference," Hedrick & Kremers recommended the Strauss proposal as the Strauss Co. could offer "many designs" while the Chicago Bascule Bridge Co. had only the fixed counterweight design.[57] The Board of Multnomah County Commissioners signed a contract with the Strauss Bascule Bridge Co. on 31 July 1923, with the Strauss fee set at ten percent of cost, or approximately $56,000.[58]

As of 1 July that same year, the Strauss Co. had already built 241 movable bridges. Of those, 82 were the Underneath Counterweight type, the same bascule type as that found on the Burnside Bridge. What was different about Burnside from the other 81 Underneath Counterweight types built or under construction at the time, was that Burnside was the first bascule bridge to be built with a concrete floor on the moving leaf. "This has been successfully accomplished for the first time under Strauss patents in the Burnside Street Bridge at Portland, Oregon, which is further distinguished by being the largest double leaf deck bascule yet built."[59]

It is interesting that the bridge's concrete counterweights were built in place in the bascule piers prior to the erection of the two 130' leaves of the main span. The concrete counterweights anchored the inner ends at the trusses, erected over the river as cantilevers. The weights of the trusses rested upon the trunnion bearings. (**Plate 2**, photograph showing the erection of the Burnside Bridge bascule span leaves.)[60]

---

[56] Commissioners Journals, "Burnside and Ross Island Bridges," 20 June 1923.

[57] Commissioners Journals, "Burnside and Ross Island Bridges," 20 June 1923.

[58] Although Strauss's fee is not mentioned specifically in the comprehensive construction report by resident engineer Hans Rode about the Burnside Bridge, dated 21 May 1926, the fee probably was included in Rode's line item for engineering, under "Other Engineering," and included in the $147,044.81 figure shown. Copy of letter to Amedee M. Smith, from Hans Rode, dated 21 May 1926, Files, Multnomah County, Yeon facilities. Also see Commissioners Journals, "Burnside and Ross Island Bridges," 31 July 1923.

[59] A.B. Reeve, Research Engineer, "The Story of Strauss Bridges," The Strauss Bascule Bridge Co. (Chicago, June 1925), 41.

[60] From "Experience Record, Kurt H. Siecke Engineer," Files, Multnomah County, Yeon facilities. A descriptive paragraph that accompanied the photo noted, "The massive trunnion bearings can be clearly seen at the top of the 'A' frame column bracing." Siecke adds, "The concrete forming the upper portion of the bascule piers has not yet

About the time of the construction of the Burnside Bridge in Portland, Strauss was not only promoting his design for the Golden Gate Bridge (that would not open until 1937), he was serving as engineer on the Shands Bridge in Green Cove, Florida; the Columbia River (Lewis and Clark) Bridge, at Longview, WA. (49 miles north of Portland)[61]; and the George Washington-Wakefield Memorial Bridge across the Potomac River. The Burnside Bridge is similar in proportions and operation to Arlington Memorial Bridge, Washington, D.C., another large Strauss bascule.[62]

Clifford Paine, the Strauss Bascule Bridge Co. chief of staff, visited Portland at least once, just before the bridge's opening on 28 May 1926.[63] "During the past week the writer has made a thorough inspection of Burnside Bridge bascule and directed the making of several adjustments."[64] Nine months later, the Burnside's "electrical mechanism" was still troublesome. Lindenthal, therefore, informed the Strauss Co. it had to send an expert to overhaul the "whole operating machinery."[65] Lindenthal, writing from New York, assured the Board of County Commissioners that Rode, who was "in constant touch," could direct the work in Portland as if he (Lindenthal) were present. Lindenthal may not have gone to Portland on account of the Burnside's woes, but it appears Strauss himself visited in early May 1927, and then sent a letter to the Board of Multnomah County Commissioners:

> It seems the bridge is working quite satisfactorily now and that there has been no further trouble. It also appears from my conversation with Mr. Rode that the center locks have never actually failed to function but that there was some fear in Mr. Rode's mind that they would fail to function and it was for this reason that he suggested a larger motor. Since, however, the motors are more than ample for the services to be performed, and

---

been pla[61] Also known as the Longview Bridge, when this Strauss structure opened in 1930, it was the longest cantilever span in the United States. See Smith and others, *Historic Highway Bridges of Oregon*, 212.

[62] See Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Arlington Memorial Bridge," HAER No. DC-7. This vehicular and pedestrian bridge was completed in 1932. Other reports of Strauss structures include Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior "Military Street Bridge," HAER No. MI-38, Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Smithfield Street Bridge," HAER No. PA-2, Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Congress Street" HAER No. MA-38, Historic American Engineering Record (HAER), National Park Service, U. S. Department of the Interior, "New York, New Haven and Hartford Railroad," HAER No. CT-25, and Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Henry Ford Bridge HAER No. CA-156.

[63] A 4 May 1927 entry in the Commissioners Journals, "Burnside and Ross Island Bridges," a letter from Strauss to the Board of Commissioners indicates that Paine was to visit Portland for a "detailed inspection" in the latter part of 1927. There are no notes in later entries indicating Paine did so.

[64] Commissioners Journals, "Burnside and Ross Island Bridges," 24 May 1926.

[65] Commissioners Journals, "Burnside and Ross Island Bridges," 14 February 1927.

since the introduction of heavier machinery would over-stress the lock gear, we have suggested to Mr. Rode that it would be best not to substitute the heavier motors, leaving the matter until our Mr. Paine can come out for a detailed inspection, which we hope will be within the next few months.[66]

Joseph Strauss (1870-1938) was born in Cincinnati, Ohio, graduating from the University of Cincinnati in 1892 with a degree in civil engineering. He gained practical experience as a draftsman for the New Jersey Steel & Iron Company of Trenton, N.J. In 1899, he became the principal assistant and draftsman in the Chicago office of Ralph Modjeski, working for Modjeski until 1902.[67] In 1904 he formed the Strauss Bascule and Concrete Bridge Co., located in Chicago. As much inventor as engineer, Strauss was one of the first engineers to incorporate "ribbed arch" construction in the U.S. and to erect a multiple-arch concrete bridge without falsework.[68] He received his first patent while in college, and designed everything from carnival fun rides, to disappearing searchlights, to concrete railway cars.[69]

**Contractors**

Pacific Bridge, the contractor for the main span of the Burnside Bridge, was established in California in 1869 by W.H. and C.H. Gorrill, and moved to Portland in 1880. As reported in the newspaper stories for the opening ceremonies of Burnside, Pacific Bridge also built, in 1887, the Morrison Bridge, the first highway bridge across the lower Willamette River near Portland. Charles F. Swigert, born in Ohio in 1862, worked for Pacific Bridge in California, migrated with the company to Portland, and then bought the firm in 1886. Pacific Bridge did not fabricate steel, but it did erect steel work and maintained a corps of engineers who designed "when

[66] Commissioners Journals, "Burnside and Ross Island Bridges," 4 May 1927. Strauss goes on to say that it is desirable to make certain that the bridge's piers had not settled, and suggests the county make a check of the alignment. "This is always desirable after the bridge has been in service for some time where the foundations are not on rock . . . ." Strauss said that the bridge "should be handled only by the most experienced and capable operators" and that, "the ordinary electrician is not competent to operate and maintain a structure of this character." Strauss suggests a special operating and maintenance crew just for Burnside. Doing so, he said, would prevent a reoccurrence of "such causes as were responsible for the failure of the bridge to operate on the two occasions in the past." ibid.

[67] Patrick O'Neil, "Strauss, Joseph Baermann," *National American Biography* (New York: Oxford University Press, 1999), 10-13. In Oregon, Modjeski also designed the Broadway Bridge, opened across the Willamette River. See Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Broadway Bridge," HAER No. OR-22 in 1913; the Spokane, Portland, and Seattle (now Burlington Northern-Santa Fe) railroad and highway structures in North Portland, completed in 1908-1909; and the steel braced-spandrel arch designed for the Oregon Trunk Railroad, built in 1911 across the Crooked River Canyon in Central Oregon. For more about Modjeski, see Smith and others, *Historic Highway Bridges of Oregon*, 244.

[68] O'Neil, "Strauss," 10.

[69] O'Neil, "Strauss," 10.

requested."[70] In addition to the Burnside Bridge steel erection, Pacific Bridge also contracted for the substructure work on the Interstate Bridge, its northbound span opened in 1917 across the Columbia River between Portland and Vancouver, Washington; the substructure work for the river piers of Ross Island Bridge, also opened in 1926; the construction of the Portland Harbor Wall and the wall's backfill, opened in 1929; and other Portland projects.[71]

**Lindstrom & Feigenson**

In addition to working in either a prime or sub-contracting capacity on the Burnside, Ross Island, and St. Johns bridges, Lindstrom & Feigenson also worked on the McCullough Bridge at Waldport, Oregon, and the Strauss bridge at Longview, WA. Oscar J. Lindstrom, founder of Lindstrom & Feigenson, general contractors with headquarters in Portland, was born in Umea, Sweden in 1878, emigrating in 1903. The company quit business in 1937, a year after the death of William H. Feigenson, Lindstrom's partner, and president of the business.[72]

**Architectural and Aesthetic Details and Operator Towers**

The Burnside Bridge is an excellent example of, and was the first "downtown" Willamette River bridge to benefit from, the conscience-raising City Beautiful Movement.[73] Consulting engineers Hedrick & Kremers recommended architects be involved with initial stages of the bridge in a report to the Board of Multnomah County Commissioners, in June 1923:

> "Generally speaking, a bridge will have the most pleasing appearance when the members have been properly proportioned from an engineering standpoint, and it is not believed that much advantage would result in the employment of architects on this part of the work. There are, however, certain parts of a bridge which do not affect the strength,

[70] Fred Lockley, "Charles F. Swigert," *History of the Columbia River Valley, From the Dalles to the Sea* (Chicago: s.J. Clarke, 1928), 3 Vol., 618.

[71] The company also operated outside Portland. In 1931, Pacific Bridge was the contractor for the superstructure of the Lake Union Bridge over the Lake Washington Canal at Aurora Ave., in Seattle, Washington "News of the Week, Lake Union Bridge, Seattle, Wash.," *Engineering News-Record*, 16 July 1931, 111. Construction began on the Lake Union Bridge in late 1929.

[72] Oscar Lindstrom died 7 December 1945. "Oscar J. Lindstrom," *The Oregon Journal*, 7 December 1945, 6; "W.H. Feigenson, Contractor, Dies," *The Oregonian*, 26 January 1936, sec. 2, 1. Feigenson was 56 at the time of his death. He was also president of Albina Fuel Co., another prominent Portland company.

[73] Of the City Beautiful Movement, started in the 1890s, nobody said it better than a couple of 1950s writers: ". . . Slowly it dawned that there was danger in urban disorder and that America was not to be measured by bigness alone—art too must have its role." Christopher Tunnard and Henry Hope Reed, *American Skyline* (New York: Houghton Mifflin, 1953), 136.

where architectural services could well be used. These include such features as hand rails, map and trolley poles, operating houses for draw-spans, and waiting shelters. It is important that the best possible design be obtained for these portions of the bridges, particularly in view of the fact that in deck bridges such as are proposed here, they constitute practically the only portions visible to the users of the bridges, aside from the pavements. Architectural treatment could also advantageously be given to those portions of the approaches of the bridges where crossing over streets . . . . In view of the above, it is our opinion that a reasonable amount for architectural services in connection with the two bridges would be money well spent."[74]

The Board of Multnomah County Commissioners voted to defer action until Hedrick & Kremers had submitted tentative designs for the bridges,[75] with Houghtaling and Dougan Architects, Portland, finally hired and a contract signed 31 July 1923.[76] Due to the subsequent indictments involving the commissioners, contractors, and one of the engineers, the consulting engineering contract was terminated and the three construction contracts for the individual bridges were voided, but the contract for the architects, and for the Strauss Bascule Bridge Co.'s design of the bascule stood after the county district attorney found them both valid.[77] On 22 July 1925, the firm of Houghtaling and Dougan advised the district attorney that the firm had dissolved and that future payments were to be made to Houghtaling alone. Final payment was ordered on 28 February 1927.[78]

Architectural treatment of Burnside Bridge includes an ornate spindle-type balustrade concrete railing, with cast steel and cast iron ornamental railing on the center span. The ornamental tile is original and was supplied by Gladding McBean & Co., Auburn, Washington.[79]

---

[74] Commissioners Journals, "Burnside and Ross Island Bridges," 6 June 1923.

[75] The first Hedrick & Kremer design called for a bascule bridge with concrete arch side spans, and is drawn with two simple operators' towers with flat roofs. "Double-Leaf Trunnion Bascule Bridge Over the Willamette River at Burnside Street," engineering drawing with the Hedrick & Kremers title block is dated 12 July 1923. This drawing is referred to as Design No. 1, Files, Multnomah County, Bridge Section.

[76] Commissioners Journals, "Burnside and Ross Island Bridges," 31 July 1923.

[77] Commissioners Journals, "Burnside and Ross Island Bridges," 26 May 1924.

[78] Appendix 1, "Selected Time Line of Events." See dates noted.

[79] Melville E. Reed, "The New Burnside Bridge," *Western Construction News*, 23.

Architectural drawing, "Details of Main Piers," Sheet No. 59, calls for "pre-cast concrete balusters."[80] (For more about the balusters, see "Summary of Changes Post-1920s" section.)

The turret-styled octagonal-shaped operator towers are cantilevered from the south sides of the massive bascule piers: the west side tower above Pier No. 2, and the east side tower above Pier No. 3.[81] Entry to the Italianate-style operator towers is at street level. (See **Plate 3**, Engineering Drawing, "Top Main River Piers," dated 21 February 1924.)

The west tower is the only tower used for bridge lift operations, with the east tower, save for its circular stairway, an empty shell used for storage purposes. According to the drawings, the west tower opened with a "Mechanical Indicator," "Control Panel," and "Instrument Panel," located, respectively, against the tower's north, east and south walls.[82] This original equipment was replaced by a PLC (programmable logic controller) system in 1996 and 1997, but the no-longer operable Jaggar Sroufe panel showing west leaf and east leaf DC voltage and amperes is still in place. (For more about the electrical evolution of Burnside, see "Summary of Changes to Bridge Post-1920s" and "Description of Bridge" sections.) A small bathroom containing a single marine-style toilet[83] and sink with hot and cold running water is located to the left of the main entrance door. A circular steel stairway in each tower leads both to the uppermost and lower

---

[80] There are six Houghtaling and Dougan architectural drawings for the Burnside Bridge: "Miscellaneous Details," Sheet No. 57; "Details of Main River Piers," Sheet No. 59; "Top Main River Piers," Sheet No. 60; "Trolley Pole & Rail," Sheet No. 61; "East & West Abutment Top & Hand Rail," Sheet No. 62; and "Detail of Precast Panel Over Abutments." The latter are the drawings for the ornate railing panels over Pier 1 (west side) and Pier 4 (east side). Other drawings pertinent to architectural features are the shop drawings by American Bridge Co., particularly Sheet No. 69, showing the composition and dimension of the bascule span railing. Also shop drawings by Pacific Bridge for the operator's porch and "wrot" iron brackets, Sheet No. 59PB-2; "Details of Operators' Houses, Piers 2 & 3," Sheet 59PB-3; and "Spiral Stairs, Control Room to Operating Room," no sheet number, Files, Multnomah County, Bridge Section.

[81] Shop drawing, "Details of Operators Houses, Piers 2 & 3," Pacific Bridge Co., 2 January 1926, Files, Multnomah County, Bridge Section.

[82] "Details of Main River Piers," Houghtaling and Dougan Sheet No. 59, shows these details as part of the "Second Floor Plan."

[83] Design drawings do not always cover all the final construction details. It appears Burnside's final plumbing was left to the contractors, in this case, Pacific Bridge, or U.S. Steel (American Bridge). It would have been typical for Burnside's sewage to have dumped directly into the Willamette River in the 1920s. The bridge opened prior to 1929 and the opening of the Portland Harbor Wall, before which all the central city's west side sewage dumped directly into the river (and still does at times from sewer outfalls on the east bank of the Willamette). Two Multnomah County employees, both employed since the 1970s, recall that Burnside Bridge's extant 500-gallon sewage holding tank was installed on the bridge in 1985, located beneath the southwest corner of the leaf. The extant tank replaced an earlier tank, installed in the 1960s in response to efforts to clean up the Willamette River. The 1960s tank was located in the transformer room in the bridge's lower level. David Pickthorne, Multnomah County Bridge Operations Supervisor, and Tony Lester, Multnomah County Bridge Maintenance Supervisor, telephone interview with Sharon Wood Wortman, 3 May 2000. For mention of 1985 holding tank, see, "Burnside Bridge No. 0511 Seismic Evaluation Report," Sverdrup Civil, November 1995, Files, Multnomah County, Bridge Section.

levels. The operator raises and lowers the bridge from the upstairs room (west tower only). According to the drawings, the bridge was designed to be operated from either the west or east control towers. However, it is unknown whether the equipment needed to operate the bridge from the east tower was ever installed.[84] David Pickthorne, Bridge Operations Supervisor and Multnomah County employee since 1978, recalls that the east tower once contained a single lever control panel used by the gateman on duty to disconnect the trolley tracks prior to each bridge opening.[85]

Both eight-sided tower rooms are 11' across, with the entry quadrant devoted to stairwell. The focal point of the west tower's interior is the control panel, with a bright yellow-painted steel "dead man" pedal at its base. The foot control ensures that an alert operator is running the bridge. The control panel is four feet tall, by 30" across, with a slanted face 20" high. A two-page sheet giving step-by-step opening instructions, titled "Burnside Bridge," hangs on the wall to the right of the panel. The walls carry a public address system, long-neck lamp, fan, digital clock, and burglar alarm. The room also contains a wooden desk, several chairs, stationary marine radio, portable marine radio, touch-tone telephone, television and VCR, microwave oven, and window air-conditioner. The air-conditioner takes up the bottom half of one window, leaving the operator a 360-degree view. The recently installed windows are double-paned "Milgard"-brand, with sills painted the same color as the bridge's mauve-brown interior. All windows have venetian-style blinds. On the walls above five of the windows hang as many wooden-framed oil paintings, each about 18"x30" wide.[86] Multnomah County bridge operator Pam Patrie, a well-known Portland weaver and artist, describes the paintings as such: "They appear to have been painted in the 1940s or '50s. They look like hobby paintings, whimsical made-up landscapes. One of them, however, looks quite a bit like Crater Lake."[87] The tower is lighted by a rectangular fluorescent lighting fixture, set in the center of the ceiling. Floor to ceiling measures 8'-6". A standard doorway on the northeast corner of the upper level leads outside the tower to what bridge operator Pam Patrie calls "a gazing porch."[88] This outdoor walkway, present on both towers, runs parallel with the roadway, is 15' long by five feet wide, and is located 12' above the sidewalk. A folding wooden ship-type "hatch" cover closes off the upstairs control room and operations area from the circular stairway. This hatch entrance and covering is made of hardwood, part of which was replaced in 1999 with vertical grain fir

---

[84] "Details of Main River Piers," Houghtaling and Dougan Sheet No. 59.

[85] Pickthorne, telephone interview with Sharon Wood Wortman, 3 May 2000.

[86] None of the five paintings are signed, but according to David Pickthorne they were created by a former full-time bridge operator. Pickthorne, telephone interview 9 May 2000.

[87] Pam Patrie, telephone interview with Sharon Wood Wortman, 9 May 2000.

[88] Patrie, telephone interview.

finished with a dark walnut stain.[89] The entrance level floor is painted concrete. A shellacked wooden paneling several years old lines the walls of the entry way. The upper tower floor is covered with wall-to-wall carpet. The circular stairway, at the entrance, is partitioned on its outside perimeter by three-foot-high wooden slats, with the stairs continuing down to the lower levels of the bridge. The lower level contains the mechanical and electrical rooms and access to the bascule pit. Two glass peep holes in the front door, one above the other (for operators of different heights), aid security.

A solid brass name plate is located outside and to the left of the west tower entrance, in a recessed area made especially for the plate. The nameplate, 3' high by 2-1/2' wide, lists the names of the Board of Multnomah County Commissioners and the district attorney in office at the time of the opening of the bridge. The commission names are followed by all the engineers, including Gustav Lindenthal (listed as "Engineer-in-Chief"); Hedrick & Kremers, Consulting Engineers; Hans Rode, Assistant Engineer; M.E. Reed, Principal Assistant Engineer; and John Zoss, Assistant Engineer. Listed, too, are Pacific Bridge, the prime contractor; American Bridge, the steel fabricator; and the other prime contractors and sub-contractors, including Lindstrom & Feigenson. There is no brass name plate in the recession located by the front door of the east tower.

Paint color of the Burnside Bridge has been an integral part of its identifiable character. When it opened, the structural steel was painted with a shop coat of red lead and graphite, followed by a field coat of graphite and a second field coat of lead and oil of a light gray color.[90] It is unknown when the extant yellow, red, and green colors were selected for the operator towers, but in the 1990's both towers were repainted their trademark red, beige and green. Before that, the bridge superstructure was repainted yellow ochre in 1966 to harmonize with its surroundings, while still emphasizing its presence.[91] This was the objective of the color selections by architect Lewis Crutcher, hired by Multnomah County in the 1960s, in choosing colors for the Burnside Bridge and the county's other Willamette River bridges.[92] References

[89] Lester, telephone interview 9 May 2000.

[90] The paint was furnished by W. P. Fuller Co., of Portland. Reed, "The New Burnside Bridge," 23.

[91] The available records are unclear about when the Burnside Bridge was repainted, but the implication was that it was painted in 1966. "Portland's River Bridges May Wear Gay Colors," *The Oregonian*, 22 March 1962, n.p.; "Colors Set For Bridges," ibid., 6 June 1962, n.p.

[92] Lewis Crutcher, interview with Sharon Wood Wortman, 11 Sept. 1996. Lewis Crutcher's daughter, who lived in West Linn, Oregon at the time, called to inform me that her father would be visiting Portland from his home in Seattle. Crutcher still had his file and original paint chips, a help later when colors were being considered for painting the Hawthorne Bridge, an upstream repainting project that was finished in March 1999. See Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Hawthorne Bridge,", HAER No. OR-20. During the time of Portland's Fremont Bridge's initial design process during the late 1960s, Crutcher was one of the members of the Portland Art Commission board who served during the period the commission and its engineering consultant chose Fremont's tied-arch design. See Historic American Engineering Record (HAER), National

made during the 1966 color change indicate that prior to 1966, the Burnside Bridge superstructure was either painted entirely green, or was trimmed in green.[93] A black and white photograph at the Oregon Historical Society taken while the bridge was under construction indicates that the wrought iron railing on the bascule span roadway deck was initially painted a solid, dark color.[94]

A Portland Historical Landmarks Commission report on another Houghtaling and Dougan structure noted that "the firm was formed in 1914 and by 1921 had become a well patronized and respected firm as a result of their excellent work and reliable dealings."[95] Chester A. Houghtaling, the senior member of the firm, was a native of Cleveland, Ohio, born 27 October 1882. He studied construction engineering at the Lewis Institute of Chicago, after which he worked for the firm of Purdy and Henderson Engineers for two years in Chicago. He moved to Portland in 1913. In addition to the Burnside and Ross Island bridges, the firm was the architect for the Elks's Temple (Old), and the Fitzpatrick Building, all in Portland. Houghtaling died on 31 March 1940.[96]

Leigh L. Dougan, the junior partner, was born in Princeton, Indiana, on 28 July 1883. He studied architecture at the Armour Institute of Technology in Chicago, withdrawing in his junior year to gain practical experience in Tulsa, OK. He arrived in Portland in 1911. In 1925, when the partnership dissolved, Dougan went into private practice. Among some of the buildings he designed after his partnership with Houghtaling were the Medical Dental Building and the Studio Building in Portland and the First National Bank Building of Salem. "Dougan gained a reputation for his authoritative scholarship, enabling him to draw upon the classical styles for

---

Park Service, U.S. Department of the Interior, "Fremont Bridge," HAER No. OR-104. Each commission board member had a specialty, with Crutcher, A.I.A., Portland chapter, representing architecture. Crutcher worked for several years in Pietro Belluschi's Portland offices.

[93] Max Berg, "Gold Color Out; Span Goes Green," and "Gold Bridge Turns Green," *The Oregonian*, 5 March 1964, 1. This story is primarily about Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Hawthorne Bridge," HAER No. OR-20, but included is the following paragraph: "The Burnside bridge needs only to be trimmed. It has been proposed that the trim match the color of the Hawthorne bridge, now to be green instead of yellow. It remains to be seen whether this will be changed." History proved the Hawthorne Bridge to be painted yellow ochre.

[94] Oregon Historical Society, Maps and Photo Library, File, "Burnside Bridge."

[95] George A. McMath, "Elks Temple (Old)," Portland Historical Landmarks Commission Inventory Form 3-20, April 1970, Files, City of Portland.

[96] Houghtaling's obituary said he attended the first officers' training camp at the Presidio in San Francisco and served in the army as a captain in the engineers corps, and that he was also the architect for Washington High School and the Fitzpatrick Building, both in Portland, "C.A. Houghtaling Taken by Death," *The Oregon Daily Journal*, 2 April 1940, 13.

usage in large design and ornamentation."[97] Perhaps the best-known work of the firm of Houghtaling and Dougan in the Italian Renaissance idiom is the Elks Temple (1923) in Portland, "a full-blown imitation of Florentine palace architecture."[98] Dougan, who was also an artist and illustrator, died 9 October 1983 in Palos Verdes Estates, California at the age of 100.[99]

**Bridge Operation and Closed Periods**

One month after the first Burnside Bridge opened across the Willamette River, the U.S. River and Harbor Act of 18 August 1894 outlined the rules and regulations granting vessels free range on navigable waters near Portland.[100] The question of whether the drawbridges across the Willamette River were to be kept down during morning and evening commuter rush hours became an issue in the early twentieth century. As population grew and motor vehicle and electric trolley traffic on the bridges increased, the pro-navigation drawbridge policy came under fire. In 1910, the Multnomah County Commissioners ordered that the county's drawbridges remain shut during morning rush hour, despite orders of the local representative of the U.S. War Department, Major James McIndoe, Portland District Commander of the U.S. Army Corps of Engineers. After several legal battles, in June 1911, the Secretary of War formally authorized the Multnomah County clerk to close the drawbridges to river traffic during morning and evening hours, "except when raising them might prevent an accident on the river." The closed periods in 1930 were from 7:30 to 9:00 a.m. and 4:45 to 6:15 p.m. A Multnomah County employee, hired in 1978, believes that the 1930s closed times rule was in effect until World War II, when the closed periods were set earlier, from 7:00 to 8:30 a.m. and 4:00 to 5:30 p.m.

---

[97] Dougan's obituary said he also designed the Civic Building in The Dalles, Oregon, "Architect Dougan Dies," *The Oregonian*, 12 October 1983, D14. In a profile of Dougan published in 1979, at the time of the renovation of the Medical Dental Building at 833 S.W. 11th in Portland, he is quoted as saying that he had run away from home at the age of 15 because he did not want to take over the family farming and food brokerage business as his father wished. "To support his training at the Armour Institute of Chicago, Dougan worked at odd jobs, including ones as office boy in the firms of architects Frank Lloyd Wright and Louis Sullivan." He also claims Washington High School, and Oswego Grade School. "In Salem, he designed the Oregon State Office Building, the state Tuberculosis Hospital and the First National Bank Building." Fran Jones, "Renovations Please Building Architect," *The Oregonian*, 8 December 1979, D2.

[98] John Tess, "Medical Arts Building," National Registry of Historic Places Inventory Nomination Form, Portland, 1983, 5. The Burnside Bridge certainly reflects Italian architecture.

[99] "Architect Dougan Dies," *The Oregonian*. D14..

[100] "Rules and Regulations to Govern the Opening of Drawbridges Across the Willamette River at Portland, Oregon, the Columbia River at Vancouver, Washington, and North Portland Harbor (Oregon Slough)," Misc. 821/30.5, Files, Multnomah County, Yeon facilities and Bridge Section.

In 1967, the Transportation Act moved responsibility for bridge openings from the U.S. Army Corps of Engineers to the U.S. Coast Guard.[101] Effective 22 February 2000, the closed periods for the county's bridges were extended one-half hour, both morning and evening, to 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m. The latest closed period change was in response to Multnomah County's request to the U.S. Coast Guard, made as a result of a derrick barge raising havoc on a daily basis with commuters crossing the upstream Hawthorne Bridge at 8:30 a.m. during 1998.[102]

The bridge station call designation for the Burnside is KTA-520. The vessel whistle call signal is one long, followed by two short blasts. An opening takes an average of six minutes, but during the annual Rose Festival, when several U.S. Navy ships come to town, openings can take as long as 40 minutes.[103] For some time prior to installation of the programmable logic controller (PLC) system in 1997 (see "Changes to Bridge" section below), the Burnside Bridge was controlled by the operator as follows, beginning with the bascule leaves in the closed position:

1. Preparation to open:
    a. Receive vessel signal and acknowledge
    b. Note Time
    c. Turn off gate by-pass switch located on upper left side of the console.
    d. Turn on motor brakes switch located on upper left side of console.
    e. Pull pin on traffic gates "go" button.
    f. Depress traffic signals "stop" button.
    g. Clear pedestrians from draw span (use the public announcing system, if needed)
    h. Depress both lower on-bound gate buttons.
    i. When traffic has cleared the draw span, depress

[101] "Rules and Regulations to Govern the Opening of Drawbridges Across the Willamette River at Portland, Oregon, the Columbia River at Vancouver, Washington, and North Portland Harbor (Oregon Slough)," approved 18 January 1930, Patrick J. Hurley, Secretary of War, Files, Multnomah County, Yeon facilities; "Rules and Regulations for Operators and Gatemen on Willamette River Bridges," Multnomah County, dated 10 December 1942, Files, ibid.; "County Wins," *County Lines* (Multnomah County 1979), n.d.; David Pickthorne, telephone interview with Sharon Wood Wortman, ibid.; also see www.access.gpo.gov/su_docs/asces.

[102] The request coincided with the full closure of Hawthorne Bridge for 13 months for major rehabilitation between 31 March 1998 and 30 April 1999. Closed periods for the drawbridges on the Columbia River at Vancouver, Washington also changed at this time. "Department of Transportation, Coast Guard," *Federal Register, Rules and Regulations*, Vol. 65, No. 11/Tues. 18 January 2000, 2539.

[103] Bart Bonney, Multnomah County Bridge Maintenance Supervisor, telephone interview with Sharon Wood Wortman, 10 January 1988.

j. Turn centerlock lever to the left to open locks. At this time, visually check under your canopy for unauthorized pedestrians.

2. Raise Bascule Leaves:
a. Release emergency breaks. Lights on both sides of the position meters will come on.
b. Move both "raise" control levers through position #1, position #2, position # 3 (which is drift) to position #4.[104]

The bridge is operated from the west tower only. During high water, an operator is required to be on duty Monday through Friday, day shift only, or 7:30 a.m. to 3:30 p.m. (The bridge is staffed 24 hours a day only during high water.)[105] By U.S. Coast Guard regulations, the rule in Portland is that any time the Willamette River is 12' above zero datum (defined as "highwater")at the nearby Morrison Bridge, all five of the Central City movable bridges, including the Burnside Bridge, must be staffed by operators 24 hours a day.[106] This rule dates to 1975, when Multnomah County first began lobbying to eliminate operators on its movable bridges as a cost-saving measure.[107] The change was finally implemented in 1982, when

---

104 "V. Burnside Bridge," n.d., 177, Files, Multnomah County, Bridge Section.

105 Day Shift Hours of 7:30 a.m. to 3:30 p.m. hold true for the Burnside and Morrison Bridges. the county's two "on-cal" structures. Day shift on Hawthorne and Broadway, staffed full-time, is 6 a.m. until 2.00 p.m.

106 *C oast Guard Department of Transportation*, "Code of Federal Regulations," Chapter 1, 1 July 1999 ed., paragraph 117.903. It appears that the Coast Guard brought up the 12' issue because that was the water level at which many of the tugs and the fireboat would need opening. Also, the current at 12' is such that it might justify an immediate opening. Austin Pratt, Bridge Management Specialist, 13th Coast Guard District, Seattle, WA., telephone interview with Sharon Wood Wortman, 15 May 2000.

107 Ken Gervais, former Environmental Services Director, Multnomah County, "Selling Two Bridges," an essay for "BridgeStories," *Bridging the City Exhibit*, Oregon Historical Society, March 1999-2001. Also see letter dated May 20, 1981 from Tor Lyshaug, Director of Operations and Maintenance, Multnomah County, to Capt. J.H. Holmead III, Chief, Aids to Navigation Branch, 13th Coast Guard District, Seattle, WA. The county asked for an on-call protocol for the Burnside, Morrison and Broadway bridges, noting that the only two commercial docks existing within the limits of the structures were Zidell's, located upstream from the Hawthorne Bridge, and the Louis Dreyfus grain loading dock between the Steel and Broadway bridges. After hearings, the Coast Guard found that the average number of daily openings was not sufficient to require that drawtenders be kept in constant attendance. They granted permission for staffing Morrison and Burnside bridges on an on-call basis only, but not for the Hawthorne and Broadway bridges. The rule established that on weekdays, Monday through Friday, 8 a.m. to 4:30 p.m., one hour advance notice was required for bridge openings; at all other times two hours advance notice is required. "Department of Transportation, Coast Guard," *Federal Register, Rules and Regulations*, Vol. 47, No. 109/Mon. 7 June 1982, 24544.

Multnomah County was allowed to staff the Burnside Bridge 24 hours a day only during high water.[108] A call-out procedure applies for river craft openings, public bridge tours, or other special cases. Requests to open the draw during the times an operator is not on duty must be directed to the upstream Hawthorne Bridge, as the Hawthorne Bridge is staffed 24 hours a day no matter what the water level.[109]

## Political Background[110]

Before Burnside, Ross Island and Sellwood bridges were built, the extant highway bridges across the Willamette in the central city area were the Broadway (1913), Steel (1912), Burnside (1894), Morrison (1905) and Hawthorne (1910). These and the predecessor structures, the first dating to 1887, were all initially designed for horse drawn vehicles, and then for street cars. During the decade of the 1920s, government sought to respond to an increasing population and a deteriorating downtown waterfront, as well as to demands for wider streets, new bridges and wider old bridges, and other infrastructure to accommodate the proliferating motor vehicle. Portland's 1920s bridge building undertaking was more than justified by several planning studies done in conjunction with the arrival of cars, with the first big study the Bennett Plan of 1911.[111]

---

108 "Department of Transportation, Coast Guard," *Federal Register, Rules and Regulations*. Multnomah County bridge operator Bill Smith, who has more seniority in 2000 than he did in the early 1980s, remembers the event, as he was one of the bridge operators laid off on account of the reduction in forces, telephone interview with Sharon Wood Wortman, 5 April 2000.

109 "Department of Transportation," Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior "Hawthorne Bridge," HAER No. OR-20. The Hawthorne Bridge operator coordinates the activities of the 11 full-time and seven part-time ("on-call") Multnomah County bridge operators. County bridge operators belong to Local 88 of the American Federation of State and County employees. Pay ranges in 2000 from $11.57 to $13.40 an hour. In addition to opening and closing the bridge, the operator also performs routine maintenance. David Pickthorne, telephone interview with Sharon Wood Wortman, 6 April 2000.

110 The "Political Background" section of Burnside Bridge, Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior "Burnside Bridge," HAER No. 101 is based on events recorded in "Records of the Proceedings of the Board of County Commissioners." References here are specific to "Burnside and Ross Island Bridges," Vol. 1 and 2. A well-documented history about the legal problems of the ousted commission, its consultants and bridge contractors is found in several *Engineering News-Record* articles: "Collusion Suspected in Portland Bridge Awards," 24 April 1924, Vol. 92, 740; "Three Indicted in Portland Bridge Tangle," 15 May 1924, Vol. 92, 873; "Portland Bridge Scandal Causes Recall of County Commission," 22 May 1924, 912; "Portland Bridge Scandal Leads to Twelve Indictments," 12 June 1924, 1036; "Commissioners Void Portland Contracts," 19 June 1924, 1074; "Lindenthal to Examine Plans for Portland Bridges," 26 June 1926, 1115; "Lindenthal Advises Redesign of Portland Bridges," 17 July 1924, Vol. 93, 118; "New Bridge Opened at Portland," 7 January 1926, Vol. 96, 36. Also see Appendix 1, "Selected Time Line of Events."

111 See "Summary of Previous Studies, Terminal Unification, Bridge Locations," Files, City of Portland, Office of Transportation; Carl Abbott, *Portland Planning, Politics, and Growth in a Twentieth-Century City* (Omaha:

The plan considered access to the central business district Portland's single most important problem.

Portland's principal retail and business district had been receding from the riverfront for many years, leaving dilapidated docks and wharves. Getting in and out of the downtown area was hampered by narrow bridges that were slow in their openings. In addition, freight-carrying trains along the east bank and interurban tracks on both sides of the river obstructed several of the already-inadequate street approaches to the bridges. Although the City of Portland was no longer in charge of construction of bridges across the Willamette River in the 1920s, it was involved in the approaches, and in the process of what was going where and by whom. Olaf Laurgaard, Portland City Engineer from 1917 to 1933, devised an ambitious plan to simultaneously solve Portland's traffic, narrow street, bridge and waterfront problems: Replace the 1894 Burnside, build five or six other new Willamette River bridges; acquire a mile-long length of west side waterfront property between the four centrally located downtown bridges, from Glisan Street on the north to Jefferson Street on the south; construct a mile-long concrete seawall along the harbor line of the river as part of a west side intercepting sewer system; fill behind the wall to create a waterfront esplanade; widen Front Street from 50' to 100'; remove all the interurban tracks from seven downtown streets (including Front, First and Second streets); and create a large public market building and a consolidated interurban terminal.[112]

The three 1920s Willamette River bridges, Burnside, Ross Island and Sellwood, and the Lovejoy Viaduct were the first spans in "downtown" Portland built exclusively to accommodate the rapidly growing volume of motor cars and trucks.[113] The bridges provided greater or first-time access across the Willamette River between west Portland, the location of the city's Central Business District, and the city's northeast and southeast sections. There was nowhere else for easy expansion, as the west bank of the Willamette consisted of a narrow bench, less than a mile wide, constricted between the Willamette River and the 15-mile-long Tualatin Mountain range, a scarp referred to as the West Hills. While the first generation of Portland's Central City waterfront bridges, with their streetcar systems, had opened up the east side for development in about 1910, the 1920s bridges expedited a shift in residential demographics. By the time of the

University of Nebraska Press, 1983), 62.

[112] If this was not enough, Laurgaard was also responsible for renumbering all Portland street addresses at about this same time. Not a more dominating personality than Laurgaard is to be found in Portland's history. He was also Oregon's first licensed professional engineer and a staunch advocate for such licensure. Nearly all of what he proposed during his tenure was built, with all the above ideas officially outlined in "The Laurgaard Plan of 1923." Also see "O. Laurgaard," *The Blue Book of Portland and Adjacent Cities*, Joseph Boswell, 1921, 72. "The Laurgaard Plan" is well covered by E. Kimbark MacColl, *The Growth of a City, Power and Politics in Portland, Oregon 1915 to 1950* (Portland: Georgian Press, 1979), 315-320.

[113] Between 1919 and 1924, trans-Willamette bridge traffic doubled, from 45,000 to 90,000 daily crossings. In the same period of time, county automobile registrations tripled, from 25,000 to 75,000. By 1925, the daily crossings would increase to 130,000 vehicles. E. Kimbark MacColl, *Merchants, Money, & Power, The Portland Establishment 1843-1913* (Portland: Georgian Press, 1988), 260.

opening of Burnside, Ross Island and Sellwood, 75 percent of the city's population resided on the east side of the Willamette River.[114] Two of the three new Willamette River bridges, Sellwood and Ross Island, were also designed to be the first bridges to span the Willamette near the Central City Waterfront high enough to allow river traffic to clear. Until then, all the downtown bridges had been movable bridges.

Voters approved $4.6 million in bridge bonds in the general election of November 7, 1922, which funded replacement of the 1894 Burnside Bridge, and a new bridge at Ross Island. Multnomah County, serving as a form of regional government in the early twentieth century, was able to collect taxes from a broader base than just within Portland city limits for building and maintaining the bridges across the lower Willamette River. Accordingly, the Oregon State Legislature authorized the county to issue bonds for the construction or reconstruction of non-railroad bridges across the Willamette River.[115] In 1923, with funding for a new Burnside Bridge and Ross Island Bridge in hand, the Board of Multnomah County Commissioners, consisting of Dow Walker, Charles Rudeen and J.H. Rankin, hired Robert Kremers, a 43-year-old engineer who had been employed in the city's Engineering Department for eight years. Kremers resigned his position to be in charge of the county's ambitious 1920s bridge building program. Several citizens questioned Kremers' experience with long-span bridges. At this point, Ira G. Hedrick, an experienced engineer in his 50s, and a former partner of J.A.L. Waddell, formed a partnership

---

[114] Portland's Central Business District and cultural institutions were fixed on the west side of the river, beginning from the time of European settlement, in about 1842, with the city's more prosperous choosing thereafter to live as close to that center as possible. MacColl, *Merchants, Money, & Power*, 259; Martha Jane Bianco, "Private Profit Versus Public Service: Competing Demands in Urban Transportation History and Policy, Portland, Oregon 1872-1970," dissertation (Portland State University, 1994), 38; Abbott, *Portland*, 12. MacColl notes (260) that 75 percent of Portland's residents lived on the east side by 1925.

[115] ORS 382.335 and 382.340 (O.C.L.A. 100-3291) are originally enacted as 1919 Oregon Law, Chapter 338, Sec. 1, "An Act Authorizing Multnomah County, Oregon to issue bonds for the construction or reconstruction of bridges across the Willamette River, etc." The wording does not directly authorize the county to construct the bridges—the authority is only implied. The authority of Multnomah County to take over, operate and maintain the bridges across the Willamette River built and owned by the City of Portland was enacted as 1913 Oregon Law, Chapter 141, which became O.C.L.A., Secs. 100-3270 to 100-3275. Ordinance 58426, passed in 1930, established and outlined the City of Portland's and Multnomah County's jurisdiction over the approaches to the Hawthorne, Morrison, Broadway, Burnside, Ross Island, Sellwood and Interstate bridges and the Upper Albina, Lower Albina and St. Johns ferries, repealing Ordinance No. 33720 entitled "An Ordinance establishing the boundary lines for the approaches to the bridges, and for the approaches and landings of ferries operated within the City of Portland," passed by the City Council in 1918. In any event, the bridges over the Willamette in the city of Portland are defined as permanent roads, with Multnomah County responsible for the structures and the city responsible for the traffic across the bridges. The Marquam Bridge, opened in 1966, was the first non-railroad, non-county lower Willamette River bridge. It was designed and built by the Oregon State Highway Department (ODOT). Ordinance No. 54826, Files, Multnomah County, Yeon facilities; letter dated 28 March 1961, from Multnomah County District Attorney Charles E. Raymond, to Lansing Stout, Assistant to the Board of County Commissioners, ibid.

with Kremers, and moved from Kansas City to Portland.[116]

Hedrick & Kremers, Hedrick's name first, signed a contract with the commissioners on 21 March 1923 to plan and supervise construction of Burnside and Ross Island bridges for a fee of $180,000. They proposed several designs for Burnside, the first as a steel bascule span with concrete arch side spans. The county had also invited Hedrick & Kremers to study and report on the feasibility of reusing spans from the 1894 Burnside (to be removed to make room for the new Burnside Bridge) for a bridge at Sellwood that would replace the Sellwood Ferry.[117] Hedrick & Kremers finished their design work for all three bridges in June 1923. Their final design for Burnside was a steel deck truss bridge, with two truss side spans and a bascule opening span, and eventually was built as the bridge seen today. The Multnomah County Board of Commissioners looked at the patented designs of both the Chicago Bascule Co. and the Strauss Bascule Bridge Co., also of Chicago, and signed a design contract for the Burnside bascule with the Strauss Co. on 31 July 1923. Hedrick & Kremers had designed Ross Island as a six-barrel concrete arch structure, and Sellwood as a through truss bridge, using two spans from the 1894 Burnside.[118] The local architectural firm of Houghtaling and Dougan contracted with the county on 14 September 1923, to design the railings and light poles for Burnside and Ross Island bridges, and the interior of the operator towers on Burnside.[119]

Another election was held in March 1924, with voters approving bonds to create street access to the soon-to-be Burnside and Ross Island bridges, and to improve access to Steel and Broadway bridges. Bids were opened 1 April 1924, with awards made to three separate contractors: J.H. Tillman Co., who had bid $2,820,000 to construct Burnside; Parker & Banfield Co., who had bid $1,670,374 to construct Ross Island, and the Union Bridge Co., who had bid $377,500 to construct Sellwood from the recycled Burnside—all three contractors from Portland.

---

[116] Waddell was the designer, with John Lyle Harrington, of Portland's Hawthorne (1910), Steel (1912), and northbound Interstate (1917) bridges. See Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior "Hawthorne Bridge," HAER No. OR-20 and Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior "Steel Bridge," HAER No. OR-21.

[117] Funding for this cost-cutting scheme was approved in a bond election held in November 1923. For more about the recycling of the 1894 Burnside Bridge through-truss side spans, see Smith and others, *Historic Highway Bridges* (59, 60). The two are the oldest bridges on Oregon's highway system. The Sandy River (Lusted Road) Bridge, originally located to the east of the Burnside Bridge draw span when it opened in 1894, is now located in Clackamas County in Dodge Park. At 300', it is the longest of the two spans. The Sandy River Bridge was rehabilitated in 1998 by Sverdrup Civil, Inc. (now Jacobs Engineering) for Clackamas County. The Bull Run River Bridge, located on Bull Run Road east of the Sandy River Bridge, was the former Burnside's westerly truss side span. Both bridges contain nautical design elements, appropriate to their former setting. The Sandy River Bridge is interpreted by a sign at the Dodge Park (southeast) end of the bridge.

[118] Plans for the not-built Ross Island and Sellwood bridges as proposed by Hedrick & Kremers can be found in plan books 25" high by 22" long in the Multnomah County Central Library Wilson Rare Book Room, Portland.

[119] "Details of Trolley Pole & Rail," Sheet No. 61, Files, Multnomah County, Bridge Section.

An uproar followed immediately, as a lower bid from Pacific Bridge Co., also of Portland, for Burnside had been disregarded. On the 5 April, the County Commissioners rescinded the awards for all three bridges, but it was too late. Charges of collusion and bribery resulted in the indictments and arrests of all three commissioners, all three contracting firms and Robert Kremers. The Hedrick & Kremers team, who had already been paid more than $70,000 for their work on Burnside, nearly $43,000 for their work on Ross Island and almost $10,000 for their work on Sellwood, signed a "release of contract" agreement with Multnomah County on 9 July 1924. As noted in the record of proceedings dated 29 July 1924, Hedrick & Kremers were paid an additional $25,000, for "full settlement of all rights which it might have against said county arising out of contract or otherwise." While Hedrick was not arrested or charged with any crime, five days after signing the termination agreement, he did make the newspapers under the headline, "Hedrick is Called Drunkard by Wife."[120] Following the recall of all three Multnomah County Commissioners on 16 May 1924, the newly-appointed Board of Commissioner, Amedee Smith, Grant Phegley, and Erwin Taft, avoided all contracts for the Burnside Bridge, except the agreements with the architects, Houghtaling and Dougan, and with the Strauss Bascule Bridge Co.[121] The new commissioners were in a fix: thousands of dollars had been paid out for bridges yet to be built and with designs that were now being questioned.

**Hendrick and Kremers - Ira G. Hedrick**

Ira G. Hedrick, born 6 April 1868, already had 31 years experience with large bridges at the time he signed his agreement with Multnomah County in partnership with Robert Kremers.[122]

A native of West Salem, Illinois, Hedrick received a bachelor's degree in civil engineering in 1892 and a civil engineering degree in 1901 from the Arkansas Industrial University (now the University of Arkansas). He also received B.S., M.S. and D.Sc. degrees from McGill University, Montreal, Canada in 1898, 1899, and 1900, respectively.[123] Hedrick

---

[120] Hedrick's third wife, Della M., who had moved to Portland with him in 1923, filed for divorce on July 2 1924, the same date this article was published on page 1 of *The Oregon Daily Journal*—she alleging he was an alcoholic, he alleging she had thrown a catsup bottle and cut his face. The story gets worse.

[121] By then, Strauss and the architects also had been paid more than 50% of their fees. Commissioners Journals, "Burnside and Ross Island Bridges," 26 May 1926, Files (Multnomah County, Ford Building Archives); *Engineering News-Record*, 19 June 1924, Vol. 92, 1074.

[122] *Engineering News-Record;* Commissioners Journals, "Burnside and Ross Island Brides," 7 March 1923, Files, Multnomah County, Ford Building Archives. Hedrick signs first. One of the witnesses was Melville (M.E.) Reed who would transition from the Hedrick & Kremers' staff to become a key engineer on the Lindenthal team.

[123] In Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "East 27th Street Viaduct Spanning Vince Street," HAER No. MO-103, 18-22, HAER historian Cydney E. Millstein covers most aspects of Ira Hedrick's career, accomplishments, three marriages and the loss of a son who was also a

began working with J.A.L. Waddell in 1892 in Kansas City, doing bridge design and construction supervision. In 1899, he formed a partnership with Waddell, under the name of Waddell and Hedrick.[124] Among the structures attributed to Hedrick are the Northwestern Lake Street and Union Loop Viaduct in Chicago, a bridge over the Missouri River at Kansas City, the East Omaha Bridge for the Illinois Central Railroad, the intercity viaduct project at Kansas City, Mo., and the Fraser River Bridge, Westminster, B.C. He was experienced in design and construction of bridges built both of concrete and of steel. According to Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "East 27th Street Viaduct Spanning Vince Street," HAER No. MO-103, "Hedrick, at the turn-of-the-century, saw the advantages of employing riveted trusses and according to his memoir published by the ASCE, was a pioneer in their development." In 1904 Hedrick designed 300' riveted spans for the 6th Street Viaduct.

Hedrick's name shows up in Portland in at least two other places. In a 1923 report to the City Planning Commission about traffic on the Burnside Bridge, J. P. Newell, the first chairman of the Portland Planning Commission, and a consultant to the county, cites the records of Hedrick's other bridges: "Mr. Hedrick built a viaduct in 1913, in Dallas, Texas, which is over a mile long, and carries a very heavy traffic between that City and Fort Worth."[125] At the time of its construction, the Dallas-Oak Cliff Viaduct was the longest reinforced concrete highway viaduct in the world. It was designed by Hedrick when he was in business as Hedrick & Cochrane, consulting engineers, with M.R. Ash, associate Engineer.[126] Hedrick's design for Ross Island as a concrete arch, had it been built, would have been similar in appearance to Hedrick's Dallas-Oak Cliff Viaduct.

Also in 1913, Hedrick & Cochrane, Kansas City, Missouri, was one of eight bidders for design of the Interstate Bridge across the Columbia River, between Portland and Vancouver, with engineers Waddell & Harrington winning the contract.[127]

---

business partner. Justin Spivey, one of the members of a HAER recording project in Chicago during 1999, was very helpful, both with directing me to Millstein's work, and providing information about Joseph Strauss's patents.

[124] Hedrick was acknowledged by J.A.L. Waddell for his assistance helping Waddell write *De Pontibus*, the latter's pioneering book on bridge engineering published in 1898 by John Wiley and Sons, New York.

[125] J.P. Newell, "Traffic on the Proposed Burnside Bridge Over Willamette River," 6 June 1923, 20, Files, City of Portland, Office of Transportation, Portland Building.

[126] The Dallas-Oak Cliff Viaduct, also known as the Houston Street Viaduct, was also the first high-level crossing of the Trinity River at Dallas. It was nominated to the National Register of Historic Places in 1984. See Robert W. Jackson in Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Dallas-Oak Cliff Viaduct," HAER No. TX-33, 1996, 1.

[127] Commissioners Journals, "Columbia River Interstate Bridge Commission," Vol. 1, 29 November 1913-10 February 1920, 1, Files, Multnomah County, Ford Building Archives. The Interstate Bridge opened in 1917.

After the problems in Portland, Hedrick left the city and started an engineering practice in New Orleans and Shreveport, LA., with Lloyd Garner Frost, whose names appearing on the engineering drawings for the Burnside Bridge.[128] Hedrick moved to Arkansas in 1928,[129] and died in 1937 at his home in Hot Springs, Arkansas at the age of 69. His Portland obituary said he also designed Chicago's first elevated railway.[130]

**Robert C. Kremers**

A newspaper article states that Kremers was born in Ottawa County, Missouri and received a bachelor of science degree in civil engineering from the University of Michigan in 1900. He worked in the City Engineer's office at Salt Lake City, and between 1905 and 1910, was employed in the bridge construction department of the Oregon Short Line Railroad. After the railroad, he helped design the Nisqually power plant in Washington state, arriving in Portland in the fall of 1910. In 1911, he was hired by the city of Portland Building Department and worked as an inspector for two years. He then moved to the city's Engineer's office.[131] During his tenure with the City of Portland, he was chief of the highway and bridges department for three years. When that department was abolished and the Bureau of Construction was formed, Kremers then worked as the head of construction for five years. He resigned from the city effective 1 April 1923, to work on the Multnomah County bridges.[132] Only two of the three county commissioners, Dow V. Walker and Charles Rudeen, had voted for Kremers's appointment, with the third, J.H. Rankin, casting a dissenting vote. Rankin and others wanted to know why the board appointed Kremers unconditionally, before considering the terms of a contract, or the relationship between Kremers and the consultant yet to be hired who would be designing the bridges.[133]

---

[128] Frost's signature and initials appear in the title block of drawings for the three Portland bridges before and after Lindenthal took over the Hedrick & Kremers offices, Files, Multnomah County, Bridge Section.

[129] Historic American Engineering Record (HAER), National Park Service, U. S. Department of the Interior, "East 27th Street Viaduct," HAER No. MO-103, 18-22. While in Arkansas, Hedrick's office was located in Hot Springs National Park. During these last years of his prolific but unsettled career, Hedrick continued to design significant bridges, including two Arkansas River spans; a bridge over the Atchafalaya River, Simmesport, Louisiana; the Lake Worth and Royal Street Bridges, Fort Worth, Texas; the Back Bay Bridge, Biloxi, Mississippi; and the Main Street Viaduct, North Little Rock, Arkansas."

[130] "Initial Engineer on City Span Job Dead in Arkansas," *The Oregon Journal*, 29 December 1937, 25.

[131] "Citizens are Reticent on Bridge Plans," *The Oregon Daily Journal*, 27 January 1923, 1, 7.

[132] "Robert C. Kremers to Resign City Job for Bridge Work," *The Oregon Daily Journal*, 10 March 1923, 3; "Engineer Resigns as Bureau Chief to Take up Bridge work with County," *The Portland Telegram*, 10 March 1923, 5.

[133] "Transcript from Journal of County Commissioners of Multnomah County, Pertaining to Construction of Ross Island and Burnside Bridge," 13 September 1924 to 23 January 1924, Files, Multnomah County, Ford Building

Not much is heard about Kremers after his arrest, but when Hawthorne Bridge's wooden deck was replaced with Irving Subway steel grating in 1945 at a cost of $305,000, Kremers is reported as the project engineer for L.H. Hoffman Co., the latter then and now one of Portland's largest construction firms. Kremers would have been about 60 years old at the time.[134]

**Gustav Lindenthal In Portland**

If J.A.L. Waddell was involved with designing Portland bridges because of his vertical lift technology and Ralph Modjeski because of his railroad connections, then Gustav Lindenthal was in Portland because Multnomah County needed a "big gun" of impeccable reputation, who also was both capable of and willing to 1) produce three long-span bridges simultaneously in a short amount of time and, given the financial disorder that had preceded the project, 2) do all the foregoing within a reduced budget. They could not have done better than Lindenthal, called from his offices at Pennsylvania Station in New York City to Portland where he would design the last bridges of his long career when it was really designing a bridge across the Hudson River that interested him most.[135] It does appear Lindenthal was called to Portland rather than calling Portland, according to an entry in the Commissioners Journals, "Burnside and Ross Island Bridges," dated 16 June 1924:

> The following communication was received from Gustav Lindenthal, Pennsylvania Station, New York City, N.Y.: 'Just for record, I beg to enclose copies of telegrams received and sent in the matter of the proposed examination of plans for the three bridges named therein. I confess that I at first felt disinclined to undertake this long trip in the midst of pressing engagements, but after reading the account of your bridge situation in the *Engineering News-Record,* to which the Strong & McNaughton [sic] Trust Co. had called my attention in their telegram, I thought the matter important enough to assist you with any professional advice I could give. The telegrams cover all that needs to be said

Archives.[134] "3 Companies Lay Grating Bridge Deck," *The Daily Journal,* June 14 1945, n.p. There is no local obituary for Kremers, but other newspaper articles that deal with his activities with Burnside Bridge, Ross Island and Sellwood bridges include: *The Journal,* 27 January 1923, 1; *The Portland Telegram,* 27 January 1923, 1; *The Oregonian,* 27 January 1923, 1 and 18 February 1923, 4.

[135] Lindenthal's preoccupation with a bridge across the Hudson is well documented. When I spoke with Lindenthal's daughter, Franziska Gebhardt, at her home in Germany by telephone on 15 November 1992, Gebhardt said, "My father thought about that bridge as long as I could remember." Born around 1915, she also remembers being in Portland during the mid-1920s when she was a child while her father worked on the Willamette River bridges. In *Engineers of Dreams* (New York: Knopf, 1995), 122-216, Henry Petroski, with the perception of a teaching engineer expert on structural disaster, devotes a chapter to the life and work of Lindenthal. For more on Lindenthal, see a paper recommended to me by Professor David B. Billington, "Gustav Lindenthal, Premier Bridge Designer of the Age of Iron," 16 April 1990, submitted by Kenneth G. Patrick as a requirement for the Degree of Bachelor of Science in Engineering, Princeton University. For Lindenthal's brief but factual biography, see Eric DeLony, "Gustav Lindenthal," *American National Biography,* eds. John A. Garraty and Mark C. Carnes, Vol. 13 (New York: Oxford University Press, 1999).

at present in a business way.[136]

Gustav Lindenthal (1850-1935) and Ralph Modjeski (1861-1940), more than any other American bridge engineers, set precedent in designing early Industrial-era long-span steel bridges. As noted in *Landmark American Bridges*, by Eric DeLony, chief of the Historic American Engineering Record, Lindenthal was a German engineer who emigrated to the U.S., "bringing his talent and technology." In *Bridges: Spans of North America*, David Plowden writes, "No other man ever designed bridges of such titanic proportions as Lindenthal."[137] Plowden is referring to the Hell Gate Arch across the East River in New York City, and the Sciotoville Bridge across the Ohio River near Portsmouth, Ohio, both railroad bridges opened in 1917 and designed by Lindenthal. Lindenthal also served as a mentor to two other titans of the twentieth century, bridge engineers David Steinman, and Othmar Ammann[138].

On 9 June 1924, the Multnomah County Board went on record with a list of the New York engineer's qualifications:

> There is attached hereto a statement of some of the work which has been designed and directed by Mr. Lindenthal. Commr. of Bridges for New York under Seth Low, 1902-3, established practice of architectural designing of city's bridge structures; made plans for Queensborough (sic) and Manhattan Bridges over East River and for reconstruction of old Brooklyn suspension bridge, Mrm. Bd. of Consulting engrs. Penna R.R. tunnels under North and East Rivers; also cons. engr., South Ferry rapid transit tunnels. Designed large wharf and steamship piers at Baltimore and Havana, Cuba. Rebuilt Kentucky river high-bridge, 315 ft. high, replacing first cantilever bridge in U.S. (Built by Shaler Smith in 1874). Since 1904 cons. engr. and architect, N.Y. Connecting R.R., designed to connect N.Y., N.H., & H. R.R. with Penna system (most expensive road in world to build per mile of line); especially notable part of this work was bridging of L.I. Sound and Hell Gate, involving deep and difficult foundations and expensive work of const., and several unprecedented eng. problems, the curved approach to Hell Gate making impossible the use of either a suspension or cantilever type of bridge. As completed in 1917, it is a broad steel arch, with span between towers

---

[136] E.B. MacNaughton (1880-1960), a partner in the Strong & MacNaughton Trust Co., was one of Portland's most influential civic leaders, before, during and after the 1920s. As a graduate of M.I.T. and former Bostonian, he was certain to know of Lindenthal's reputation and capabilities. For more about MacNaughton, see MacColl, 187.

[137] DeLony, Eric, *Landmark American Bridges*, (New York: American Society of Civil Engineers, 1992), 82-83; Plowden, *Bridges, Long Spans of North America*, (Norton, N.Y., 1974), 171.

[138] For more about Steinman in Portland, see Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "St. John's Bridge," HAER No. OR-40. Ammann's newest biography, with information about Lindenthal, is *Six Bridges*, by Darl Rastorfder (New Haven: Yale University Press, 2000).

of 1017 ft. long, whose top from mean low water is 305 ft. with clear space below the arch to mean low water of 140 ft., designed for four ry tracks; required three miles of viaducts and a lift bridge over Bronx Kill containing altogether 90,000 tons of steel and costing $25,000,000. Also designing and cons. engr. for double-track bridge of Chesapeake & Ohio Northern R.R. over Ohio River at Sciotoville, Ohio (two spans each 775 ft. long of continuous riveted trusses). Author of many articles on bridges and other eng. subjects in tech journals. Fellow A.A. A.S.; mem. Am. Soc. C.E., Instu. Civil Engrs (London), Can. Soc. Civil Engrs., Am. Inst. Cons. Engrs., Cleveland Eng. Soc., Ingenieur and Architeckten Verein (Vienna).[139]

On 4 June 1924, Lindenthal signed a contract with the newly appointed Board of County Commissioners. He agreed to examine the Hedrick & Kremers engineering plans for Burnside, Ross Island and Sellwood for soundness of design. He was paid $5,000, plus travel expenses for himself and one assistant.[140] Lindenthal's qualifications were entered in the record by the Board on 9 June, as noted above, with Lindenthal arriving in Portland on 20 June, staying at the Benson Hotel on S.W. Broadway Street. On 9 July, Hedrick & Kremers, in exchange for $25,000, signed a release of contract with Multnomah County. Two days later, Lindenthal contracted with the county, for $119,000, to complete Burnside's design, to redesign Ross Island and Sellwood, and to supervise construction of all three bridges. On 21 July 1924, upon Lindenthal's recommendation, Multnomah County contracted with Pacific Bridge, the low bidder in the April 1924 bid opening, to take down the draw of the 1894 Burnside and to begin construction of the new bridge. From the Palace Hotel in San Francisco, Lindenthal wrote the following letter to the County Board of Commissioners, entered in the Commissioners Journals, "Burnside and Ross Island Bridges," on 21 July 1924:

> I have just put M.E. Reed, Assistant Engineer, in temporary charge of the engineer's office taken over from Hedrick & Kremers, until Mr. H. Rode, my representative, shall arrive first week in August. In the meantime I have sent Mr. Cuneot back to N.Y. with all the necessary data to prepare the redesigning of the two bridges. Before leaving Portland I asked Mr. Reed to see you and present to the Commission the advisability and reasons for letting the contract for the

[139] Commissioners Journals, "Burnside and Ross Island Bridges," 9 June 1924, Files, Multnomah County, Ford Building Archives.

[140] One other mention of an assistant comes from the Commissioners Journals, "Burnside and Ross Island Bridges." Under date of 21 July 1924, as part of his preliminary activities, Lindenthal reported (see full text below): "In the meantime I have sent Mr. Cuneot back to N.Y. with all the necessary data to prepare the redesigning of the two bridges . . . ." An "H.C." is shown on the post-Lindenthal drawings for Burnside in one place, and not at all on Ross Island and Sellwood bridges. How much designing was done in New York and how much in Portland is unknown.

> Burnside bridge without much delay. I will stay here only a few days (as you may see from enclosed clipping). I have also to meet engagements in Chicago and Pittsburgh and expect to reach N.H. about 1st August; but it will cause no delay in the Portland work.[141]

On 18 August 1924, the first Lindenthal drawing is dated for Burnside. As part of Hedrick & Kremers' termination agreement with the county, Hedrick and Kremers agreed to turn all drawings over to the county. As it turned out, they also turned over their engineering design team as well as their offices, located at what is now the block occupied by the Multnomah County Detention Center, or the Portland Justice Center, at 1130 S.W. Third (formerly 250-1/2 Third Street).[142] Lindenthal took over both team and office the same date he signed his contract with the county, 11 July 1924.[143]

In his 7 July 1924 preliminary report about the three bridges, Lindenthal noted the four conditions he felt must be considered in order to ensure that a bridge is both "appropriate and adequate": "Location, Traffic Capacity, Structural Character, and for a City Bridge the Architectural Features, in the order named." Lindenthal recommended completion of the Burnside Bridge as designed by Hedrick & Kremers, with some modifications, and the immediate letting of the contract for its construction to the Pacific Bridge Co., the low bidder at the opening 1 April. He noted that the roadway on the new bridge would be about 40' higher than the old bridge at the middle of the river, and 77.85' above city datum and with longer approaches on ascending grades. He also recommended complete redesign of the Ross Island as a steel span instead of a concrete arch structure, with the redesign to lower the bridge from a proposed 135' overhead channel clearance to 80', and the elimination of street car tracks. He advised using new steel for the Sellwood Bridge, instead of the steel from the 1894 Burnside structure, and a new design of Sellwood to secure better architectural effects.[144] He critiqued Hedrick & Kremers' bridge design choices at the Burnside location, and, engages in an early argument about the merit of steel versus concrete bridges:

> The choice of the two-leaf bascule type for this bridge requiring heavy piers in deep water on pile foundations was not good economy and led to an incongruous design. It

---

[141] Commissioners Journals, "Burnside and Ross Island Bridges," 21 July 1924, Files, Multnomah County, Ford Building Archives. The clipping Lindenthal refers to is missing.

[142] It also appears that Lindenthal used some of the former firm's linen paper for his own drawings, possibly as a convenience as well as a cost saving measure. Noticeable erasures are easily apparent on some of the title blocks for Sellwood and Burnside tracings, a professional no-no. Ed Wortman theorizes that Lindenthal's staff, rushed to get moving on design, used Hedrick & Kremers linen until the linen imprinted with the Lindenthal title block arrived.

[143] See Commissioners Journals, "Burnside and Ross Island Bridges," same date.

[144] Commissioners Journals, "Burnside and Ross Island Bridges," 11 July 1924.

would not be admissible for a railroad bridge which must support concentrated moving loads, but it will do for a street bridge. It is only fair to state that in order to obtain the convenience of an unobstructed Deck Bridge, the Engineers, after setting for themselves that problem, would choose nothing else on this location. It is in a way a luxury under the given adverse conditions. The thick and expensive piers are needed to hide in their hollow interior the counterweights and moving mechanism and, with their great mass, to better resist the jerky vibrations during the operation of the bascules, which, for instance, are so noticeable in the Broadway bascule bridge. The costliness of the bascule type, in this instance, is also illustrated by the fact that the weight of steel, about 1800 tons (without machinery) for the bascule of 213 foot span is nearly equal to the combined weight of steel in the two flanking spans of 266'5-1/4" each. If the flanking spans had been concrete arches as proposed in design #1, it would have resulted in a still more irrational arrangement, requiring still heavier and more expensive piers and foundations which would have had to resist the thrust from the arches combined with the excentric (sic) pressure from the bascules. The additional cost would have been $104,000 and would not have been compensated by greater durability of the concrete arches, as believed by the Engineers. Strong and well built steel bridges have a longer life than the fifty to seventy-five years assigned to them by the Engineers in their report (p. 14) on Burnside Bridge. In fact, they should last as long as concrete bridges. It is not the wear of the steel but the neglect of frequent painting which causes their gradual deterioration by corrosion. On the other hand we do not know enough yet about the durability of modern reinforced and attenuated concrete structures, to be sure that they will last longer than steel structures.

Lindenthal said that he thought another design for this location might have produced a bridge with "more pleasing architectural appearance," but he did not recommend a change of plans. He expressed concern about Burnside's foundations: "Actual bearing capacity is always a matter for judgment and scrutiny during the execution of the work and requires close watchfulness of the Engineers and their inspectors." He also approved employing an architect for the Burnside's artistic features, regardless that "the squatty massiveness of the piers in the middle of the river will appear in silhouette strangely out of proportion to the framed steel trusses resting on them."[145]

Later, in 1926, after construction was well under way on Burnside and Sellwood, Lindenthal was also asked by Multnomah County to submit a study for the erection of new bridges at St. Johns and at Interstate Avenue.[146] In addition, Lindenthal signed another contract

---

145 Commissioners Journals, "Burnside and Ross Island Bridges," 11 July 1924.

146 During the same bond election held November 2, 1926 that approved the partial reconstruction of Broadway Bridge and the 2,000'-long Lovejoy Viaduct addition to the west end of the Broadway Bridge, the $4 million bond issue for St. Johns Bridge was defeated (37,222 votes against, 34,387 votes for), as was the $6.5 million bond for a bridge at Interstate Avenue (40,331 votes against, 30,570 for). The Interstate Avenue Bridge would have been about the location

with the county in 1926, for $42,000, to design a new viaduct from Broadway Bridge to the intersection of N.W. Ninth and Lovejoy Streets, and partial reconstruction of Broadway Bridge to improve the roadway.[147] Broadway, designed by Ralph Modjeski of Chicago that carried a Rall bascule span, had opened in 1913 just north of downtown. By the 1920s, it, too, was inadequate to deal with the growing number of motor vehicles.[148]

## Burnside Bridge - Lindenthal Design Team

From the signatures found on the design drawings, before and after Lindenthal's involvement, it seems that a small group of engineers and drafters comprised the team designing Burnside, Ross Island and Sellwood bridges, and later, the partial reconstruction of Broadway Bridge, and the Lovejoy Viaduct to Broadway Bridge, as well as the proposed bridges in North

---

of Fremont Bridge, opened in 1973 at about river mile 11.7. See Historic American Engineering Record (HAER), National Park Service, U. S. Department of the Interior, "Fremont Bridge," HAER No. OR-104. "Broadway Bridge Reconstruction and Lovejoy Ramp: In the Matter of Report on Canvass of Votes Cast at General Election on Bridge Bond Measures, Submitted to the Board by the County Clerk," Commissioners Journals, 19 April 1926-12 December 1927, Files, Multnomah County, Ford Building Archives. Other prominent American civil engineers designed bridges or their opening mechanisms in metropolitan Portland preceding Lindenthal, among them J.A.L. Waddell, John Lyle Harrington, Ralph Modjeski, Conde B. McCullough and, at Burnside, Hedrick and Strauss. Later in the 1920s, David Steinman, Lindenthal's former assistant for Hell Gate Arch and Sciotoville bridges, would beat out Lindenthal's designs to win the contract for the only major highway suspension bridge built in the Willamette Valley in the twentieth century, the St. Johns Bridge. The latter opened across the Willamette River in North Portland in 1931. See "Proposed New Bridges Over the Willamette River, Gustav Lindenthal 1926," Multnomah County Central Library. These well-preserved Lindenthal drawings, paper backed on linen, show a cantilever bridge and a suspension bridge, both with mains spans of 1,120', proposed between North Tyler Street and St. Helens Road, and a 1,120' continuous truss, a suspension bridge (with two spans, 960' each), and an arch (similar to Hell Gate), to be located between North Portsmouth Street and St. Helens Road. All the suspension bridges are drawn with eyebar chains, a favored Lindenthal form. Most interesting is that the continuous truss proposed at North Portsmouth was a near-duplicate of Lindenthal's giant Sciotoville Bridge.

[147] Lindenthal's design replaced the existing wooden deck on the Broadway fixed truss spans with concrete. The Lindenthal team rejected proposals to add traffic lanes outside the trusses due to additional weight. Copy of three-page letter dated 7 April 1926, from Lindenthal to the Board of County Commissioners, Files, Multnomah County Bridge Section. Also see drawings: "Broadway Bridge Truss Span Deck," Sheet 6-A, rev. 27 November 1927; "Details of Floor and Sidewalk, Broadway Bridge," C4161/2A, rev. 21 May 1912; "Details of Floor and Sidewalk Rall Bascule Span Broadway Bridge," C4161/2B.

[148] Appendix 1, "Selected Time Line of Events." For more about Broadway, see Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Broadway Bridge," HAER No. OR-22. Lindenthal's Lovejoy Viaduct opened in 1927 and remained in service until it was closed July 30, 1999 and razed soon thereafter to make room for housing in the urban renewal project called River District. The first River District condominium building broke ground at 1420 N.W. Hoyt Street in 1998, and burned to the ground shortly before its completion. "Briefly," *The Oregonian*, 29 July 1999, C2. Also, Commissioners Journals, "Broadway Bridge Reconstruction and Lovejoy Ramp," Nov. 15 1926, Files, Multnomah County, Ford Building Archives. Lindenthal's estimate for construction of the Lovejoy Viaduct and reconstruction of Broadway was $920,000, more than twice as much as the budget he had to work with for a new bridge at Sellwood.

Portland. Other names in addition to Reed's and Rode's that appear on the original Hedrick & Kremers drawings are the same names that appear on the final drawings for Burnside, Ross Island and Sellwood and other drawings, after Hedrick & Kremers are out and Lindenthal has taken over. Those names that appear on the Burnside Bridge drawings, before and after Lindenthal's involvement, include: Lloyd Frost, who would become a partner of Hedrick after leaving Portland; John Zoss and N.W. Reese, who would become assistant engineers for Burnside, Ross Island and Sellwood bridges; R. Coventry, W.D. Smith, and a few others. These are the drafters, tracers and checkers during the life of Lindenthal's work in Portland, from June 1924 until January 1928.

Between August 1924, when the first Lindenthal drawings calling for changes to Burnside are finished and dated, and January 1927, when the final detail drawing is finished and dated for Ross Island, this team produced 90 tracings, with 18 for Burnside, 34 for Sellwood, and 40 for Ross Island, with some additional sketches, an extraordinary amount of complicated structural design, drafting and checking. Sellwood's design and drawings were done during the August through October period in 1924, about the same time the Burnside Bridge changes and additions were being made. The bulk of Ross Island's drawings were completed in March and April of 1925.[149]

In a letter dated 28 November1931, to the Board of Multnomah County Commissioners, K.H. Siecke, consulting engineer, describes the roles of Lindenthal's Portland engineering staff:

> The Lindenthal organization in Portland consisted of Mr. Hans Rode, resident engineer, Mr. M.E. Reed, principal assistant engineer in charge of the Sellwood and Burnside bridges, myself as chief draftsman and principal assistant engineer in charge of the Ross Island bridge, assistant engineers N.W. Reese and John Zoss, and quite a number of draftsmen and field assistants, including L.R. Stiger.

---

[149] Multnomah County owns a collection of 133 design drawings and sketches for Burnside Bridge. Of these, 62 are drawings by Hedrick & Kremers, 36 are drawings by the Strauss Bascule Bridge Co., 19 are Lindenthal drawings, and nine are design drawings by the contractor, Pacific Bridge Co. There are also seven half-size design sketches made by the Lindenthal team showing Burnside's lighting system, ladders and details of the retaining walls. None of Burnside's design drawings bear Lindenthal's signature or initials, and none of the design sketches are initialed or signed by anyone. When reference is made to Lindenthal's design of Portland's bridges, it would be more accurate to say the "Lindenthal team's" design of Portland's bridges. "Burnside Bridge, 1924, Hedrick & Kremers, Consulting Engineers, Design No. 2" (Multnomah County drawing number AB1-2) is an ink-on-linen drawing that shows a Burnside engineering drawing index with the Hedrick & Kremers' drawings marked either "T" or "S", with 61 "T" drawings and 36 "S" drawings ("T" referring to truss spans and "S" referring to Strauss components.) In the upper right hand corner, written in red ink, are listed the 19 Burnside drawings by Lindenthal. These are preceded by an "L," and designated L-12 through L-77. Some bridge upgrades done in recent years resulted in ink-on-mylar drawings, made by CAD (computer-aided drafting). Multnomah County owned a total of 936 contract and shop drawings for Burnside in 2000. Cheryl Strubb, a structural drafter employed at the Multnomah County Bridge Section, is to be commended for her efforts, diligence and perseverance in gathering together all the county's bridge engineering drawings, and creating and implementing the county's comprehensive indexing and filing system for them.

> John Zoss was originally employed as draftsman until construction commenced on the Burnside bridge, when he went into the field as assistant engineer under the supervision of Mr. Reed. N.W. Reese was assistant engineer in similar capacity in charge of work on the Sellwood bridge from start to finish. Mr. Zoss took over the field work on the Ross Island bridge under Mr. Reed in July 1926, after all foundations had been constructed and the first three steel spans erected. I had until that time been in entire charge of this work, generally under the instructions of Mr. Rode, but during his absence I was in independent charge. My resignation was responsible for this change in supervision.[150]

Some of the key engineers involved with the Burnside Bridge included:

**Hans Henrik Rode:**

Hans Rode, born in Norway in 1885, graduated in 1908 as a civil engineer from the Polytechnical College of Hannover, in Germany.[151] His first position was as a designer in the bridge department of the firm Louis Eilers, in Hannover, and, at the same time, he was also Assistant in Statics and Steel Structures at the Polytechnical College. Rode was granted membership in the American Society of Civil Engineers in August 1925, during the time the Burnside and Sellwood bridges were under construction, and the same month he was in Portland supervising Lindstrom & Feigenson's construction of Ross Island Bridge's approaches. He was in every way Lindenthal's lieutenant during all but the last five months of Lindenthal's bridge dealings in Portland: Except for summer vacations, Rode was in Portland from August 1924 until 30 July 1927. (Lindenthal's work was finished with the Broadway Bridge on January 31 1928.) For the most part, it is Rode who corresponds and communicates with the Multnomah County Board of Commissioners, keeping the exchange open between the commissioners, contractors, the other engineering staff, and Lindenthal, whose office was located in New York

---

150 Siecke was competing in 1931 with Messrs. Zoss and Stiger for a contract with Multnomah County for consulting work as inspector for Burnside, Ross Island and Sellwood bridges, then six and five years old. Siecke lost out, and he sets the board straight about Zoss's and Stiger's padded contention that they were '"in direct charge of construction and all inspection of these bridges under Gustav Lindenthal,'" Files, Multnomah County, Yeon facilities. It is an interesting phenomenon among those involved with erecting bridges, that no matter what their job, they will later say, "I built that bridge." This claim holds true whether ironworker, contractor, or design engineer. Those associated with the Burnside Bridge are no exception. In an *Oregonian* story dated 31 October 1926, about the pros and cons of bridges at St. Johns and Interstate Avenue bridges ("Bridge Opposition Called Inaccurate," 3), W.D. Smith, listed on the Hedrick and Kremers drawings for Burnside under the notation "checked by," is reported as being, among other things, "designer of the Burnside Bridge." Prior to 1919, before engineers were required, by law, to be licensed in Oregon, such statements were even more questionable as anyone who got near a bridge could and did call themselves an engineer. This clipping was provided by Dr. Judith McGaw; she and Linda Dodds, the other HAER historians involved in the 1999-2000 Portland bridges recordation, provided many such insightful references.

151 Gustav Lindenthal, "Hans Henrik Rode, M. Am. Soc. C.E., Died 18 July 1930," *Transactions of the American Society of Civil Engineers* (New York: 1931), Vol. 95, 1594.

City during this time. It is also Rode that writes the final report for Burnside Bridge, dated 21 May 1926, a week before Burnside opens. We do not know how much of the bridge design work in Portland was Rode's, but he was certainly capable. In a letter to Lindenthal dated 22 September 1926, addressing Lindenthal at Pennsylvania Station in New York City, Rode reports about the upcoming bond election for funding bridges at Interstate Avenue and at St. Johns. He adds a "P.S." about what was the mighty accomplishment of joining Ross Island Bridge's cantilevered center span: "The Ross Island arch was closed successfully about a week ago [13 September 1926]. The cantilever ends came together within about a quarter of an inch. I shall soon write you a report on the progress of the work."[152] For two months each summer during 1925 and 1926, Rode left Portland to spend time in Norway, with the Portland office staffed by Reed and Siecke as noted in Siecke's letter above.

Two years after leaving Portland for the last time, Rode, age 45 at the time, and his wife died in an automobile accident in 1929. Their car went out of control, and into a river in northern Italy's mountainous Tyrol. Rode's memoir, written by Lindenthal for the American Society of Civil Engineers *Transactions*, said, in part, that Professor Rode, who taught up until the time of his death at Polytechnical College of Technical Mechanics in Hannover, "appealed greatly to his students because of his happy blending of a keen theoretical insight and practical executive ability." Lindenthal added that he highly regarded Rode for the same reasons. In addition to the thesis for his doctorate, granted in 1916, Rode had written a textbook on mechanics and articles for Norwegian technical magazines. His association with Lindenthal dated to 1909. Shortly after emigrating to the U.S. that year, Rode worked for three years as "Assistant to Gustav Lindenthal." The memoir goes on:

> He was engaged as a Supervisor of Design with the McClintic-Marshall Company, Pittsburgh, Pa., on the design of the New York Connecting Railroad, including the Hell Gate Bridge, and on the design and field inspection of the Kentucky River High Bridge. He also took active part in developing the plans of Mr. Lindenthal's unique, competitive design for the Quebec Bridge, a braced three-hinged suspension bridge with a center span of 1758 ft.

In 1913, Rode returned to Germany, as Chief Engineer for the Steel Bridge Department of Steffens and Oelle, Berlin-Tempelhof. In 1914, the Norwegian government appointed him Professor of Technical Mechanics at the Polytechnical College in Tronkhem (Nidaros). He also spent two years in Germany on a government scholarship, and earned his doctorate. Lindenthal further notes:

> From 1924 to 1926, Professor Rode was in the United States, this time as Resident Engineer in charge of the Burnside, Ross Island, and Sellwood bridges, which were built

[152] Files, Multnomah County, Yeon facilities.

for Multnomah County, in Portland, Ore. Of these the Burnside Bridge has a large bascule span; the Ross Island Bridge is characterized by its graceful appearance and its ingenious cantilever scheme; and the Sellwood Bridge has the distinction of having continuous girders over four openings.[153]

**Meville E. Reed**

M.E. Reed was a witness to Hedrick & Kremers partnership agreement in March 1923, and his initials appear on key drawings for Burnside Bridge prior to Lindenthal's participation.[154] Reed proved to be one of the top three engineers for Lindenthal's team, serving as assistant engineer on Burnside, and as principal assistant engineer on both Burnside and Sellwood when Lindenthal's resident engineer Rode was in Europe during the summer months.[155] Reed was also author of one of the more comprehensive articles about Burnside's construction, "The New Burnside Bridge, Portland, Oregon," published by *Western Construction News*, in July 1926.[156] Some time after the Broadway work and the Lovejoy projects were completed, Reed worked as a Multnomah County bridge engineer for some unknown length of time.[157] Reed wrote an article, also for *Western Construction News*, published in 1936, about the Yaquina Bay Bridge on the Oregon Coast wherein he is identified as "Resident Engineer Inspector Public Works Administration, Newport, Ore."[158] He was born in 1865, graduated from the University of Minnesota in 1888, and obtained his engineering training on the job. Reed worked on the Pacific extension for the Great Northern Railroad, built between 1890 and 1893,[159] and for the

---

[153] Rode actually left Portland on 30 July 1927, according to the Commissioners Journals, "Burnside and Ross Island Bridges," 30 July 1927, Files, Multnomah County, Yeon facilities.

[154] See, for example, "Main Web Members," Hedrick & Kremers drawing T37, 28 January 1924, with Reed initials under "Made By."

[155] Wood Wortman, "Engineering staff and Contractors for the 1920s Willamette River Bridges."

[156] Melville E. Reed, "The New Burnside Bridge at Portland, Oregon," *Western Construction News*,10 July 1926, 20-24.

[157] Reed does not show up in Multnomah County file records in the Yeon facilities as being either "the" or "a" Multnomah County engineer. However, at Multnomah County Bridge Section offices, a design drawing for revisions to the approaches to Hawthorne Bridge, dated 1930, shows "M.E. Reed Bridge Engineer." Reed's obituary, published in 1946, identifies him as having, among other things, "served as county bridge engineer." *The Oregon Journal*, 13 October 1946, 12A.

[158] "Building the Yaquina Bay Bridge on the Oregon Coast Highway," *Western Construction News*, May 1936, 133-136. In another article, published the same year and month, "Yaquina Bay Bridge," by C.B. McCullough (publication title unknown), Reed is identified as "Resident Engineer Inspector."

[159] Ralph W. Hidy and others, *The Great Northern Railway* (Boston: Harvard Business School Press, 1988),

reclamation service in Montana. He lived for 36 years in Portland, at the end of his life employed by the Kaiser Company. Reed died at the age of 81 on 12 October 1946.[160]

**Kurt Siecke**

Kurt Siecke was another carry-over from the Hedrick & Kremers team. His name appears under both "made by" and "checked by" during design and construction of Burnside Bridge for both Hedrick & Kremers and Lindenthal, and, for Lindenthal, under "made by" and "checked by" for Ross Island Bridge, and under "made by" for Sellwood Bridge.[161] According to letters written by Siecke in 1931 to the Board of County Commissioners, he served as the principal assistant engineer and chief draftsman on Ross Island Bridge, except during Rode's summer absences. During July and August 1925, when Reed took over for Rode as general supervisor of the construction for Burnside and Sellwood (and also the surveying for Lindenthal of three sites for proposed bridges between Broadway and Ross Island), Siekce was put in charge of "office work and Ross Island Bridge."[162] He also wrote, "My position on the staff of Gustav Lindenthal afforded me the opportunity of designing the concrete structure of the Ross Island Bridge and serving as principal assistant engineer on its construction, as well as design of the east approaches to the Burnside Bridge, and checking the design of the Sellwood Bridge."[163]

Siecke's obituary at the time of his death, 18 March 1965, reported he had been a consulting engineer and associate professor of structural engineering at the University of Portland; that he was licensed for civil, structural and mechanical engineering in Oregon, Washington, California, Missouri, Illinois and Iowa; and that he had been born in Freeport, Illinois, 7 July 1895 and had graduated from the University of Illinois in 1921.[164]

---

78-85. [160] *Oregon Journal,* 13 October 1946, 12A.

[161] Drawings for Burnside and Sellwood, Files, Multnomah County Bridge Section; drawings for Ross Island, ODOT Bridge Engineering offices, Region 1, and Salem. The earliest signed Siecke drawing during Hedrick & Kremers designing for Burnside was "Operator House Support," T-15, dated 20 February 1924, showing "K.H. Siecke," under "Made By."

[162] A letter from Lindenthal, to the Board of Multnomah County Commissioners, Commissioners Journals, "Burnside and Ross Island Bridges," 17 June 1925, Files, Multnomah County, Yeon facilities; copy of letter from K.H. Siecke to the Honorable Board of Commissioners, dated 28 November 1931, Files, ibid.

[163] Copy of letter from K.H. Siecke to the Honorable Board of Commissioners, dated 17 July 1931, Files, Multnomah County, Yeon facilities. Siecke's name does not appear on Burnside's brass nameplate.

[164] "Kurt Siecke Dies at 69," *The Oregonian,* 18 March 1965, 17c. More revealing than the obituary is Siecke's "Experience Record, Kurt H. Siecke," sent to Multnomah County to solicit consulting work in the 1950s. Siecke's letterhead shows his office at the time of application at 429 S.W. Fourth Ave., Portland. Although the letter is not dated, the report is titled 1954. In addition to enclosing original construction photos of the Burnside, Ross Island and other bridges, Siecke lists an employment history that shows he was an inspector and draftsman for the Illinois Central Railroad in Chicago, where he designed and detailed concrete and structural steel railroad bridges in the office.

**Portland Bridges - Warren Trusses and Panel Lengths**

As J.A.L. Waddell noted, "When plate-girders cannot be used on account of the length of span being too great, it is necessary to resort to some form of truss bridge."[165] Several truss types were introduced and patented nationally, with the Warren truss, introduced in 1848, a type that has withstood the test of time. Named for James Warren, the truss members are in the form of connected, repeating "Ws." *Historic Highway Bridges of Oregon* includes sketches of 12 truss types described as "Common Historic Bridge Designs in Oregon."[166] Of the 12, four are varieties of Warrens: Warren (simple), Warren with Verticals, Warren with Polygonal Top Chord, and Double-Intersection Warren (Lattice).[167] Burnside's two side spans use the last of these four varieties, the Double-Intersection Warren. *Historic Highway Bridges* states that there are only two Double-Intersection Warren highway bridges still existing in the state.[168] Both these remaining structures are through trusses, rather than deck trusses as are the Burnside side spans. Thus it appears that the Burnside spans may be the only Double-Intersection Warren highway deck trusses in Oregon.[169]

---

According to his resume, he left the Illinois Central Railroad in May 1923, that same month becoming "the designer" for Hedrick and Kremers, Consulting Engineers, Portland, Oregon. "The work consisted of designing a steel viaduct with concrete slab deck and in checking the design of steel trusses for secondary stresses and in designing 250 foot concrete arches." No location is given for the concrete arch work, but on the next line, Siecke is shown as beginning work in August 1924 as "Chief Draftsman, Principal Asst. Engineer, Gustav Lindenthal, Consulting Engineer." Siecke writes, "The applicant prepared the plans for approaches and was in charge of the field work on the $2,000,000 Ross Island bridge in Portland, Oregon." The line after this shows Siecke resigned from the Lindenthal team in July 1926 to go to work in August 1926 for the general contractors on construction of the Vantage Ferry Bridge over the Columbia River, a position he said he accepted because of the opportunity for pneumatic caisson experience. In 1927, he worked for Parker & Banfield, the same firm that had been indicted for illegal bidding activities on the Willamette River bridges during the Hedrick & Kremers regime. (Siecke's work was cut short as estimator and engineer for Parker & Banfield when C.J. Parker was killed in an airplane crash.) "Professional Record of Kurt Hugo Siecke," included in "Experience Record," Files, Multnomah County, Yeon facilities. For more about Parker & Banfield, read MacColl, *The Growth of a City,* 199.

[165] *Bridge Engineering,* (New York: Wiley & Sons, 1916), Vol. 1, 24.

[166] Smith and others, *Historic Highway Bridges of Oregon,* 22. The source for "Common Historic Truss Designs in Oregon" is the Historic American Engineering Record, National Park Service, United States Department of the Interior, Washington, D.C.

[167] According to Waddell, a true Warren requires triangles that are equilateral. *Bridge Engineering,* Vol. 1, 468, 472; Smith and others, *Historic Highway Bridges,* 263-264. However, Waddell also notes " . . . later writers generally use the name for any triangular truss." The Burnside trusses do not have equilateral triangles.

[168] Smith and others, *Historic Highway Bridges,* 71, 274.

[169] J.A.L. Waddell observed that the Double-Intersection Triangular truss had managed to survive "with apparently very little good reason for having done so." Besides the secondary stresses running high, Waddell didn't like it that this type truss had "unavoidable ambiguity," which meant it was statically indeterminate, something that Waddell didn't like. Lindenthal favored the statically indeterminate bridge, in both Ross Island and Sellwood finding the cost

Another distinctive aspect of the Burnside side span trusses is the use of vertical posts running from the top chords down to the diagonal intersections. This use of "sub-verticals" in Double-Intersection trusses may be unusual but is not unique. J.A.L. Waddell included this arrangement in his discussion of truss types. He was critical of the arrangement in general, but did note an exception: "In deck trusses such vertical posts are sometimes employed to support floorbeams, thus halving the panel lengths of the floor system; and in this case their use is entirely proper."[170]

Consistent with Waddell's observation, the sub-verticals in Burnside's side span trusses do serve to halve the panel lengths of the floor system. "Panel lengths" are the distances between the floorbeams that run across the bridge at right angles to traffic; floorbeams are located at joints in the truss framing called "panel points." The benefit of halving the floor system panel lengths is to substantially reduce the weight of the steel framing that supports the roadway deck and sidewalks. The deck and sidewalks are supported by "stringers" that run lengthways, in the direction of traffic, and connect to the floorbeams. When the panel lengths are cut in half, as by use of the sub-verticals in Burnside, each stringer will be only half as long and will carry only half as much load. Required size, thus weight, of the stringers will be substantially less than would be required with the longer panel lengths. Similarly, the load on each floorbeam will be only half as great when the panel lengths are cut in half. (However, much of this floorbeam benefit will be offset by the need for twice as many floorbeams.)

The idea of sub-dividing bridge trusses by adding additional members to reduce floor system panel lengths was far from new at the time of Burnside's design. This technique became common in the late Nineteenth Century as bridge trusses became longer and taller. Without subdividing, the panel lengths of larger bridges would have been excessively long, and the weight of stringers and floorbeams would have been uneconomical. As Waddell noted, the name of the game was to make a bridge as light as possible, and thus as economical as possible. In his words: "For many years American bridge-designers exercised their ingenuity in devising new forms of trusses and girders, the principal object of their endeavors being to find forms involving the use of the smallest amount of metal."[171]

savings in material a fair trade for the calculations necessary. J.A.L. Waddell, *Bridge Engineering*, Vol. 1, (New York, Wiley & Sons), 471; G. Lindenthal, "Continuous Girder Bridges," Letter to the Editor, 13 February 1929, *Engineering News-Record*, 7 March 1929, 397. For more about statically indeterminate structures, see Gustav Lindenthal, "The Continuous Truss Bridge Over the Ohio River at Sciotoville, Ohio of the Chesapeake and Ohio Northern Railway," Paper No. 1496, presented 5 April 1922, *Transactions*, Vol. 85 (New York: American Society of Civil Engineers, 1922), 915.

170 Waddell, *Bridge Engineering*, 471.

171 Waddell, *Bridge Engineering*, 471.

What is highly unusual about the sub-dividing of the Burnside trusses, and for the trusses on Sellwood and Ross Island bridges also, is the extremely short panel lengths produced. For most truss bridges built in the first third of the 20th century (as well as later), floor system panel lengths ranged from about 22' up to about 30'. For example, see the following list of floor panel lengths for several Portland-area bridges designed between 1909 and 1956. With one exception (Morrison Bridge bascule span), none of the bridges listed has panel lengths shorter than 22' except for Burnside Bridge, Ross Island Bridge and Sellwood Bridge. For these three, panel lengths are respectively about 16', 13' and 14'. These short panel lengths are extremely unusual, whether looked at from a Portland-area point of view, or a nationwide point of view.

As one example of floor panel lengths that were typical of bridges elsewhere in the U.S. in the period, consider the Queensboro Bridge in New York, designed by Lindenthal 20 years before his Portland work. Although the Queensboro trusses are sub-divided, panel lengths along this large and complex structure all are in the range of 24' to 35'.[172]

**Floor System Panel Lengths, Portland-Area Bridges**
(Dates shown refer to design)

| | | |
|---|---|---|
| Burnside (1923-24) | Side spans | 16'-9-5/16" |
| | Bascule | 15'-9" |
| Ross Island (1925) | Center span | 13'-4-1/2" |
| Sellwood (1924) | All four spans | 13'-7-3/4" |
| Hawthorne (1909) | 209'-3" spans | 23'-3" |
| | 244' spans | 22'-2-1/2" |
| Morrison (1956) | Side spans | 25'-10" |
| | Bascule | 18'-8" |
| Broadway (1912) | Span 1 123'-0-7/8" | 24'-7-3/8" |
| | Span 2 267'-0" | 22'-3" |
| | Span 3 282'-0-3/4" | 23'-6-1/16" |
| | Span 4 295'-2-1/2" | 26'-4-1/4" |
| | Span 5 139'-2" | 22'-7" |
| | Span 6 295'-2-1/2" | 26'-4-1/4" |
| Steel (1911) | East fixed span | 26'-0-15/16" |
| | West fixed span | 26'-0-15/16" |
| | Lift span | 30'-2" |
| Sauvie Island (1949) | All thru spans | 25' |

172 "Queensboro Bridge Over East River, Rehabilitation Main Span and Approaches, General Elevation and Plan," City of New York, n.d.

Interstate (1917) Northbound span 23'-9-3/4"

Who designed these unusually short panels for Burnside, Ross Island and Sellwood Bridges? Lindenthal had spent most of his career designing large railroad bridges, or highway bridges that included railroad tracks. His three largest were the Hell Gate Arch, Sciotoville and Queensboro. From the available records, it appears that Lindenthal's only non-railroad, all-highway bridge prior to Portland was the Smithfield Bridge in Pittsburgh, opened in 1883. If true, this makes the Portland bridges rare or unique examples of Lindenthal-designed highway-only spans. They certainly have the Lindenthal touch, i.e., the cantilevers on Ross Island that look like an arch (similar to an inverted Queensboro), and the continuous truss and statically indeterminate Sellwood (similar to Queensboro and Sciotoville). No doubt, Lindenthal was responsible for the "big picture" design of the Portland bridges. However, because of his travel schedule, the capabilities of his Portland team, and the fact that this team was, in large part, comprised of carry-over members from the Hedrick & Kremers team (who had just finished designing Burnside, a Warren truss with finely sub-divided panels), it is possible that the preference for sub-divided trusses with short floor panels came from Hedrick, as designer of Burnside, or Reed, first in charge of the Portland work, or perhaps one or all of the Hedrick & Kremers team members.[173]

**Burnside Bridge Design Changes - Additions by the Lindenthal Team**

Burnside's design was, for the most part, finished when Lindenthal took over in July 1924. With the public clamoring for its completion, Lindenthal turned his attention to the Burnside Bridge first, and the Sellwood and Ross Island bridges next. Lindenthal judged that Hedrick & Kremers' design for Burnside was acceptable. He did, however, make some changes and additions to Burnside. For example, while in Portland, Lindenthal discussed with Rode his objections to black paint as a finishing coast as had been originally chosen. Instead, Lindenthal decided on a grey finishing coat for all three bridges alike: "Black steel absorbs much more heat than a lighter color. When parts of the steel structure are in the sun and others in the shade, the difference in the temperature stresses may cause warping and inert stresses, which can never be completely eradicated, but neither must they be accentuated to the detriment of the structure."[174]

In all, Lindenthal or the Lindenthal team created 19 additional drawings. For example, on drawing L-12, "Details of Bascule Piers," dated 3 December 1925 (late in construction), a 2-

[173] The extremely short floor panel lengths prevalent on all three Portland Lindenthal bridges were pointed out by Ed Wortman.

[174] Commissioners Journals, "Burnside and Ross Island Bridges," 28 September 1924. The Board of County Commissioners, acting on Rode's recommendation, orders changing paint on the Burnside Bridge from two graphite coats to one coat of graphite paint and a second coat of gray zinc lead paint, and allowing Pacific Bridge an additional $1675, with Booth & Pomeroy Construction Co. to apply. Also see copy of letter from Lindenthal to Reed, 1 August 1925, Files, Multnomah County, Yeon facilities.

3/4"-round steel rod is added in each bascule pier. The rod runs from one side of the pier to the other, passing through the middle of the trunnions and into the concrete wings. Perhaps someone thought the concrete wings were threatening to fall into the river.[175] Some of the other Burnside drawings that reflect either Lindenthal's changes or his additions:

- L-17, "Reinforcing Details Pier 4 Pylon" (supersedes T-17), 27 October 1924. Changes the reinforcing steel and redesigns the concrete top of the pier (located near the east river bank), possibly for the same reasons the tie-rods were inserted in the bascule piers.

- L-56, "Stairway Span 32" (supersedes 56), 17 January 1925. Changes the direction of the stairway leading from the bridge sidewalk down to S.E. Third.

- L-58, "Sway Bracing Plate Girder Spans" (supersedes T-58), 19 August 1924. Modifies the sway bracing between the east approach girders, in order to improve the strength of the bracing.

- L-63, "Plan & Elevation Spans 20 to 27," 16 October 1924. Involves the concrete encasement of the girders on the bridge's east end, some of them 104' long.

- L-64 "General Details Pier 4 Pylon," 27 October 1924. Changes reinforcement and adds roadway details on top of Pier 4, located at east end of the truss span.

- L-65, "Details of Trolley Poles," 24 October 1925. Adds trolley poles on the concrete approaches, girder spans and truss side spans.

- L-66, "Masonry Elevation," 31 October 1924. Specifies elevations of the tops of the piers.

- L-67, "Layout Street Railway Tracks," 11 November 1924, and L-68, "Detail of Track

[175] These are the pier-top structures that include the operator's house and ornate concrete porches. The only drawing showing the tie-rod is L-12, "Burnside Bridge, Details of Bascule Piers," 3 December 1925. While working on the bridge's seismic evaluation in early 1995, Multnomah County bridge engineers noticed the rod running through the trunnions and wondered what its purpose was. Ed Wortman said, "We looked it up on the drawings, and following the drawings back, we inferred—the way it was tied in on the ends—that it was intended to keep the concrete wings from spreading apart. The title block and date on the drawing indicate that it was designed by Lindenthal, and not part of the original design by Hedrick & Kremers." Ed Wortman handles the Burnside's drawings on a day to day basis. He helped interpret drawings, theorized about Lindenthal and Hedrick & Kremers engineering activities, and collaborated with me for all three HAER reports on the Lindenthal bridges, i.e., Historic American Engineering Record (HAER), National Park Service, U. S. Department of the Interior, "Burnside Bridge," HAER No. OR-101 and Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Ross Island Bridge," HAER No. OR-102 and Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "Sellwood Bridge," HAER No. OR-103.

Expansion Joint," 11 November 1924. Adds locations and details of streetcar tracks.

- L-69, "Retaining Walls East Approach," 1 December 1924. Adds retaining walls along the sides of the bridge to protect the buildings that were already along Burnside street. Lindenthal left the old street, and added gravel fill between the retaining walls to bring the street up to the extant grade.[176]

- L-70, "General Plan West Approach Fill," 8 December 1924. Works out the details for the west side approach ramp, and where the bridge crosses First, Second and Third streets.

- L-70A, a continuation of L-70, and made one year later, on 28 December 1925. Shows revisions in stairways to get down below the west approach ramp. A walkway under the street connected to stairs on each side of the bridge and to stairs by the streetcar tracks in the center of the ramp.

- L-71 through L-75, completed in 1925, also deal with approach work.

- A half-size Lindenthal design sketch dated 24 July 1925, titled, "Burnside Bridge Sketch Showing Harbor Wall West of Pier No. 1." The drawing shows how the Burnside Bridge Pier No. 1 anticipated the Portland Harbor Wall, dedicated 7 June 1929.[177]

---

[176] Lindenthal drawings L-69 through L-75 present designs for the gravel-filled approach ramps at the west and east ends of the bridges. Hedrick & Kremers had not addressed these ramps, possibly because street widening and right-of-way issues had not been resolved when their contract was terminated.

[177] The sketch called for a section of harbor wall to sit on piling behind Burnside Bridge's Pier No. 1, different than the rest of the harbor wall. During negotiations between the Board of County Commissioners and the City Council while the bridge was being constructed, it was agreed that piling would be driven adjacent to the west bridge pier as the foundation for a concrete wall at the foot of Burnside Street. The work was done by the low bidder, J.F. Shea Co., for $5,850. (Shea, also a subcontractor on Ross Island Bridge doing sewer work at the bridge's west end at Wood Street, was a prime contractor for the Front Street Intercepting Sewer and Drainage System, as part of the Portland Harbor Wall project, signing the sewer contract with the city of Portland in 1926. For more about Shea, see contracts at City of Portland, Stanley Parr Archives, 9360 North Columbia Blvd.) The city completed the wall under the Burnside Bridge between S.W. Naito Parkway (formerly Front Street) and the harbor line. The entire project cost $2.8 million and was one of the city's first urban renewal projects. It is an enormous structure, built to retain Portland's first major waste water unification system and to eliminate flooding of west side businesses. Beneath the concrete portion, and only visible during low water, are 51 wooden cribs filled with rocks. Each crib is 37' tall, 100' long, and 46' wide at the bottom. Letter dated 21 October 1926, from O. Laurgaard, City Engineer, to A.L. Barbur, Commissioner of Public Works, File 2008V2, City of Portland, Stanley Parr Archives; Contract drawings, "Elevation and Plan," Portland Harbor Wall, City of Portland, Engineering offices.

**Summary of Changes Post-1920s**

**Sidewalks and Railings**: The higher elevation created by the Burnside Bridge also created a new access level to any building with upper floors adjacent to the bridge whose owner wanted entrances from the bridge sidewalk.[178] A photograph taken in about 1926 from S.W. First Avenue at Burnside (looking east) shows the conditions created as a result of widening Burnside Street on the bridge's west end. (See **Plate 4**, photograph showing the widening of Burnside Street, ca. 1925-26.) The tower shown in the background on the right is a pile driver tower. It was placed at S.W. Naito Parkway (formerly Front Street), and would have been used to drive the piles for the Burnside Bridge's west end foundations, and/or for construction of part of the Portland Harbor Wall. (The driver's hammer is visible to the bottom left of the tower.) The buildings on the right in the foreground were cut on their facing, with the front parts removed to make room for the new right-of-way. These buildings still exist (one of them the Saturday Market building), but with flat exteriors where they face Burnside Street. The buildings on the left, moving from west to east, are the extant Skidmore Block (shown with the name "Lang & Co.," a facade that was also removed), and the extant Hirsch Weis building, now known as the White Stag building, and/or the Norcrest China building. The two buildings shown here east of S.W. Naito Parkway (formerly Front Street) were eventually destroyed.

For certain areas along both sides of the bridge, six-rail metal pipe was put along the outside sidewalks of the bridge, probably intended as a temporary solution, with the cast-stone balusters on the approach and side spans installed as permanent railing. There have been at least three major changes to Burnside's pipe railing/balusters since 1928. In 1992, the ten-story Bridgeport Hotel, a former Skid Road hotel located on the bridge's northeast end at 239 East Burnside Street, was demolished.[179] Multnomah County then installed new balustrade along the

---

[178] Nine extant buildings are located adjacent to the four corners of the Burnside Bridge. Moving from street level toward the center of the bridge, beginning at the southeast corner, are the Recovery Inn (formerly Baloney Joe's Men's Shelter). The lot east of the Recovery Inn is vacant and most recently housed a gasoline station. At the northeast corner: Fishel's and Fishel building garage, Towne building, and the Templeton (Frigidaire) building. (The Templeton Building, listed on the National Register of Historic Places in 1989, was built adjacent to the Burnside Bridge in 1929, three years after the bridge opened.) At the northwest corner, Portland Rescue Mission building, Central City Concern building, Skidmore Block building, and the Norcrest China/White Stag building (formerly the Hirsch Weis Building), which carries a lighted reindeer sign on its roof. At the southwest corner: Western States Chiropractic College (formerly the Salvation Army building), and the Portland Saturday Market building. The Oregon Historical Society Maps and Photos Department, File, "Burnside Bridge," shows the same number of buildings on the bridge's northwest end at the time it opened. However, additional buildings once existed at the bridge's southwest end.

[179] Rick Bella, "Developer, City on Collision Course Over Future of Burnside Eyesore," *The Oregonian*, 25 July 1992, D1; Ibid., "Officials Take Steps to End Foul Problem, 17 December 1993, E2. In 1998, the Portland Development Commission approved city purchase of six lots near the east end of the Burnside Bridge, including the former Baloney Joe's men's shelter building, for redevelopment. Janet Christ, "PDC Plans Redevelopment for Former

block where none had previously existed.[180] In 1996, the county installed 195' of new balustrade, almost the length of a typical Portland city block, where only a metal pipe rail had previously existed. This was along the southwest side of the bridge, just above Saturday Market, from S.W. Naito Parkway (formerly Front Street), to First Avenue.[181] Multnomah County Maintenance Supervisor Tony Lester estimates that the steel pipe railing formerly in place at this location was, due to its rusted condition, "at least 30 to 40 years old." Also in 1996, the county replaced a 120'-long section of pipe with new balustrade west from the Fishel Furniture Building, located at Burnside and S.E. Martin Luther King, Jr. Blvd. (formerly Union Avenue). The drawing "General Elevation and Plan," Sheet T-2, shows that the bridge opened with pipe railing on the southeast end for nearly 170'. The bulk of the bridge's extant concrete railing, both sides of the bridge, is composed of 27 balustrade sections, with 13 balusters (each baluster 26 inches high) to the section, or 13 balusters between posts. Each post has a head 16" square. It is four feet from the sidewalk to the top of posts. The distance from the sidewalk to the top of the balustrade rail between posts is 3'-6". There are approximately 15 balustrade sections per side, with the number of individual balusters per section ranging between six and 19 balusters.

**Stairs/Access (West End)**: In 1994-95, a concrete walkway "tunnel" running transversely beneath the west end of the bridge at the west perimeter of S.W. Naito Parkway (formerly Front Street) was razed, along with concrete stairs located beneath both sides of the bridge's west end that connected the walkway and then went to ground at S.W. Naito Parkway and N.W. Naito Parkway. New steel stairs and "Saturday Market Old Town" signs, both painted black, were placed on the north and south sides of the bridge.[182] The extant stairs

Baloney Joe's Site," *The Oregonian*, 19 June 1998, B2.

[180] Tony Lester, interview with Sharon Wood Wortman, 5 May 2000. The historic posts, top rails, and bottom rails were cast-in-place, also true of contemporary balustrade replacement by the county. The county completed the 1992 balustrade work with baluster molds since replaced. An outside pattern maker, using a discarded baluster, made a new mold. A county maintenance worker then used this mold to create a fiberglass mold, which was reinforced with metal corners in anticipation of repeated concrete pours. (Both the historic and contemporary posts were cast-in-place.) Most of the Burnside Bridge baluster pours are done in the winter months at the Bridge Section maintenance shop, located in a former trolley barn at the east end of the Hawthorne Bridge.

[181] Plan, Multnomah County, "Railing at Front Avenue and First," by Ed Wortman. Wortman designed the scaffolding for Multnomah County construction workers. He recalled that the pipe railing was unable to defend against runaway skateboards that were shooting between the rails and landing on the property and people shopping at Saturday Market below. This skateboard traffic emanated from skateboarders crossing to the southwest side of the bridge from the public skateboard ramp located under the bridge's east end. (The bridge's west end slope is greater than that at the east end.) Steve Dotterrer, of the city, recalls that a building at the west end of the bridge in the balustrade replacement location burned some time in the 1960s. Telephone interviews with Sharon Wood Wortman, 5 May 2000.

[182] These stairs were engineered by Multnomah County, and designed by architect Lane Brown. "Stairs Burnside Bridge," Files, Multnomah County Bridge Section. The old stairs and walkway "tunnel" had caused a great deal of controversy because of drug dealing and other illegal activity, with the Portland Police Dept. spearheading the charge to have the stairs removed. Brown was involved in the initial planning studies for placement of the extant stairs

are situated perpendicular to the bridge, ascending from Burnside Street and the bridge to First Street, where they land just west of the MAX light rail tracks.

**Stairs/Access (East End):** The original Hedrick & Kremers drawings called for concrete stairs to be built parallel to the bridge, on both the north and south sides, at E. Third Street. From the drawings, it appears the bridge opened with concrete stairs running perpendicular to the southeast end of the bridge at E. Third Street.[183] However, Multnomah County Bridge Section employees said that concrete stairs existed on both the north and south sides of the bridge until 1989.[184] That year, a local property owner removed the concrete stairs without a permit, and was required to replace them. The replacement stairs, installed in 1989, were made of steel, ran perpendicular to the bridge and were also located above the sidewalk (west side) of E. Third Street.[185] The replacement stairs were removed in 1992, when the Bridgeport Hotel, located on the northeast corner of the bridge, was razed. The stairs at both ends of the bridge have been controversial for years due to drug dealing and other illegal activities.

**Traffic Lanes:** The bridge opened with six lanes, four for motor vehicle traffic and two lanes with trolley tracks.[186] In 1995 the city requested that bicycle lanes be added to the bridge. As a result, one lane of the six traffic lanes was taken for two bikes lanes, now located one each in the outside westbound and eastbound between the vehicular traffic lanes and the pedestrian sidewalks. This left five vehicular travel lanes: three for east bound traffic and two for west bound traffic.

**Trolleys and Traffic Gates:** The bridge opened in 1926 equipped with T-shaped trolley poles that measured 14' across at the top. (See **Plate 5**, photograph showing trolley poles and trolleys on the bridge, ca. 1926). A total of eight steel traffic gates, four at each end of the

---

and remembers a number of pedestrian and transit studies to determine the best placement. A number of agencies were involved in the project, including the city's Urban Forestry Dept., Portland Police Bureau, Portland Water Bureau, Tri-Met, the Skidmore/Old Town Historic District, and others. Lane Brown, A.I.A., Portland interview with Sharon Wood Wortman, June 27 2000.

[183] "Burnside Bridge, General Elevation & Plan, Design No. 2," Sheet No. T-2, Files, Multnomah County, Bridge Section.

[184] Stan Ghezzi, Bridge Section Operations Supervisor; and Ray Couture, Lead Mechanic, Bridge Section, interview with Sharon Wood Wortman, 16 May 2000.

[185] "Stair Replacement, Burnside Bridge," 8 September 1986, Zarosinski-Tatone Engineers, Inc., Files, Multnomah County, Bridge Section.

[186] Rode, letter dated 21 May 1926, Files, Multnomah County, Yeon facilities. Photographs taken at the time of and for sometime after the Burnside Bridge's opening do not show any lane striping painted on the bridge.

bridge, measured 17' each.[187] A franchise was granted that year to Portland Traction Co. (successor to the Portland Electric Power Company) to operate trolley coaches and overhead and under bridge equipment to operate those trolleys across the bridge.[188] The trolleys required one line for power. In 1936, when trackless trolley coaches, equipped with rubber wheels, started operating across the bridge, the T-shaped trolley poles were equipped with double wires (one wire for positive, and one for negative).[189] (See **Plate 6**, photograph showing both types of wires on the T-shaped trolley poles). As late as 1956, Rose City Transit Co., a successor to Portland Traction Co. (and forerunner of Tri-Met, Portland's extant public tri-county transportation system since 1970[190]), used Burnside Bridge's trolley wire system to make connections between the east and west sides of the Willamette as a result of the termination of a trolley system across Hawthorne Bridge.[191] The trolley wire system, however, made it impossible for the county to go forward with plans to install new automatic traffic gates across the bridge, also in 1956. The engineering consultant Moffat, Nichol & Taylor Co. had already completed preliminary engineering and final design for the installation of new automatic gates for three county bridges, including the Burnside Bridge, earlier that year.[192] The traffic gates were finally installed in December 1959, as well as a portal frame for the overhead traffic lights, and submarine cable.[193] It is unknown whether the rails still extend down the center of the bridge. They may still be in

---

[187] See drawings, "Details of Trolley Pole & Rail," and "Traffic Gate TG3," both with Hedrick & Kremers title block, Files, Multnomah County, Bridge Section. Photographs at the Oregon Historical Society shows the black traffic gate in place.

[188] Multnomah County Commissioner Board Order of 24 March 1926, Files, Multnomah County, Yeon facilities.

[189] Bill Forbes, Portland, interview with Sharon Wood Wortman, 17 May 2000.

[190] Bianco, "Private Profit Versus Public Service," ibid., 2-3.

[191] Letter dated 16 April 1956, from Rose City Transit Co., signed by Gordon G. Steele, to P.C. Northrop, Multnomah County Roadmaster, Files, Multnomah County, Yeon facilities. The county had sent a letter (April 12 1956, from Northrop to Steele) noting that when gas buses were substituted for the trackless trolleys across the Burnside Bridge, the trolley system was permitted to remain on the bridge for emergency use: "Since the trackless trolleys are virtually eliminated, this emergency feature is no longer of benefit and will never be used." The subsequent 16 April letter refuses the county permission to remove the trolley wires. With the closing of Hawthorne Bridge to trolley coach operation, due to the construction of the new east side approaches, Rose City would be operating trolley coaches from its garage "via S.E. Center Street, S.E. Milwaukie Ave., S.E. 12th Ave., S.E. Hawthorne Ave., S.E. 28th Ave., N.E. 28th Ave., N.E. Sandy Boulevard, East Burnside Street, Burnside Bridge, West Burnside Street," etc.

[192] Letter dated 26 April 1956, from P.C. Northrop to Board of County Commissioners, Files Multnomah County, Yeon facilities.

[193] File "Contract 1959, Burnside Bridge, Installation of Traffic Control Devices, Project No. 339, Contract No. 1073-R-59, completed 31 December 1959," Ibid.

place under the asphalt surfacing.[194]

**Electrical:** In late November 1996 and mid-1997, the electrical control panel, consisting of relay contacts on a slate board eight feet long by seven feet wide, was replaced with an SCR (silicon-controlled rectifier) drive housed in a cabinet enclosure of about the same dimensions. A PLC (programmable logic controller) system was installed at the same time. The PLC automated lifting and seating procedures, as well as speed of lift.[195]

**Power to the bridge:** Originally direct current (DC) electrical power was delivered to the bridge from both the east and the west sides of the river. Some time in the past, the utility company stopped supplying DC power. Since then, the bridge has been supplied with AC power from the west side only. Two extant submarine cables connecting the two bascule piers carry power and control signals to the east side operating machinery, traffic gates, etc. In July 2000, Multnomah County announced plans to revamp the Burnside Bridge's electrical system in the next few years. Changes would include a new submarine cable.

**Bascule:** Originally, the bascule leaves could tilt up until the counterweights hit timber bumpers located under the trunnions. In the 1970s, due to rutting of the concrete roadway, an asphalt overlay was applied to the deck. This made the lift span considerably heavier. To counterbalance the weight of the new asphalt, Multnomah County and ODOT designed a series of large concrete blocks that were hung on the bottom of the original counterweights. The concrete blocks made the counterweights three feet taller. With these blocks in place, the counterweights can hit the pit floor inside the piers before reaching the bumpers under the trunnions. Electrical limit switches are designed to cut the power when the bridge leaves get to a certain angle, to prevent the counterweights from hitting the floor. However, the leaves occasionally pass by the limit switches and the counterweights hit the floor. The county plans to install new rubber bumpers in the Burnside piers in 2000, to prevent this from happening.[196] The

---

194 Tony Lester, Maintenance Supervisor, Multnomah County, interview with Sharon Wood Wortman, 1 May 2000.

195 Larry Skinner, lead electrician and project manager for this PLC and electrical upgrade, telephone interview with Sharon Wood Wortman, 12 April 2000. Skinner estimated the cost at $100,000.

196 In the 1970s, Ken Rountree, the Multnomah County Bridge Engineer at the time, came up with the ideas, and then ODOT put out the drawings and bids, and hired a contractor to do the construction. The drawings for work in the 1970s were made by ODOT. (A similar procedure is followed at the turn of the century for the county's federal aid bridge construction projects.) In 1989, the maintenance, operations, and engineering duties for the Willamette River bridges were reorganized and consolidated at the County Bridge Section's Water Avenue facilities located at the east end of the Hawthorne Bridge under the supervision of Bridge Operations Manager Stan Ghezzi, P.E. Ghezzi is one of five licensed professional engineers currently employed at the Water Avenue facility. He reports to the Multnomah County Director of Transportation, who reports to the Multnomah County Director of Environmental Services, who reports to the Chair of the Board of Multnomah County Commissioners, Multnomah County's top executive, who chairs a five-member board. By Multnomah County regulation, the Bridge Section must contract with outside providers for

following is a list of other major repairs/changes to Burnside between 1949 and 1985.[197]

| | | |
|---|---|---|
| 1949 | Two new starlings | $34,270 |
| 1957 | Sash and doors | 3,573 |
| 1957 | Relighting | 29,950 |
| 1959 | Traffic control devices | 39,850 |
| 1964 | Epoxy resin paving | 81,400 |
| 1964 | Expansion joints | 20,995 |
| 1965 | Rip-rap (with Sauvie Island Ross Island and Hawthorne bridges) | 15,550 |
| 1965 | Restore piers with underwater concrete | 12,400 |
| 1966 | Painting | 87,000 |
| 1968 | Emergency repairs (No Bid) materials | 10,000 |
| 1969 | Repair damage to starling | 11,615 |
| 1970 | Repair of timber fender structure on upstream face of west drawspan | 20,000 |
| 1971 | Gates and iron work [auto traffic] | 8,850 |
| 1971 | Auto gates and traffic control | 31,770 |
| 1973 | Rip-rap (with Sellwood and Hawthorne) | 18,495 |
| 1975 | Rectifiers (with Broadway) | 19,617 |
| 1978 | Resurface | 288,930 |
| 1983 | Starling replacement | 234,814 |
| 1985 | New holding tank installed | – |

**Scheduled:** Multnomah County has scheduled the bridge for rehabilitation of its roadway deck, and some Phase I seismic retrofit in 2002. In 1995, Sverdrup Civil, Inc., and its subcontractor Shannon & Wilson Geotechnical Consultants surveyed the Burnside Bridge and five other river bridges owned by Multnomah County to determine seismic vulnerability. Burnside, the only designated emergency "lifeline" bridge across the Willamette River, received a top priority rating under the ODOT Prioritization Index for seismic retrofit. The report found that Burnside was inadequately braced at the bascule leaves and trunnion support frames, and that the anchor bolts were inadequate at the trunnion support frames and fixed ends of the side spans. Sverdrup recommended prioritizing potential Phase I and Phase II retrofitting options for

any maintenance work required for the Willamette River bridges in excess of $50,000. Ed Wortman, interview with Sharon Wood Wortman 25 May 2000.

[197] "Burnside 1925," a report by Sverdrup & Parcel and Associates, Inc., 9 April 1985, Files, Multnomah County, Yeon facilities.

the main river spans, estimated to cost between $1 million and $21.3 million. Phase I retrofits are commonly called "superstructure retrofits" and are intended to reduce the risk of the superstructure falling off its supports during an earthquake. They include such measures as adding longitudinal and transverse restrainers, catcher blocks, seat width extenders, girder stops, etc. Phase II retrofits are intended to increase the structural capacity of the vulnerable bridge structure, and are sometimes referred to as "substructure retrofits." Examples of Phase II measures include column or footing strengthening, adding foundation piling, adding shear walls to piers, steel jacketing of columns, etc.[198]

**Decorative/Architectural Lighting**: In 1999, Portland Mayor Vera Katz announced that Burnside Bridge and other Central City Willamette River bridges would be lighted with architectural lights as a "Millennium Legacy" and as recognition of Portland's 150th birthday, celebrated January 2001. Portland-based artist Bill Will worked with the Willamette Light Brigade, a non-profit citizens group who began lighting the lower Willamette River bridges with decorative and architectural lights in 1987, to create Burnside's lighting scheme.[199]

**Painting:** See "Architectural/Aesthetic and Operator Tower" section, above
The 1926 Burnside Bridge was completed as a much wider and heavier replacement for an earlier swing span at the same location. (See **Plate 7**, "Burnside Bridge Removal of Old [1894] Structure Elevation and Plan Existing Structure 1923.")

The earlier structure was approved by the Secretary of War on 24 August 1892.[200] Prior to this, under an act of the state legislature of 1891 drafted by C. H. Meussdorffer of Multnomah County, a committee of eight Portland citizens, with J.L. Sperry as chairman, was formed for "the purpose of buying, building, or leasing one or more suitable and commodious bridges across the Willamette River within the confines of Portland [then Portland, East Portland and Albina]." The committee first bought the Madison Street [Hawthorne] Bridge from the Mount Tabor Street Railway Company, and attempted to buy the privately-held Morrison Bridge, opened in 1887. After the Morrison deal fell through, the committee proposed building two additional bridges: one across the Willamette between the first Morrison Bridge and the first Steel Bridge, opened in

---

198 "Burnside Bridge No. 0511 Seismic Evaluation Report," Sverdrup Civil, Nov. 1995, 1, 20, 23, Files, Multnomah County Bridge Section.

199 Funding to complete the architectural lighting of the Burnside Bridge and other Central City Willamette River bridges has yet to be obtained. See web page wlbrigade.org. Street lighting for the bridge's approaches was originally done with Union metal posts placed on the curb line about 100' apart. The posts carried two General Electric Novalux tops with 10,000 lumen lamps. On the bridge proper the posts were reinforced concrete placed on the railing pylons and carried single tops with 10,000 lumen lamps. The lighting system was in multiple series. Reed, "The New Burnside Bridge, Portland, Oregon," 23.

200 Letter dated 11August 1904, from Major W.C. Laugfits, United States Engineer Office, Portland, Ore., to George Himes, Assistant Secretary, Oregon Historical Society, Portland, Oregon.

1887 and 1888 respectively, and one at Knight and Quimby streets in the city of Albina.[201] The Portland office of the U.S. Army Engineers made an adverse recommendation against the two new bridges. A delegation formed to make an appeal in Washington, D.C. Secretary of War Stephen Elkins, in President Harrison's cabinet, found in favor of the bridge committee, and approved two new bridges. In the end, however, only one bridge was funded.[202] The committee was also responsible for purchasing the site.[203] They located the bridge between West Front Street and East First Avenue (now occupied by the Union Pacific-Southern Pacific Railroad, formerly the S.P.&S.R.R. main line). The east side property cost $10,000, but litigation ensued over the west approaches, with the owners claiming the west side as private property. The Oregon Supreme Court found in favor of the property owners, who originally asked $100,000, and later reduced their claim to $60,000. The committee refused to pay and began condemnation proceedings before Judge Erasmus Shattuck. The jury awarded damages of $19,200. When the court denied a motion for a new trial, the owners accepted the award. During the trial, bridge construction had been going forward, with bids called for and contract let to the Bullen Bridge Co. on October 15, 1892.[204] W.B. Chase was appointed chief engineer, "on account of his recognized engineering ability and his knowledge of the Willamette River." Chase had worked for the Northern Pacific Railroad Co., and was assistant engineer on the Albina Bridge (1888 Steel Bridge) for Henry Villard, and engineer of bridges for the Oregon Pacific Railroad during its construction from Corvallis to Yaquina.[205]

[201] Now near the Fremont Bridge.

[202] Rather than a bridge at Albina, a new free ferry opened June 23 1895. The bridge committee had authority to buy the franchise, boat and landings of the old Albina Ferry Co. for $20,000. A toll ferry at Albina had been in operation for several years. The amount of travel following the establishment of the free ferry compelled the bridge committee to build a larger boat for the route. W.B. Chase, chief engineer for the 1894 Burnside, drew up the plans and specifications for the new ferry, named the *W.B. Mason*. A bridge would not arrive near this Albina site for another 78 years, when the Fremont Bridge opened. *The Morning Oregonian,* "The Burnside Bridge, Finest Bridge in the State," Jan. 1 1895, p. 20.

[203] Commissioners Journals, "Burnside and Ross Island Bridges," March 14 1923, cites a letter dated Feb. 6 1923, from the county district attorney to the planning committee for the new Burnside Bridge. The report notes that legislative act directed the location of the first Burnside Bridge, i.e., "over and across the Willamette River at such points between the north line of Section 28, township 1 north, range 1 east, and the south line of Section 3, township 1 south, range 1 east (Laws of Oregon 1891, p. 633)." The report then cites the parcels of land that the city condemned to construct the bridge.

[204] The Bullen Bridge Co. also built the truss bridge carrying water lines from Bull Run Reservoir across the Sandy River in Clackamas County. The water line bridge, opened in 1893, has not moved since its erection. It is located adjacent to and within a few feet of the Sandy River (Lusted Road) Bridge, also built by Bullen. Smith and others, *Historic Highway Bridges of Oregon*, 60.

[205] *The Morning Oregonian*, Jan. 1 1895, 20. Chase, born in 1855, died of a stroke at the age of 53 in 1908. His obituary states that he was born in Ohio and came to Oregon as a young man. Four years after completing the Burnside Bridge, he served as City Engineer under three mayors: William F. Mason (1898), W.A. Storey (1899), and

Opened 4 July 1894 after two years construction, the Burnside Street Bridge was primarily a steel, pin-connected through truss with a 385'-long swing span. It became the fourth bridge across the lower Willamette within Portland city limits and the first to be constructed as a public bridge.[206] It carried tracks for the Portland Consolidated Street Railway Co.[207] With approaches, the bridge cost $315,924.[208] It had two Pennsylvania-Petit fixed truss spans over the river, one 240'-long (west side) and one 300'-long (east side).[209] The timber trestle west approach to the bridge was 190'-7", and the east approach trestle was 692'-3". The total length of the bridge was 1,621'. The roadway was built 32' wide, with a seven foot "footway" on either side. The clearance was 43' at low water, and 18' at high water.[210] The swing span operated by steam power, with the machinery located in a steel room over the roadway, giving the operator an unobstructed view up and down the harbor and over the bridge.[211] To carry the weight of the pivot pier, 300 piles were driven into the bottom of the river to an average depth of 27', with some to 32'. The piling was cut off close to the river bed and then covered with a grillage built

---

H.S. Rowe (1900). *The Oregonian*, 27 October 1908, p. 10.

[206] Regarding the question of whether the 1894 Burnside Bridge was made of wrought iron as shown on some records, a microscopic analysis conducted of the bridge in 1920 reported: The preponderance of the trusses was made of carbon steel (0.15-0.20%). The shop and field rivets on the draw span, the east fixed span, and the lower flange of the floor beam at the west end of the east fixed span (now Lusted Road Bridge) were made of wrought iron, as was a bearing plate (location unstated) and the floor beam. It is possible the flanges on the truss members of the east fixed span were also wrought iron. "Investigation of Burnside Street Bridge, Portland, Oregon," Oregon State Highway Commission, by Conde B. McCullough, Oregon State Bridge Engineer, 1920, 13-23, Wilson Rare Book Room, Multnomah County Central Library.

[207] John T. Labbe, *Fares, Please! Those Portland Trolley Years* (Caldwell: Caxton, 1980), 80-81. Not many images exist for the first Burnside Street Bridge. Page 81 of Labbe's book shows a close-up of the bridge's deck and wooden sidewalk during an accident, with Car 82 of the Portland Railway Co. off its tracks and pointed toward the railing and the Willamette River.

[208] *The Oregonian*, 1 January 1895, p. 5. The contract price was increased from $285,000 when the bridge committee decided to build a bridge of greater width than was planned in the original estimate.

[209] Now the Bull Run and Sandy River bridges.

[210] "Willamette River Bridge Data," by Multnomah County, shows the old bridge with a sidewalk width in 1924 of 2'-6", and two car tracks of narrow gauge rail along curbs with 20'-6" centers. Another report, dated 1920, claimed the bridge had a clear roadway of 30'-6" between curbs and two sidewalks each 9'-9" overall, having an effective width of seven feet. The latter stated the roadway carried two lines of narrow gauge street car tracks placed next to the curbs, with a 10'-wide single vehicular path between the tracks. An elevation dated 1923 shows 30'-6" between curbs. At the time of the 1920 report two lines were crossing the bridge: Rose City Park, a Class 600 car and Beaumont, a Class 100 car, or City and Suburban standards. "Investigation of Burnside Street Bridge," 1-5; "Multnomah County Oregon Burnside Bridge Removal of Old Structure Elevation and Plan of Existing Structure 1923," dated Sept. 9 1923, sheet no. 3, Files, Multnomah County, Bridge Section.

[211] The 1894 Burnside was reputed to be "the best of the wide wagon bridges in the United States," and "gave ample room for four teams to travel abreast at one time." "Free Bridge Opens," 4 July 1894, *The Oregonian*, 1.

of 12"x12" timber. The grillage structure was 44'x60' at the base and maintained this size for 15' upward. It then gradually became smaller by steps 1'x2' deep on the north and south ends until its dimensions were square, 44'x44'. The depth of the grillage was 41', with its top 16' below low water. A steel drum of 1-1/2" steel, 43' in diameter and 14-1/2" high, rested on the grillage. The drum was filled with concrete in layers. Above this base was the masonry pier, 42' in diameter and about 33' high, finished with heavy coping and stone. The bridge had five piers in all, with the western pier designated as A, and the one on the east abutment, a platform pier, known as E. Piers B and D on either side of the pivot pier (C) and draw rest were of the cushion variety, and defined the channel of the river. The spans were all of steel and some wrought iron, except the roadway floor, made of planed yellow fir. On each end of the bridge was a large cast iron plate that bore, in raised gilt letters, the names of the bridge committee, the engineer and the contractor.[212] Harry Stutsman, identified as an engineer who had been employed as a Portland fireman, was hired as the bridge's first operator, with F.G. Forbes assisting. During its life, the 1894 Burnside opened 10,000 times per year for river traffic.[213] The first Burnside Bridge was declared, at the end of its life, "a menace to life and property"[214] However, it did not close until 1924, when construction began for the extant Burnside Bridge. A speed restriction implemented in 1903 ordered that no electric street car could cross any Multnomah County bridge faster than five miles an hour, especially relevant for Burnside Bridge, according to at least one traveler on the bridge during the early 1920s.[215]

---

[212] *The Oregonian*, 2; *The Morning Oregonian*, 5 July 1894, 6. The name plates for the first Burnside Bridge are lost.

[213] See McCullough, "Investigation of Burnside Street Bridge," 15 May 1920, 4-5. This 44-page report, plus drawings, surveys the 1894 Burnside Street Bridge. Conducted at the request of the Multnomah County Commissioners, the purpose of the report was to determine the physical condition of the structure, its safe carrying capacity, and feasibility of repairing the bridge to extend its life, and to evaluate what repairs or replacement parts were necessary for immediate safety. The report found that the trestle structures forming the east and west approaches to the bridge were worn out; that the tipping and settlement of the channel piers resulting from collisions had made the piers unstable; that bridge operations were unreliable due to faulty loading of the bridge's drum, supporting the swing span; that the floor system and truss members had rusted beyond repair; and that the superstructure and fixed span steel did not meet modern standards, with the capacity of the superstructure reduced by "at least 25%." The report also commented on the bridge's "dangerously narrow vehicular path" that was confined to the center of the roadway between street cars, and about how the entire bridge was overstressed.

[214] The 1894 Burnside was closed temporarily in January 1923 during severe flood conditions out of concern for its durability. *Growth of a City*, 260. Also see "Old Burnside Bridge, 28 Years Old Proves Faithful Servant of Portland," *The Sunday Oregonian*, 26 November 1922, n.p.

[215] See Appendix 2, Seeb DeBonney, interview with Sharon Wood Wortman, 16 September 1999. After my presentation about Portland bridges at a local retirement center, DeBonney introduced himself and told of his youthful experiences with the shaky 1894 Burnside Bridge; declaration dated 10 July 1903 and signed by Judge Lionel Webster and Multnomah County Commissioners F.C. Barnes and M. Showers, Files, Multnomah County, Yeon facilities.

**Discussion of Bridge Building and Other Construction in Portland and the U.S. During the 1920's**

To say the 1920s was a booming construction decade is a gross understatement. In Portland in 1926, the Vista Avenue Viaduct, a high concrete arch, opened across Jefferson Street Canyon, allowing better access to the West Hills. Farther south and east, in Clackamas County, four major new bridges opened, and three recycled bridges were re-erected in 1926 as well. In addition to relocation of the trusses from the 1894 Burnside, the 1904-built Ford Street Bridge, a deck-truss structure, was moved in 1926 to S.W. Terwilliger in Portland (to make room for the new Vista Avenue Viaduct).[216] The four new Clackamas County bridges included a 300'-long reinforced concrete deck arch, designed by Conde B. McCullough across Oswego Creek and opened in 1920[217]; a 360' steel half-through arch across the Willamette River at Oregon City, opened in 1922[218]; a 220' steel through-truss, a major crossing of the Clackamas River on the main route from Oregon City to Portland when it opened in 1921[219]; and a Strauss-patented overhead counterweight bascule bridge with a 45' span that provided pedestrian access across the Willamette Falls Navigational Locks, also in 1922.[220] Upriver from Oregon City, the Southern Pacific Railroad Bridge, originally designated Willamette Structure 743.27 when it opened in 1910 across the Willamette River between Lake Oswego and Milwaukie, saw its Milwaukie, or east end, replaced with a 668' open-deck trestle finished in 1927.[221] Just east of Multnomah County, the Bridge of the Gods, a 706' steel through cantilever truss was erected in 1926 across the Columbia River.[222] Also in the 1920s, voters approved the construction of the Longview Bridge, north of Portland, a 1,200' steel through cantilever truss (the longest

---

[216] The Ford Street Bridge, owned and maintained by the City of Portland until 1990 when ODOT assumed ownership, remained at the Terwilliger location until ODOT replaced it with a wider concrete bridge in 1993. Kolani Roberts, "South Burlingame Neighbors Celebrate New Terwilliger Bridge," *The Oregonian*, 19 Dec. 1993, C4; "Correction," ibid., Feb 24 1994, A2; "Terwilliger Bridge Work Ends with Opening of I-5 On-Ramp," ibid., Dec. 10 1994, B2.

[217] Smith, *Bridges of Oregon*, 210.

[218] Smith, *Bridges of Oregon*, 96.

[219] Smith, *Bridges of Oregon*, 276.

[220] A contract plan, dated 6 November 1925, shows a hand-printed title block headed "45'-0" Span Strauss Trunnion Bascule Bridge over Canal Lock Chamber No. 4 Oregon City Locks - Oregon for Crown Willamette Paper Co., Union Bridge Co. Contractors, Pacific Iron Works, Portland, Oregon, J.F. Kable." From the private collection of Sharon Wood Wortman and Ed Wortman.

[221] Wood Wortman, *The Portland Bridge Book*, 91.

[222] Smith, *Bridges of Oregon*, 77.

cantilever span in the U.S. when it opened), designed by Joseph Strauss and opened in 1930.[223] They also approved St. Johns Bridge, a suspension bridge that would open in 1931 across the Willamette about seven miles north of the Central City waterfront.[224]

Major construction in Portland in the 1920s was not confined to the Burnside and other bridges. During the early part of this decade, the Port of Portland widened the shipping channel at the mouth of the Willamette River at its confluence with the Columbia River and built a 1,200'-long dike. Later in the decade, the Port filled the main Willamette River channel east of Swan Island and, at the same time, created a new 2,000'-wide channel on the island's west side. Some of the 50 million cubic yards of dredged spoils were used to fill 1,500 acres of flanking lowlands (including 900 acres in the Guilds Lake area), to raise Swan Island to its present elevation, and to create the causeway that connects the island with the east shore at North Going Street, also built then.[225] Swan Island Municipal Airport, the city's first airport, opened on Swan Island in 1927. The voters of the city of Portland and Multnomah County authorized bonds in May 1926 totaling $4 million for extending and widening streets—among the projects the reconstruction and relocation of Canyon Road (now U.S. 26) on an easier grade between Portland and the Tualatin Valley.[226] Construction in Portland during the 1920s was indicative of bridge and other construction projects on a national scale during this era. These include San Francisco's Hetch Hetchy water supply system, St. Louis's $12 million water supply system, the Chicago Drainage Canal, Muscle Shoals dam and power house, Chesapeake and Delaware Canal, Philadelphia and New York subway systems, Holland Tunnel (including the ventilation building over the Manhattan end of the tunnel), Catskill Aqueduct System, Great Lakes-St. Lawrence development, the Rincon Seawall (on the coast route from San Francisco to Los Angeles), Cascade Tunnel on the Great Northern Railway, lower deck of Wacker Drive in Chicago, the Snake River dam in Idaho, and the new harbor on Lake Ontario. At the same time, several notable bridges were being built or approved nationwide, among them the Port Authority bridges between New York and New Jersey (Arthur Kill); the Benjamin Franklin Bridge in Philadelphia; Carquinez Strait, across the Sacramento River near San Francisco; Peace Bridge, across the Niagara River; the Seventh Street Bridge over the Allegheny in Pittsburgh; the first cantilever-type concrete bridge in Michigan, the Raisin River Bridge at Monroe; a new Northumberland Bridge over the Susquehanna; the George Washington Bridge in New York City; Marble Canyon Bridge in Arizona; the Royal Gorge Bridge in Canon City, Colorado; and

---

[223] Smith, *Bridges of Oregon*, 212.

[224] See HAER No. OR-40; *Portland Bridge Book*, 1-6; *Historic Highway Bridges*, 113.

[225] "Large Channel-Dredging Project at Portland, Ore.," *Engineering News-Record* 95 ( 17 December 1925), 982. Both Guilds Lake and Swan Island are located to the north of the Central City waterfront.

[226] Ben A. Eddy, Assistant City Engineer, "Portland and Multnomah County to Expend $4,000,000 Additional for Constructing Arterial Highways and Widening Streets," *Western Construction News*, 10 July 1926, 24.

the Cappelen Memorial Bridge in Minneapolis-St. Paul. Perhaps one of the greatest engineering efforts of the 1920s was that of Joseph Strauss, who was proposing in 1924, the same year Burnside Bridge began construction, to span San Francisco's Golden Gate with a combination cantilever-suspension bridge.[227]

[227] *San Francisco Chronicle*, 16 May 1924, n.p.; "Highway Bridge Construction Activity in 1925," *Engineering News-Record*, 14 January 1926, 79; "Status of the Major Engineering Projects," *Western Construction News*, 85; "Outstanding Construction Projects of 1926," ibid., 1 January 1–30 June 1927, Vol. 98, 65-75; Files, City of Portland and Multnomah County.

## Bibliography

Abbott, Carl. *Portland Planning, Politics, and Growth in a Twentieth-Century City.* Omaha: University of Nebraska Press, 1983.

*American City Magazine.* October 1926.

Becker, Donald N. "Development of the Chicago Type Bascule Bridge." *American Society of Civil Engineers.* February 1943.

Bonney, Bart. Telephone interview with Sharon Wood Wortman, 10 January 1988.

"Columbia River Channel Improvement Study." U.S. Army Corps of Engineers. Portland District, August 1999.

Crutcher, Lewis. Interview with Sharon Wood Wortman, 11 September 1996.

DeLony, Eric. *Landmark American Bridges.* New York: American Society of Civil Engineers, 1992.

Dotterrer, Steve. Telephone interview with Sharon Wood Wortman, 5 May 2000.

*Engineering News-Record.* 19 June 1924; 17 December 1925; 9 July 1925; 8 October 1925; 14 January 1926; 11 June 1928; 16 July 1931; 19 December 1929; 24 November 1932.

Forbes, Bill. Interview with Sharon Wood Wortman, 17 May 2000.

Garraty, John A. and Mark C. Carnes, eds. *American National Biography.* New York: Oxford University Press, 1999.

Gebhardt, Franziska. Telephone interview with Sharon Wood Wortman, 15 November 1992.

Ghezzi, Stan. Interview with Sharon Wood Wortman, 16 May 2000.

Hidy, Ralph W. and others. *The Great Northern Railway.* Boston: Harvard Business School Press, 1988.

"Historic Vegetation of the Willamette Valley." Compiled and published by Nature Conservancy of Oregon, Natural Heritage Program, 2000.

Hool, George A. and W.S. Kinne, eds. *Movable and Long-Span Steel Bridges*. New York: McGraw-Hill, 1943.

Hovey, Otis Ellis. *Movable Bridges*. 2 vol. New York: J. Wiley & Sons, 1926 and 1927.

Labbe, John. *Fares, Please! Those Portland Trolley Years*. Caldwell: 1980.

Lester, Tony. Interview with Sharon Wood Wortman, 1 May 2000.

Lester, Tony. Telephone interview with Sharon Wood Wortman, 3 May 2000.

Lindenthal, Gustav. *Transactions of the American Society of Civil Engineers*. Paper No. 1496, Vol. 85. New York: American Society of Civil Engineers, 1922.

________. *Transactions of the American Society of Civil Engineers*. Paper No. 1594, Vol. 95, 1931.

Locht, Fred. Interview with Sharon Wood Wortman, 2 July 2000.

Lockley, Fred. "Charles F. Swigert," *History of the Columbia River Valley, From the Dalles to the Sea*. 3 vol. Chicago: S.J. Clarke, 1928.

Mabey, Matthew A. and others. "RLIS Relative Earthquake Hazard Map, Portland, Oregon 7 ½ Minute Quadrangle." Portland: Oregon Department of Geology and Mineral Industries, and Metro, 1990 and 1997.

MacColl, E. Kimbark. *Merchants, Money, & Power, the Portland Establishment 1843-1913*. Portland: Georgian Press, 1988.

MacColl, E. Kimbark. *The Growth of a City, Power and Politics in Portland, Oregon 1915 to 1950*. Portland: Georgian Press, 1979.

*Morning Oregonian*. 5 July 1894, 1 January 1895.

Office of the Secretary of State. *Oregon Blue Book 1999-2000*. Salem, OR, 1999.

O'Neil, Patrick. "Strauss, Joseph Baermann," *American National Biography*. New York: Oxford University Press, 1999.

Oregon. 1913 Oregon Law, Chapter 141 (became O.C.L.A., Secs. 100-3270 to 100-3275)

Oregon. 1919 Oregon Law, Chapter 338, Sec. 1.

*Oregon Daily Journal.* 27 January 1923; 10 March 1923; 2 July 1924; 2 April 1940; 14 June 1945.

*Oregon Journal.* 27 January 1923; 29 December 1937; 7 December 1945; 13 October 1946.

Oregon State Marine Board and Oregon Parks and Recreation Department. "Willamette River Recreation Guide." Salem, OR, 1998.

*Oregonian.* 4 July 1894; 1 January 1895; 27 October 1908; 27 January 1923; 18 February 1923; 31 October 1926; 26 January 1936; 22 March 1962; 5 March 1964; 18 March 1965; 8 December 1979; 12 October 1983; 25 July 1992; 19 December 1993; 19 June 1998.

Orr, Elizabeth L. and William N. Orr. *Geology of the Pacific Northwest.* New York: McGraw-Hill, 1990.

Patrie, Pam. Telephone interview with Sharon Wood Wortman, 9 May 2000.

Petroski, Henry. *Engineers of Dreams, Great Bridge Builders and the Spanning of America.* New York: Knopf, 1995.

Pickthorne, David. Telephone interview with Sharon Wood Wortman, 3 May 2000.

Plowden, David. *Bridges: The Spans of North America.* New York: Viking Press, 1974.

*Portland Telegram.* 27 January 1923; 10 March 1923; 28 May 1926; 29 May 1926.

Pratt, Austin. Telephone interview with Sharon Wood Wortman, 15 May 2000.

Reeve, A.B. "The Story of Strauss Bridges." Chicago, The Strauss Bascule Bridge Co., June 1925.

*San Francisco Chronicle.* 16 May 1924.

Skinner, Larry. Telephone interview with Sharon Wood Wortman, 12 April 2000.

Smith, Bill. Telephone interview with Sharon Wood Wortman, 5 April 2000.

Smith, Dwight A., James B. Norman and Peter T. Dykman. *Historic Highway Bridges of Oregon*. Portland: reprinted by the Oregon Historical Society Press, 1989.

Snyder, Eugene. *Portland Names and Neighborhoods*. Portland: Thomas Binford, 1979.

Totten, Craig. Interview with Sharon Wood Wortman, 25 January 2000.

Tunnard, Christopher and Henry Hope Reed. *American Skyline*. New York: Houghton Mifflin, 1953.

Vanderleeden, Frits. *The Water Encyclopedia*. Michigan: Lewis Publishers, 1990.

Waddell, John A. Low. *Bridge Engineering*, 2 vol. New York: J.A. Wiley & Sons, 1916.

*Western Construction News*. 10 January 1926; 10 July 1926; May 1936.

Wood Wortman, Sharon. *The Portland Bridge Book*, 2nd ed. Portland: Oregon Historical Society Press, 2000.

Wortman, Ed. Interview with Sharon Wood Wortman, 25 May 2000.

Plates Index

1. Photograph, Concrete Encasement of Burnside Bridge East Approach Steel Girders. ca. 1926 (Courtesy Steve Dotterrer)

2. Photograph, Erection of Burnside Bridge Bascule Span Leaves, ca. 1926 (Courtesy Multnomah County)

3. Drawing "Details of Main River Piers"

4. Photograph, Widening of Burnside Street ca. 1925-1926 (Courtesy Steve Dotterrer)

5. Photograph, Trolley Poles and Trolleys on the Bridge ca. 1926 (Courtesy Steve Dotterrer)

6. Photograph, Trolley Poles Equipped with Double Wires, ca. 1940 (Courtesy Steve Dotterrer)

7. Elevation and Plan, 1894 Burnside Bridge

**PLATE 1**

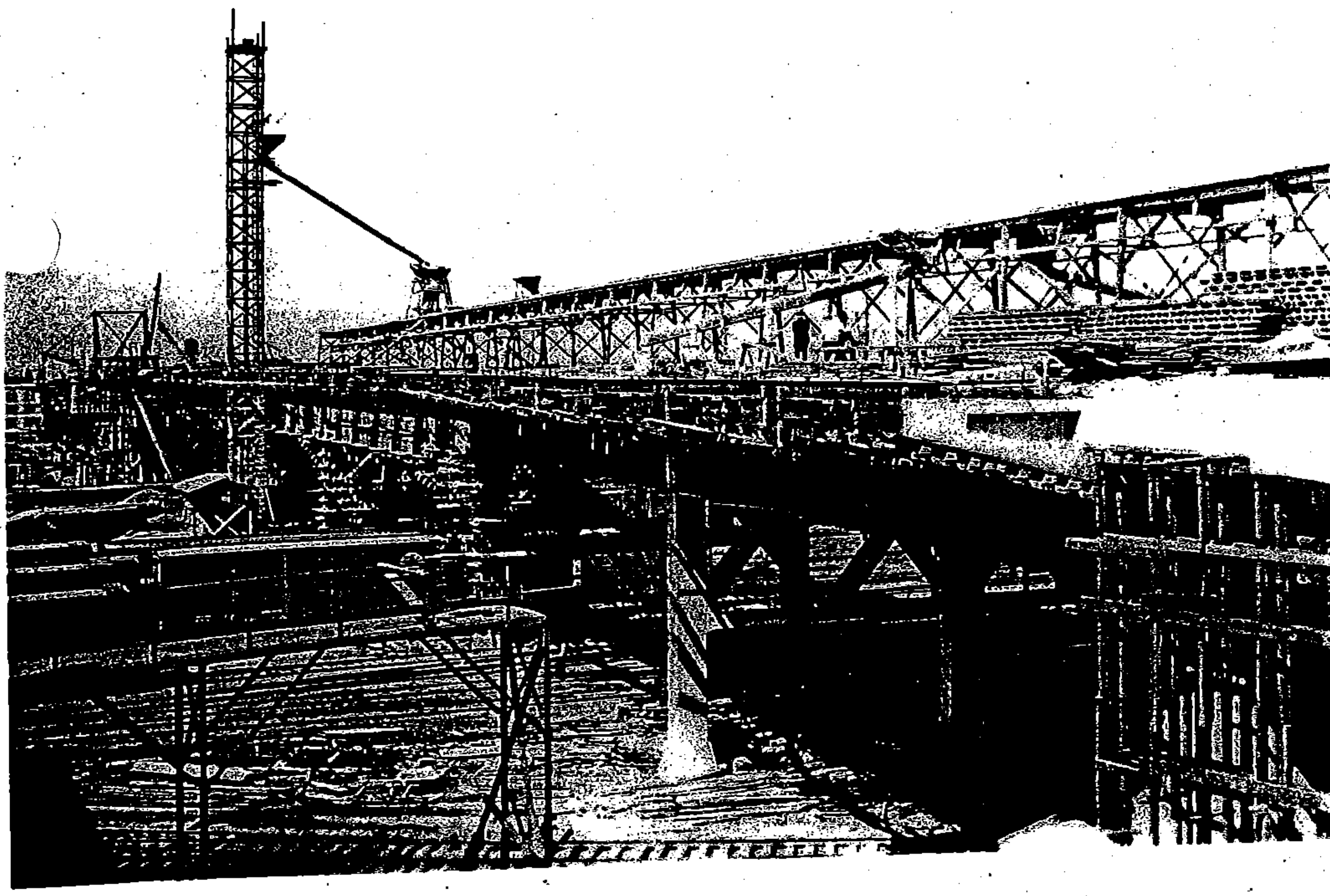


**PLATE 2**

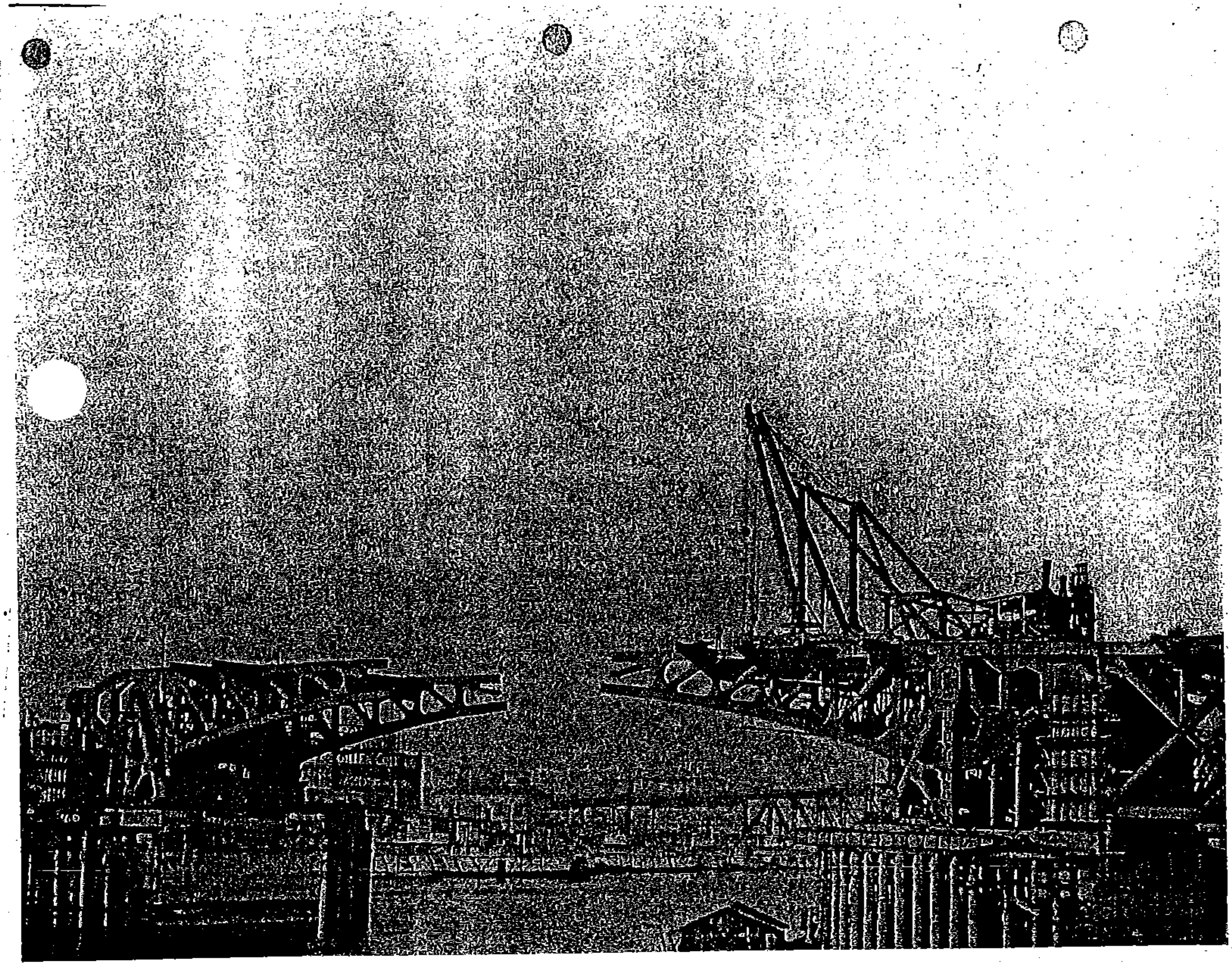
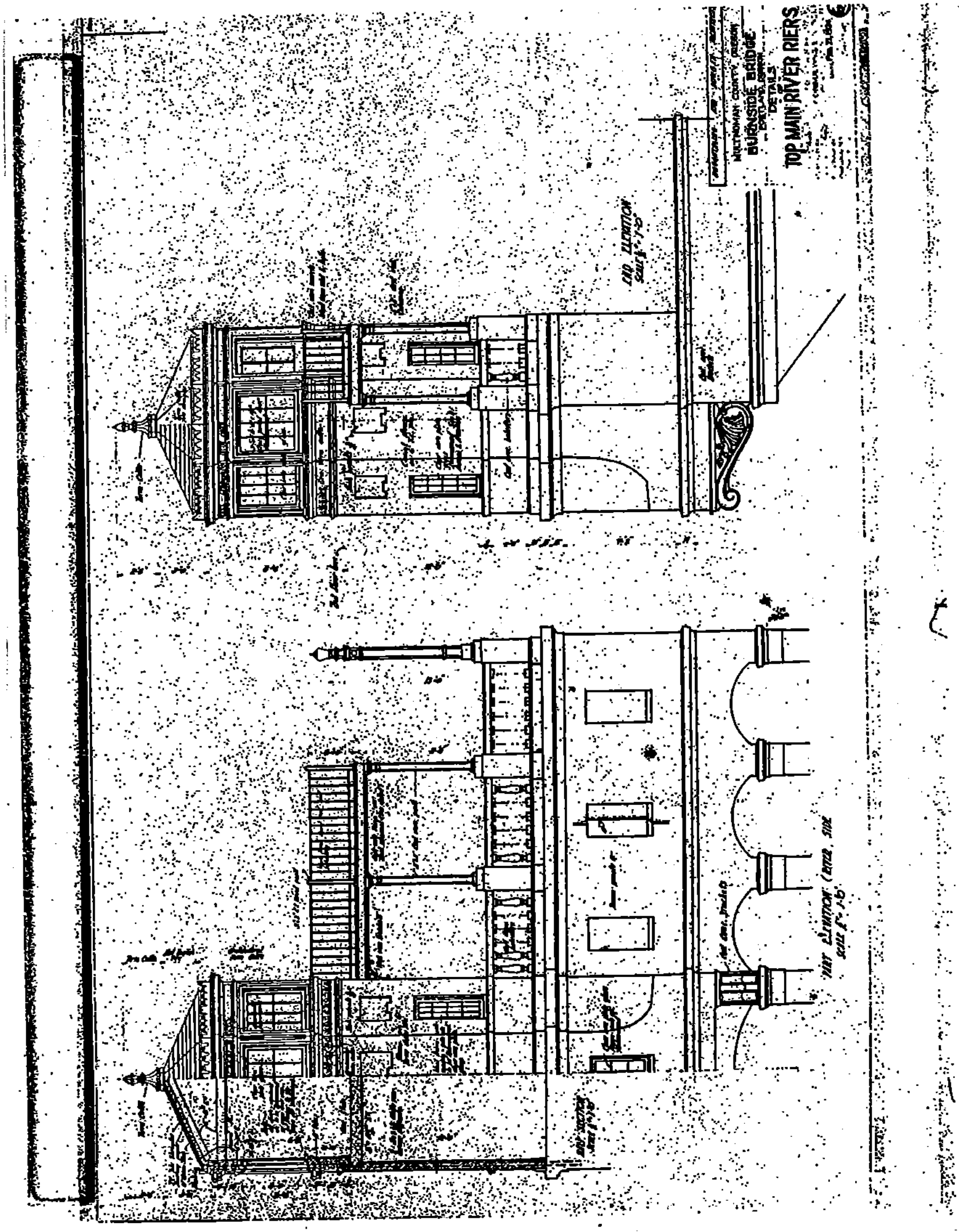


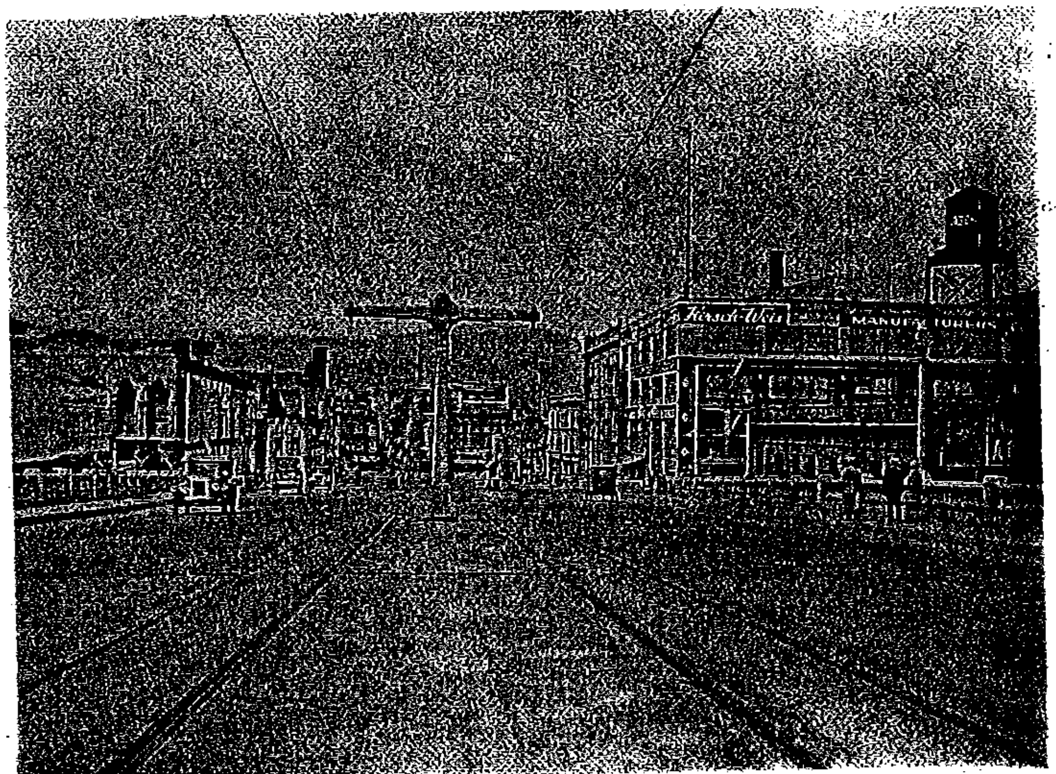
**PLATE 3**



## PLATE 4

**Burnside Street widening ca. 1925-1926. Looking East from S.W. First (new site of Max light rail and Saturday Market) Derrick on right.**

**PLATE 5**



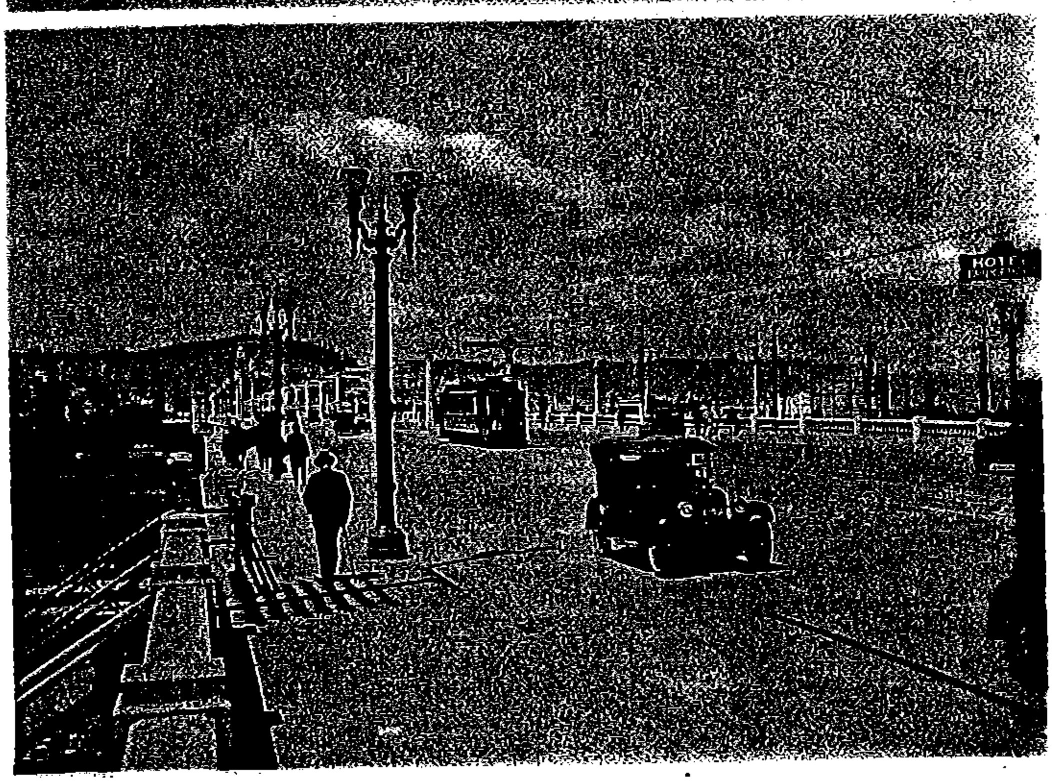


**PLATE 6**

**PLATE 7**