VANCOUVER-PORTLAND INTERSTATE BRIDGE
(Columbia River Interstate Bridge)
Interstate 5 spanning the Columbia River
Vancouver
Clark County
Washington

HAER No. WA-86

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WRITTEN HISTORICAL AND DESCRIPTIVE DATA

PHOTOGRAPHS

HISTORIC AMERICAN ENGINEERING RECORD
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VANCOUVER-PORTLAND INTERSTATE BRIDGE
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Location:	Interstate Route 5, spanning the Columbia River, between Vancouver, Clark County, Washington, and Portland, Multnomah County, Oregon UTM: 10/525200/5050950 10/525590/5051880 Quad: Portland, Wash.
Date of Construction:	1915-17 (Northbound) 1956-8 (Southbound)
Engineer:	Waddell & Harrington (1917) Oregon Department of Highways (1958)
Fabricator:	United States Steel Products Company (superstructure) (1917) Guy F. Atkinson Company, San Francisco (1958)
Owner:	Originally Clark and Multnomah counties. From 1929, Oregon and Washington Department of Highways. From 1977, the State Department of Transportation for both Oregon and Washington.
Present Use:	Vehicular and pedestrian traffic
Significance:	The original 1917 bridge represented an enormous financial and engineering accomplishment, shared by the counties of two states. It was designed by the renowned engineering firm Waddell & Harrington, leaders in the field of vertical lift bridge design in the twentieth century. The 1958 bridge was built as a twin structure to the original. The piers of this bridge were assembled from hollow precast segments, a (then) recently patented technique.
Historian:	Jonathan Clarke, August 1993.

History of the Bridge

Between 1915 and 1917, one of the largest bridges ever built up until this time was constructed over the Columbia River. But the spanning of this river - second only to the Mississippi for length and volume, and forming the boundary between the States of Oregon and Washington for 250 miles above its confluence with the Pacific Ocean at Astoria, Oregon - was more than a feat of engineering. Its construction signified an unprecedented degree of co-operation between the Citizens of Multnomah County, Oregon and Clarke County, Washington who, dissatisfied with the inadequacies of the existing ferry system - the only connecting link for pedestrians and automobiles in this vicinity - eagerly rallied to the cause of an interstate bridge campaign. The bridge paved the way for a new era in automobile transportation in the region, an era that developed so rapidly that a second, almost identical structure had to be built alongside it some forty years later to keep pace with the enormous increase in interstate traffic.[1]

The chief exponent in the enormous campaign that preceded the construction of the bridge was J.H. Nolta, former president of the Portland Commercial Club and of the Oregon Legislative Assembly. As early as 1908 he underscored the need for an interstate bridge, yet it would be another four years before these formative ideas were translated into serious proposals.[2] The obstacle was the need to obtain financial backing for the project: his effort to secure state appropriation for even the amount needed to cover a preliminary survey and cost estimate at the 1911 session of the state legislature proved ineffectual.[3]

The following year marked a leap-forward in the realization of the bridge because of both the formal involvement of the Vancouver Commercial Club, and the fact that an authoritative cost estimate for the venture was at last available. The latter, furnished in February 1912 by Ralph Modjeski, the eminent Chicago bridge engineer, put the cost at $1,930,000.[4] To many, this figure - based on a steel bridge 1360' long, made up of seven spans and a bascule, and having a 24' roadway between curbs - was unnecessarily and impossibly high, and would, furthermore, jeopardise what chance they had of securing funding from either state legislature.[5] Nolta's reply to such criticism, voiced in a meeting held at the Vancouver Commercial Club on 23 February, was in hindsight remarkably perceptive:

> We should not build the bridge for today, next week or next year, but for the next 40 years. At the end of that time, predict, this bridge would have as much traffic as all the bridges in Portland.[6]

The proposed bridge, Nolta argued, would play such a crucial role in the economic development of Oregon and Washington that a large financial investment was justifiable. Moves were already afoot to construct an extension of the Pacific Highway between Vancouver and Seattle, and the interstate bridge "would be the gateway ... connecting the two states." The great manufacturing and commercial cities of Tacoma and Seattle would be more closely linked to Portland, the manufacturing district on the Peninsula, through which the bridge would pass, would benefit, and automobile tourists from the east, tempted by the scenic splendour of the Pacific Northwest would be able to travel, and hence spend, with ease.[7]

Support for the bridge grew from strength to strength on both sides of the Columbia. Nolta and other prominent men organised a meeting between the respective commercial clubs for March 1, 1912, so that the campaign could be officially launched. Some 200 members of the Vancouver Commercial Club, headed by their president Lloyd Dubois attended, and joined with members of the Portland Commercial Club in espousing the cause. Two committees were appointed, one from either club. The purpose of the Portland body was to raise half of the $5,000 deemed necessary to fund a more in depth preliminary survey that would establish whether a bridge across the Columbia at Vancouver was indeed feasible. Vancouver had by this stage already procured its half of the sum by subscriptions in Clarke County.[8]

Organizing a three day canvass, the Portland Committee successfully secured the $2500 by donations from local dignitaries and companies.[9] On 23 March 1912 it appointed Frank B. Riley, C. C. Colt and J. H. Nolta as an engineering committee to work with a similar body from Vancouver in awarding the contract for the survey. Even by this stage the proposed project had aroused considerable interest from engineers across the continent: Riley proudly claiming that "we in Portland and Vancouver both have received letters from engineers in nearly every state offering their bid on the preliminary survey."[10] In the event it was Modjeski, who, having already provided a rough estimate and other data, won the contract.

A meeting of the Joint Pacific Highway-Columbia Bridge Committee on 23 April 1912, held at the Portland Commercial Club, requested of Modjeski a preliminary report on what was christened "The Pacific Highway Bridge." The engineer submitted this in early September of the same year: it included estimates based on the main span having either a 36′ or a 24′ wide roadway between curbs, and recommendations as to the best location for the bridge. In terms of the latter, the chief determining factors were the need to avoid interference with the ferry service during construction and operation of the draw span, and the desirability

of maintaining as direct a line of communication with the main streets on either shore. The main bridge - that portion crossing the Columbia River - was to consist of nine 320' fixed Pennsylvania Petit truss spans and a swing span having two openings of 200', of the same configuration. Modjeski reasoned that a swing span, in contrast to a bascule span, provided two openings, the one nearer to the (Vancouver) shore facilitating passage of boats mooring at the adjacent docks, whilst the other providing access for general river traffic. The Oregon approach spans crossing the secondary channels of the Columbia were to be made up of steel girder spans.[11] Two ornamental reinforced concrete pylons were to announce the start of the main bridge at the Vancouver side, intended to "make the structure as a whole handsomer and more attractive than the mere utilitarian bridges."[12] The total cost of the main bridge with a 36' roadway was estimated as $1,987,200; the equivalent cost based on a 24' roadway $1,660,700. The cost of the respective approach spans was put at $500,000 and $420,000.[13]

On 5 September 1912 Modjeski presented his findings to a bridge committee meeting at the Portland Commercial Club.[14] Probably as a result of widening support from important business people in Vancouver, Seattle and Tacoma, it was decided to back the larger, more expensive bridge option. The funding for this was anticipated as coming from three sources. Multnomah County and Clark County would appropriate $750,000 and $25,000 respectively - Multnomah County shouldering the larger amount to cover the cost of the proportionately greater length of approaches within its boundary - making a total of $1,000,000. The two states would then bear the rest of the cost, barring that which the Federal Government was willing to pay.[15]

To expedite progress of the financial side of the campaign, a separate steering committee composed of Frank B Riley, J.H.Nolta, Whitney L. Boise, W.M. Killingsworth, John F. Logan, E.G. Crawford and M.G. Munly was appointed. Seeking the aid of the 1913 Legislature, and after several trips to Salem, they secured a hearing in the House for an enabling act drafted by the lawyer members of the Portland Commercial Club. The purpose of this bill was to sanction the issuance of bonds to pay for the bridge, with the provision that the state pay the interest on those issued. On 15 February 1914, following an inspection of the proposed site by a joint committee from the legislative assemblies of Oregon and Washington, the bill passed first the house, and then a few days later, the senate.[16]

While the passing of the bill was achieved with relative ease, the selling of the bridge bonds was, for Multnomah County at least, far from straightforward. The *Vancouver Columbian* declared somewhat superciliously on 8 October 1914 that "Clarke county is

ready with its share of the money ... any minute that Multnomah county shows signs of being alive."[17] Bewildered by the apparent delay in the sale of the Multnomah bonds, the Vancouver side of the bridge committee had seen fit to send a delegation to Portland the previous month to investigate the situation over there.[18] It transpired that the commissioners of Multnomah county were not able to sell their bonds to the school fund of the state and consequently were dependent upon selling them in small denominations to local people - who would, despite growing support for the project - nevertheless require some warming to the idea. Bids for these bonds were not opened until 5 November, and it would seem that the sale was not entirely successful, for it was not until 14 January of the following year, with Multnomah County having issued $1,250,000 of bonds and Clarke County $500,000, that advertisements for bids from contractors appeared in various newspapers.[19]

The bids for the construction of the Interstate Bridge - the name accorded by the press by this stage - opened at two O'clock 23 February 1915 at the Multnomah County Courthouse in Portland. The "long awaited" plans and specifications prepared by consulting engineers Harrington, Howard and Ash, detailed 14 spans across the main river, 11 across Oregon slough and four across the Columbia slough. The *Vancouver Columbian* envisioned it becoming the largest highway bridge in the world. No firm commitment was provided for as to the type of movable span however: this - whether swing span or vertical lift - was left dependent upon the prices asked in the bids.[20] In the event, bids were received on both types of span, and it was found that the lowest bid for the bridge, including a lift span was some $70,000 less than the lowest bid for the bridge including a swing span. The choice of the former was dictated not only by the lower first cost, but by Multnomah County's experience of operating bridges of both types: lift bridges enjoyed a comparatively lower cost of both operation and maintenance.[21]

Because of the enormous scale of the whole project, it had been decided to sub-divide the total contract into twelve units. A significant proportion of the 24 contractors who submitted bids were local to Oregon and Washington, and the majority of these were successful on account of the unexpectedly low prices they were able to offer.[22] The major component of the project, the manufacture and delivery of the superstructure steel work for the main bridge was awarded to the United States Steel Products Co. The Northwest Steel Co., of Portland was appointed the same task in relation to the Slough bridges. Porter Bros., of Portland, secured the contract for the erection and painting of the superstructure. The Pacific Bridge Co.,of Portland were to be responsible for all the substructure work, and another Portland firm, the Warren Construction Co., were charged with placing the

concrete floor and pavement. The construction of the principal portion of the embankments and their concrete protection was awarded to the Tacoma Dredging Co., of Tacoma, Washington, while the second embankment was to be built by the Standard American Dredging Co., of Oakland, California.[23]

Remarkably, the aggregate contract price covering the total construction was some $230,000 less than the estimated figure of $1,750,000. The chief reason for this was the large number of duplicate spans, and the detailed manner in which they were described in the plans and specifications: consequently the steelwork manufacturers were able to offer extremely low prices.

Actual construction of the bridge began on the afternoon of 6 March 1915. Hundreds of people from Vancouver and Portland watched as Rufus C. Holman, chairman of the bridge commission, dug the first shovelful of sand at the place where the first pier was to be built. To further mark the inauguration of work, the shrill whistle of the "Ajax" dredge was sounded, and then echoed by steamers in Vancouver harbour and shouts and applause of those assembled. There followed an afternoon of speech-making by prominent figures in the bridge campaign, city and county officials, the engineer in charge of construction and one of the contractors:

> Each speaker at the conclusion of his remarks grasped the shovel and dug several shovelsful of sand, and at the conclusion of the formal program both men and women by the score took turns in shovelling sand that they might feel they had participated directly in the construction of the great bridge.

It was a truly joyous and momentous occasion, signalling to those present the closer union in both business and friendship between the two cities that the bridge would ultimately bring.[24]

In order to meet the completion deadline of 31 October 1916, the work of the various contractors was staggered so that each of the operations would proceed consecutively, without hindrance to any other.[25] Much of the initial operation of making the substructure, entailing the excavation of each pier site, construction of timber cofferdams, temporary trestles and piling supports for the piers, and the dredging of various channels was completed by July 1916 - a month ahead of schedule.[26] The first shipment of structural steel for the superstructure arrived on 23 July 1915, from the works of the Northwest Steel Co., in Portland. A few days later seven car loads arrived from the American Bridge Company's plant at Gary, Indiana. This, and subsequent shipments were unloaded in Vancouver, assembled at purposefully built assembling docks below the Northern Pacific

Railway Company's freight docks, and floated into place on the piers by barge.[27] By the end of the following month, the first of the 13 steel spans was almost completed, supported on temporary trestles via a set of steel rollers from which it was to be rolled down on to barges and then floated into place on two of the piers.

The floating of the movable span - a vertical lift span - the following year marked the only near calamity of the entire project. On the afternoon of 26 April, as the span was being positioned over its piers, a sudden storm forced it upstream some 60', tearing it loose from three tugs and smashing it into a derrick scow and piling dolphin. This equipment almost certainly prevented its over-turning, enabling it to be pulled back into permanent position the same evening.[28] The placing of the final span on 28 December 1916 was, by contrast, accomplished with ease in a slight breeze.[29] Nevertheless, by this stage the project was a month overdue, and it was not until February 1917 that the street car tracks and paving, and other final tasks were completed.[30]

On 15 February 1917, "with brilliant formality, the Interstate bridge ... swung into its niche in the great scheme of commercial and industrial development in the Northwest."[31] The official dedication took place on the lift span, when, at 12.30 the two daughters of a Multnomah and Clarke County official untied a ribbon, causing a rope that divided the thrall of Portland residents from the equally joyous crowd from Vancouver, to drop. At the same time the mayors of the two cities and the Governors of the two states clasped hands with one another, and four flags were unfurled from the towers of the lift span, all to the accompaniment of "The Star Spangled Banner", performed by the Portland Police Band. Then, two street-cars leading a procession of decorated automobiles stretching back for over a mile back into Portland made their way to Vancouver, passing a similarly sized contingent headed in the opposite direction.[32]

At two o'clock, hundreds of people stood in a circle around a decorated bandstand to listen to the programme of speeches and music. Rufus Holman reflected the overriding sentiments of the day in his opening address:

> Let us consider this bridge not only a necessary thing of great utility, but a monument commemorating the unity of interests between the states of Oregon and Washington. This is an enterprise demonstrating what we can do by co-operation.[33]

It was a gala day of possibly unrivalled proportions in the history of the two cities; even the old ferry boat which saw its

last day of operation before being officially retired "tooted a mournful salute to the cheering thousands ...".[34] Not until late that night was the bridge free from the moving throng of vehicles and pedestrians, such was the eagerness of people to gain the distinction of having crossed the bridge during its first day of its opening.[35]

To collect the revenue for payment on the $1,683,000 bond issue used to finance construction, it had been decided that the bridge would collect tolls in its initial years of operation. On its opening day it earned $287.75 on the 5-cent toll and in the first nine months of 1923 tolls on the bridge totalled $223,223 - exceeding the figures for the corresponding period of the previous year by some $49,000.[36] Within twelve years of opening it had paid for itself.[37]

In 1927 an act of the legislature was passed, giving the state of Washington the right to acquire toll bridges by purchase or by condemnation. Repealing all previously enacted state laws under which toll bridges had been built, it provided for the owners of five existing toll bridges to submit to the department of public works annual reports on their revenues, costs of repair and operation. It also provided for the regulation of all tolls collected. The five bridges, detailed in a specific report, were the Pasco-Kennewick bridge, the Pasco-Burbank bridge, the Metaline Falls bridge, the Nasel River bridge and the Vancouver-Portland bridge. The Interstate bridge was subject to a further act, enabling direct negotiations with the state of Oregon so that it could acquire part ownership of the structure, provided it was maintained and operated without tolls on private vehicles.[38]

On January 1, 1929 Oregon and Washington purchased the interstate bridge from Multnomah County and Clarke County and abolished the tolls. Washington paid Clark County $250,00 for its share of the structure and Oregon paid Multnomah County $125,000.[39] This move, and the enabling legislation that preceded it came about at a time of national concern, voiced most vehemently by the American Association of State Highway Officials, over the tremendous increase in the number of privately owned toll bridges being built on public highways. The main objection was the strategic locations chosen - locations away from competing routes - and the excessive tolls charged, which were felt to be out of all proportion with the initial construction, and ongoing operating and maintenance costs. In essence the national highway system was seen to be becoming throttled by toll bridge restrictions: private profiteering was eroding public liberty.[40] Washington's decisive legislative action on this matter was almost certainly the forerunner of a more widespread legislative backlash that swept through much of the country in the following

months and years.[41]

Despite the fact that the bridge had been built to accommodate anticipated future growth in vehicular traffic, increasing congestion and delays by the 1940s made it acutely clear that it was failing in this respect. In 1936 the average daily vehicle count was just 13,100 - well below the rated "practical capacity" of 36,250. By 1950 the daily rate had risen to 30,747, and by 1952 the "practical capacity" had been exceeded by some 2,000 vehicles daily.[42] Exacerbating the problem was the increase in water traffic: during the first year of its operation, the lift span opened 1,000 times for water traffic; by 1948 this figure had almost doubled.[43]

The problem, and various solutions was brought to a hearing in Portland on 17 March 1954. The highway departments of Oregon and Washington initially proposed a plan for building a twin bridge parallel to the existing structure, which would incorporate two long permanent spans, each having a vertical clearance of 511' with a maximum vertical clearance of 77'-6". Under this scheme the existing bridge would be remodeled by the insertion of two spans of the same dimensions.[44] A further hearing witnessed a plan to eliminate one of the two proposed 511' spans in each bridge. The plan finally authorized however - the provision for two 265' spans with vertical clearances of approximately 77' at low water in either bridge found little initial support with towboat and shipping companies. Those representatives who appeared at the original hearing sought at least two 500' spans, and preferably one 1000' span. Some had even argued for a permanent span having a vertical clearance of 200' or more! Nevertheless, with three lanes of traffic apiece, one moving it northbound and the other southbound, giving an estimated combined capacity of 75,000 to 80,000 vehicles a day, the proposal surely came as good news to motorists.[45]

On 28 June 1955 Representative Edith Green of Oregon and Representative Russell V. Mack of Washington filed a letter to the corps of engineers, Washington D.C., requesting budget bureau approval of a $1,155,000 federal contribution cover the cost of raising the existing span to the height of the proposed one. This amount would be matched by an equal amount provided by the states of Oregon and Washington.[46] Approval for this was given in December, under the terms of the Truman-Hobs act, which provided for "apportionment of costs between the federal government and bridge owner for necessary alteration of existing bridges across navigable streams when they are found to be unreasonably obstructive to navigation."[47]

Three main agencies participated in the whole project: the Oregon and Washington highway commissions and the Washington state toll

bridge authority, formed in 1938. The later issued bonds totalling $14,500,000 to finance both the construction of the new bridge and to cover the 50% contribution required for modifying the existing bridge. The bonds were sold in two issues. The first, for $9,300,000 were offered for sale in March 1956, and were used to finance the first stage of the project - the new bridge, Oregon approaches and real estate purchases. The second issue, for $5,200,000 was used to finance not only the remodelling of the existing span, but reimbursement of the state of Washington for the $2,000,000 it spent on constructing approaches on the Washington side.[48]

The contract for the construction of the new bridge was awarded late April 1956 to Guy F. Atkinson Co., San Francisco for $6,681,940 - the lowest of the five bids tendered.[49] On March 27, 1958, with the new structure nearing completion, the contract for remodelling of the old bridge was awarded to the General Construction Co., Portland, whose bid of $2,993,995 was lower than those offered by two Washington company's. Work on the old bridge however did not commence until July 1, 1958 when the new structure was dedicated and opened to traffic, allowing it to be closed to traffic for the duration of the construction period.[50]

The ceremonies accompanying the dedication of the second Interstate bridge strongly mirrored those of the original 1917 dedication. A ribbon held by the Mayors of Portland and Vancouver was untied by Mrs. Helen McAleer and Mrs. Eleanore Burkitt (the same pair who untied the original), permitting several 1917 model cars to lead a parade of vehicles across the bridge from the Vancouver side. The roar of jet aircraft overhead and artillery fire provided the opening salute, and musical accompaniment was provided by the band of the 4th Infantry, Headquarters Division, Fort Lewis, Washington who played the National Anthem.[51] From the partially raised lift-span, brief speeches were made by those involved in the project. Most spoke of their wish to make the bridge toll-free, and Francis Pearson, member of the Toll Bridge Authority asserted that both the cost and duration of operation of tolls would be significantly less than that associated with the 1917 bridge, on account of the considerably increased volume of traffic.[52]

Two years later, with the opening of the old bridge to traffic once more, Toll booths were erected. Car drivers were charged 20 cents, light trucks 40 cents and heavy trucks and buses 60 cents.[53] Despite an estimated loss of between $60 and $150 a day through the substitution of foreign objects for coins or tokens on the three automatic toll lanes, it took just six years before the $14.5 million in bonds was paid off.[54] At 9.59 a.m. on 1 November 1966 the last toll was officially collected, an event marked by more ribbon snipping by Mrs. McAleer and Mrs.

Burkitt.[55]

The Interstate bridges continue to serve an enormous volume of traffic: a record 124,474 vehicles crossed both north and south spans on May 22, 1981.[56] Until 1982 and the completion of the Glen L. Jackson bridge further upriver, it remained the only Columbia River bridge in the Portland Vicinity for 65 years.[57] In July 1982 it was listed in the National Register.

Design and Description

1917 Columbia River Interstate Bridge

The Columbia River Interstate Bridge comprises a 3,538′ main span over the Columbia River; a 1,500′ embankment section across Hayden Island, an 11-span 1,138′ plate girder bridge across the Oregon Slough, and two embankment approaches - incorporating a four-span 307′ plate girder bridge over Columbia Slough - to the south of this, giving an aggregate length of almost 23,000′. The structure was designed by the renowned firm of Waddell & Harrington, who designed the Hawthorne and the Steel bridges, also in Portland. This partnership disbanded in 1914, and despite the fact that J L Harrington's new firm, Harrington, Howard & Ash are usually credited with its design, the engineering work was handled in the name of his earlier partnership; E E Howard and L R Ash were associated as Consulting Engineers. Frank M Cortelyou acted throughout the construction as Resident Engineer for Harrington, Howard and Ash, Consulting Engineers, Kansas City, Missouri. J L Harrington was in charge of oonstruction for Waddell & Harrington, Consulting Engineers, New York City.[58]

The main span is, beginning at the north (Vancouver) end, made up of a 50′ ooncrete T-beam span; one 273′ steel-truss span and tower (Parker); one 279′ steel through vertical lift truss span (Pratt); one 275′ steel-truss span and tower (Parker); one 531′ steel truss (Pennsylvania-Pettit); seven 265′ steel-truss spans (Parker); and four reinforced concrete T-beams, 65′, 78′, 78′ and 45′ in length. Originally (before the 1958-60 modifications which substituted two 265′ spans with the 531′ truss and a span for the concrete T-beams 263′ truss) the bridge had consisted of three spans of 273′, 275′ and 279′ and ten spans 265′ long.[59]

The lift span, when fully raised, provides a waterway clearance of 250′ laterally and 150′ vertically (above ordinary high water) at right angles to the current of the river. It is of the Waddell and Harrington type having inclined rear tower posts and a mechanism operated via reinforced concrete counterweights ooupled to the lift span by steel cables over cast steel sheaves. The main control room is situated between the two bridges on the connecting web wall of Pier 2 at the south end of the lift spans. An auxiliary machine house is located above the southbound roadway on the westerly (1958) bridge.[60]

The trusses of the through-riveted truss spans are spaced 41′ centre to centre, with the 38.0′ roadway between and a 4′-6" wide sidewalk beyond one truss. Originally the deck carried six lines of rail for double-track electric street-cars, both standard and narrow gage. The floor of the roadway and sidewalk is composed

of reinforced concrete slabs, 5-1/4" thick. At the time of construction, the design of the arrangement of floor beams and roadway was unique. Steel I-beams with 8" webs, spaced 33" apart and bent to oonform to the crown of the roadway, rest on top of stringers spaced on 9' centres. These cross floor-beams support the concrete slabs, and originally supported the six rails, which were fastened by standard Carnegie steel tie clips. The rails were 7" high, and the 2" depth above the surface of the concrete slabs was filled with a bituminous concrete surfacing, forming the pavement. The advantage of this floor arrangement was that the concrete slabs were aligned longitudinal in the direction of travel, the manufacture of the floor beams entailed very simple shop work, and the resultant lateral stiffness of the floor meant that the lower laterals were comparatively lighter.[61]

The expansion joints of each of the spans, formed by checkered plates sliding upon metal supports, are positioned adjacent to each other, so that each pier supports alternately, both expansion ends and both fixed ends of each pair of spans. The expansion joints for the street-car rails consisted of manganese-steel castings placed beside the rail webs.[62]

The Oregon slough bridge consists of ten 100' and one 115' steel deck girder spans. All spans were built fixed, but the larger was designed for the possibility that it could be converted into a vertical lift span through the construction of towers at each end and the installation of machinery, counterweights etc, in the event that navigation above the site of the bridge should develop. The bridge over the Columbia Slough, consisting of four deck girder spans of the same type, each 75', was similarly equipped with this future provision. In this case, the opening of one of these spans would have provided a clear horizontal channel opening of 60', as against the 100' clearance for the Oregon Slough span.[63]

The substructure of the main channel and slough spans was designed to minimise both on weight - and hence eliminate the need for supporting piles - and quantity of concrete required. The concrete piers are of the dumbbell type, with the two cylindrical battered columns connected by a heavy web wall made up of a reinforced vertical diaphragm surmounted by a horizontal coping. They rest on unusually long (120' - 138') piles, driven inside open timber caissons by water jets to a depth of about 110' below low water. Approximately one pile to ten square feet area of crib was used, equating to some 90 piles in each of the piers under the 265' truss spans. After the piles had been sunk, concrete was poured to seal the bottom of each crib. When hardened, the water was pumped out, the piles were cut off a short distance below low water, and the remainder of the concrete

poured. The piles, the upper ends of which are embedded to a depth of 15' - 20' in the concrete base of the piers, thus form a definite portion of the piers. The great depth of penetration of these piles (possible only in areas such as the Pacific Northwest where piles over 100' long are obtainable) and the inherent rigidity of the dumbbell design of the pier shaft resulted in a substructure able to resist scour should it extend below the bottom of the base. Apart from the standard employment of heavy stone riprapping placed about the piers, no special protection of steel or stone facing was necessary on account of the extreme rarity of occurrence of ice floes on the Columbia River.[64]

The three embankments to the south of the main span were oonstructed of sand dredged from the Oregon Slough and the Columbia River. Suction dredges, equipped with a cutting head, were used to excavate the material which was then transported to place by a 24" diameter riveted pipe having a maximum length of 9,000'. The pumping operation continued 24 hours per day, the dredge pumping as much as 1,000 cubic yards per minute. The sides of the embankments were formed by the use of timber bulkheads which retained, and hence built up the hydraulic fill in steps 8' wide and 4' high. The two approach embankments were built to an elevation of 35' above low water, with a top width of 42'. The top of these were covered with bithulithic pavement laid on a broken stone base, and the upstream side was protected along its toe by a concrete slab. The remaining portions of the slopes were covered with grass and shrubs to prevent erosion.[65] In 1917, E. E. Howard, consulting engineer for the project, claimed that "such long distance dredging into an embankment so comparatively narrow and high is believed to mark a record for work of this character."[66]

The approaches to the bridge originally displayed some architectural and decorative treatment. At the two entrances of the main steel span, concrete handrails terminated in 22' high ornamental concrete lamppost columns. Built into these handrails at the Vancouver end were a pair of ornate bronze buffalo skull drinking fountains, donated by the Washington Chapter of the Daughters of the American Revolution. The columns have since been removed, but the drinking fountains, following their removal to the Washington Department of Transport's district headquarters in Vancouver, have since been restored to a park near the bridge. Five bronze plaques adorn the north and south ends of the structure; one containing the dedication to the citizens of Oregon and Washington, one listing the responsible public officials, one oontaining a quote from William Macaulay, one listing the bridge specifications and cost, and one listing the design and contracting credits.[67]

1958 Columbia River Interstate Bridge

The 1958 (west) bridge consists of a 3,538′ main span over the Columbia River and a 1,200′ bridge over the Oregon Slough. The Columbia River section is virtually identical to the (remodeled) 1917 bridge, the essential difference being the wider (40.0′ between curbs) roadway. Because of the parallel lift spans, it was desirable to keep both old and new bridges as close together as possible: the roadways are 83′ apart centre to centre, the smallest distance possible to permit new pier construction. The Oregon Slough bridge, consists of ten web-plate girder spans and ten concrete girder approach spans on the Portland end of Interstate 5, and four reinforced concrete T-beam approach spans which branch northwest toward the 'Stockyards'. The centre line of this section is 42′ from the equivalent old section centerline. It has a 39.0′ roadway between curbs.[68]

Significantly, the design of the piers of the main bridge and those used in the widening of the Oregon Slough Bridge was a relatively new one, marking a departure from the traditional cofferdam and seal method of its earlier forebear. Two alternate pier details were specified in the contract: Alternate A design was for dumbbell type piers on timber foundation piling, constructed in conventional manner within sheet pile cofferdams; Alternate B was the employment of a recently patented process whereby the piers would be constructed through the use of hollow precast sections, placed in position and filled with tremied concrete. The later option, used by the California Division of Highways for the Richmond-San Rafael Bridge and developed by Ben C. Gerwick,Inc., was chosen by the contractors, Guy F. Atkinson Company, because it offered a saving of $96,875 in their bid, compared to the next lowest which was made on the basis of the traditional cofferdam method of construction.[69]

The precast shell piers consist of three sections: a bottom ring 7′-9" high, having either a 37′ or 32′ outside diameter; a conical section, sloping in on an 8 in 12 batter; and a cylindrical shaft section of either 13′-4" or 11′-8" outside diameter, the height depending on the base and shaft diameter. The thickness of the shells is 8", and on the vertical faces of the bottom ring and shaft sections are 1-1/2" deep corrugations at 3" centers, used as keyways with the filler concrete. The upper section of the shafts were cast with openings to allow the placing of a precast reinforced concrete beam which supports, and is part of, the connecting web wall. The section of web wall above this beam were constructed through the conventional technique of forming and placing of concrete.

The various precast pier sections were cast in steel forms and steam cured in a central casting yard on the south bank of the

river. All concrete used, except that for the conical sections of the 37' base diameter piers, had a 3300 p.s.i. breaking strength after 28 days and used a 1-1/2" maximum size aggregate. The bottom ring sections employed a lightweight concrete (115 lbs. per cubic foot) so that they could be handled by the contractors barge cranes.

The initial operation of assembling the piers was the excavation of the pier base area 2' below pier base elevation and driving of timber foundation piling to grade. Following the accurate positioning to line and grade of the base rings, 2' of coarse gravel backfill was placed inside. Next, a 5' lift of tremie concrete was placed to tie the base to the piling before the remaining two precast sections and web wall beam were assembled and the piers filled 'in-the-wet' with tremie concrete.[70]

Erection and riveting of the steel truss spans then commenced: the truss steel was floated out on barges and erected on falsework towers, three towers for the 265' - 279' spans, and six for the 531' span. Exact adjustment to the true cambered position was enabled by the employment of jacks at each tower. The lift span, erected on seven panels of truss span No. 12 which in turn was mounted on three barges, was floated into position and seated 15' above the closed position. At this position, the counterweight cables, uphaul and downhaul cables and auxiliary operating machinery were installed and the concrete deck and counterweights poured. The placing of the girder spans of the Oregon Slough Bridge was undertaken synchronously with this truss steel erection stage.[71]

Repair and Maintenance

From January 1, 1929, when Washington and Oregon purchased the bridge from the counties, the cost of maintaining the structure have been borne equally by the states, with Oregon supervising the maintenance.

Prior to the remodelling of the original bridge in 1958, no major structural work was undertaken: job contracts that were executed included routine cleaning and painting of various spans (1939, 1951, 1952, 1953) or the entire structure (1932); construction of a tower stairway and lift span walkway (1932), revision of the lighting (1946), replacement of the lift-span cables (1940) and reconstruction of all expansion joints.[72]

Until November 1979, when a $946,600 contract for replacing the existing asphalt concrete with rubberized asphalt concrete and reconstructing the expansion joints was completed on both structures, the twin bridges survived without significant alteration. In the last few years however, the continual wear

and ageing of both structures finally took their toll, and two major reconstructions were undertaken. An 1987 inspection report underlined several serious deficiencies in the mechanical operating systems of both lift-spans, calling for the immediate replacement of a damaged gearing, worn operating ropes and operating drums on the 1917 bridge, as well as replacement the 1958 bridge operating ropes.[73] In 1990, a sheave in the engine room and a few lift-span cables were replaced by Donald B. Murphy Contractors, Inc. for a cost of $385,708.[74]

The other major repair, completed in March 1991, was also the most costly since the remodelling of the old bridge and construction of the new one. The contract, which called for the restoration of the decks of both bridges and repair of expansion joints was undertaken by Progressive Contractors, Inc. for a massive $2,432,385.[75]

Data Limitations

The contemporary significance of the Vancouver-Portland Interstate Bridge, as both a tremendous engineering accomplishment and a much needed social and economic link for both cities guaranteed its abundant representation in both professional engineering journals and the major state newspapers alike. In respect to the latter, which proved invaluable in piecing together the significant events preceding the construction of both bridges, the Salem Public Library Archives Department (Card Index) gives a seemingly exhaustive list of citations to both the *Oregonian* and *Vancouver Columbian*. Both these newspapers are available on microfilm at this public library, and the NorthWest Room of the Washington State Library, Olympia.

Citations for engineering articles, including those on the toll bridge issue, were obtained from the Engineering Index, available in the reference section of the University of Washington's Engineering Library. This library holds all the engineering journals included in the bibliography.

Much other useful information, especially that relevant to the repair and maintenance of the bridge, was obtained from the files of the Bridge Section of the Oregon Department of Transportation, Salem. Also useful in this respect were the files held at the Bridge Condition Unit, Washington State Department of Transportation, Olympia.

Project Information

This project is part of the Historic American Engineering Record (HAER), National Park Service. It is a long-range program to document historically significant engineering and industrial works in the United States. The Washington State Historic Bridges Recording Project was co-sponsored in 1993 by HAER, the Washington State Department of Transportation (WSDOT), and the Washington State Office of Archeology & Historic Preservation. Fieldwork, measured drawings, historical reports, and photographs were prepared under the general direction of Robert J. Kapsch, Ph.D., Chief, HABS/HAER; Eric N. DeLony, Chief and Principal Architect, HAER; and Dean Herrin, Ph.D., HAER Staff Historian.

The recording team consisted of Karl W. Stumpf, Supervisory Architect (University of Illinois at Urbana-Champaign); Robert W. Hadlow, Ph.D., Supervisory Historian (Washington State University); Vivian Chi (University of Marlyland); Erin M. Doherty (Miami University), Catherine I. Kudlik (The Catholic University of America), and Wolfgang Mayr (International Commission of Monuments and Sites/Technical University of Vienna), Architectural Technicians; Jonathan Clarke (ICOMOS/Ironbridge Institute, England) and Wm. Michael Lawrence (University of Illinois at Urbana-Champaign), Historians; and Jet Lowe (Washington, D.C.), HAER Photographer.

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