SLAB, BEAM & GIRDER BRIDGES IN OREGON

HISTORIC CONTEXT STATEMENT

BRIDGE NO. 8739, MOUNTAIN AVE OVER INTERSTATE 5, ASHLAND, JACKSON COUNTY OREGON, LOOKING SOUTH
259-Foot long Precast Concrete Girders (1963) with Type A/B Bridge Rail, Modified with Protective Fencing
June 2003

Prepared for Oregon Department of Transportation
Salem, Oregon

Prepared by George Kramer, M.S., HP
Senior Preservation Specialist
Heritage Research Associates, Inc.
Eugene, Oregon

May 2004

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THE
OREGON DEPARTMENT
OF
TRANSPORTATION

BY

GEORGE KRAMER, M.S. HP
SENIOR PRESERVATION SPECIALIST
HERITAGE RESEARCH ASSOCIATES, INC.
EUGENE, OREGON

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INTRODUCTION

Driving Interstate 5 from the Oregon-California border in the Siskiyou Mountains north through Oregon to the Interstate Bridge over the Columbia River, is slightly more than 308 miles according to most maps. Making that drive, somewhere near the halfway point, you pass Oregon Department of Transportation (ODOT) Bridge No. 7593, a small 13 by 12 foot concrete box culvert in northern Douglas County. Less than two miles later, actually 1.92 miles, you drive across Bridge No. 7569A, a three span reinforced-concrete deck girder that crosses Buck Creek. Neither of these structures, the first built in 1953 and the second in 1981, are particularly remarkable. If you are like the vast majority of the thousands who cross them every day, it's unlikely that you would give them, or the stretch of the Interstate between them, any special notice. But that 1.92 mile stretch between these two unremarkable, entirely functional, structures, is one of the longest pieces of uninterrupted pavement on Interstate 5 — pavement without a bridge, a culvert, an overpass, underpass, or other similar feature as documented in the Oregon Department of Transportation's 2002 Bridge Log.[1]

"Limited access highways" such as Interstates 5 and 84, or any of the other connecting routes, such as I-105 in Eugene or I-205 and I-405 in Portland, quite simply wouldn't be possible in a mountainous, river and creek rich state such as Oregon without a vast network of connecting features like bridges 7593 and 7569A. And, since the entire Interstate system was developed in the late 1950s and early 1960s, the vast majority of its bridges are of slab, beam, and girder design, the proverbial "basic bridge" form. Most are built of concrete — an ancient material that was so particularly well suited to the construction of modern highway bridges that examples can today be found virtually everywhere an automobile can go.

Approximately 6,500 bridges carry traffic throughout Oregon, and significantly contribute to the movement of goods, services and people upon which much of the state's economy relies. ODOT and cities or counties manage approximately 2,680 and 3,800 of the bridges, respectively. Over half of the State-owned and a third of the local agency bridges were built prior to 1960. Over two-thirds of Oregon's State-owned bridges were built in the 1930s and 1950s. Hundreds were built between 1945 and 1961, during a post-World War II era when a design and construction philosophy of material economy and precise engineering of reinforcement details drove bridge planning and construction in the state. This was the case, for example, in developing much of the Interstate Highway system in Oregon.

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[1] A slightly longer section, 2.03 miles, separates Bridge 8229B, on Hwy 210, from Seven Mile Lane, on I-5, in Linn County, but 8229B is documented as part of the Corvallis-Lebanon Highway, not I-5.

State-owned bridges during this time were designed and built in accordance with American Association of State Highway Officials (AASHTO) standards contained in *Specifications for Highway Bridges,* and using design parameters in large part based on contemporary truck weights, volumes and speeds. The slab, beam and girder bridge type accommodated these parameters. Assuming those parameters, their useful life was expected to be approximately 50 years. In 1961, driven by failures witnessed on some concrete structures, ASSHTO made significant design philosophy changes in the *Specifications for Highway Bridges* (8th Edition), including more stringent shear steel requirements within the concrete design standards (for example, previous standards had overemphasized the importance of concrete and underestimated that of steel in calculating shear capacity of bridge structures). Generally concurrently, AASHTO accepted prefabricated construction techniques, which allowed ODOT to then begin emphasizing them in new-bridge construction. (Some states began using this technique earlier.)

As many transportation projects and priorities have competed for financial, labor, and material resources over the past five decades, resources for bridge maintenance and repair have been limited. Maintenance, modifications and repairs have been primarily made on a bridge-by-bridge basis based on critical needs to accommodate safety and traffic requirements. No major statewide bridge repair or replacement program has been previously developed.

Since 2000, ODOT has inspected and noticed large working shear (diagonal) cracks in many bridges throughout the state. The cracks reveal bridge deterioration, which, if not addressed, will severely limit the weight that a bridge can accommodate without risking failure. This phenomenon, particularly prevalent in slab, beam and girder bridges built before 1961, cannot be explained by any one factor. However, several factors that substantially contribute to the situation include, but are not limited to:

- Increased traffic weights, volumes and speed from that originally used in design
- Expected service life

Over 400 State-owned bridges are at risk to failure due to these factors. Unless addressed, weight restrictions and even bridge closures would be imposed to reduce the risk, causing massive inefficiencies in the movement of goods, services and people along circuitous detour routes. Delaying needed repairs and replacement to these bridges has the potential to cost the state economy as much as $123 billion in lost production and 88,000 lost jobs over the next 25 years. Consequently, ODOT has embarked on the Oregon Transportation Investment Act (OTIA) III Statewide Bridge Assessment Program, which is the largest roadway infrastructure project in Oregon since the development of the interstate highway system. Inasmuch as most of the bridges in the

Program are slab, beam and girder bridges, it is important to understand the historic context of these bridges relative to regulatory requirements and historic resource conservation objectives.

This historic context statement, prepared under contract for the Oregon Department of Transportation, documents the history and development of several types of concrete spans used in Oregon. Specifically its focus is the slab, beam and girder bridges, or "SBG" bridges, including structures of concrete, steel, wood and various combinations of those three materials. SBG bridges, especially reinforced-concrete examples, while known and utilized throughout the early 20th century period of early public highway development, truly came into prominence during the post-World War II era. During that period their cost effectiveness, adaptability and, ultimately, their capacity for rapid construction, made them the de facto standard for the entire Interstate Highway System, a system that is still the single largest construction project in the history of the United States.

While this context statement includes information relevant to pre-WWII slab, beam and girder bridges in Oregon, many of which survive, its primary focus is to provide an evaluatory tool for the hundreds of SBG bridges built after 1945. Many of these structures have already, or will soon, reach 50 years of age and so be potentially eligible for listing in the National Register of Historic Places and subject to the review processes of Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800 et seq). The evaluation tools presented in Part 3 are intended to aide in screening SBG bridges for potential Register eligibility and so allow the concentration of public funds on those bridges that merit additional study. That such a statement presumes that the majority of SBG bridges will not be eligible is entirely the result of the obvious: most of these structures--particularly the predominate concrete examples, even where the original design or construction may have had significance--have been so dramatically altered by subsequent safety or structural improvements that they no longer retain integrity. And, of course, the very ubiquity of SBG bridges and the expectation of "exemplary" design, the latter being a typical requirement of National Register eligibility, are on the face inherently mutually exclusive terms.

As Oregon moves to replace SBG bridges in the coming years to correct inadequate structural design and the rising potential for failure, a streamlined review under the Section 106 process will aid ODOT, SHPO, and the public-at-large. Avoiding individual evaluation and eliminating unnecessary documentation for hundreds of substantially modified SBG bridges will enable the concentration of staff time and limited resources on only those structures that have both higher integrity and potential merit. If only in sheer numbers, it is hard to dismiss the entire postwar SBG bridge population from consideration but, as multiples of a type, so too is it difficult to determine which few bridges merit consideration. This context statement provides specific guidance toward the identification of which examples of the type best represent this vast resource base. In response to a growing need to replace aging highway bridges in Oregon, ODOT created the Critical Bridges Project and this context statement was prepared as an element of that process. George Kramer, Senior Preservation Specialist for Heritage Research Associates, Inc., of Eugene is the principal author, working under the direction of Kathryn Toepel at HRA and Lynda Wannamaker of Parametrix, Inc., Portland. Preliminary research began in February 2003 and the majority of the document was crafted in May with the initial focus on spans built of concrete. Additional material was drafted in August and September to augment the discussion of steel and wood/timber SBG bridges.

The writing of a statewide historic context statement that deals with quite literally thousands of potential resources in a compressed timeframe would not be possible without the gracious assistance of many individuals from ODOT's staff. From the Environmental Section, James Norman, Leslie Schwab, Robert Hadlow, Alex McMurry, and Rosalind Keeney, who served as the project's manager, all provided information and advice based on their extensive familiarity with the review of these bridges from the standpoint of historic significance. In the Bridge Section, Chris Leedam, Stephen Burgess, Frank Nelson, InTae Lee, Tom Ohren, and Cathleen McClintic answered questions, opened their files, shared photos, and helped clarify issues from bridge design to database management. Tony Stratis, also of the Bridge Section, repeatedly offered advice about the various bridge rails ODOT has used since the late 1940s and, more importantly, which drawings documented their construction and design. Pat Solomon of ODOT's General Files, a repository of an amazingly catalogued photo and document collection dating back to the Department's earliest years, was very helpful in finding photographs and primary sources that made this project far more detailed than it could have been otherwise. Garnet Elliott, of the ODOT Library, not only showed me the printed sources in that collection but made copies of things I forgot and graciously mailed them to Ashland. All of them have my appreciation and thanks.

When poets and essayists speak of the art of bridge building, of tying shores and people together, of spanning chasms and uniting what was once divided, it is highly unlikely they are thinking of slab, beam, or girder bridges. Like the comedian Rodney Dangerfield, SBG bridges get little respect. They are not the sort of cultural resource likely to inspire a calendar or excite much passion, even among engineers. Simply built, and only rarely benefiting from any exceptional design features, SBG bridges, particularly post-WWII examples, are instead something of an anomaly — they are both ubiquitous and, essentially, invisible. But, in terms of sheer quantity if not always quality of design, it is precisely the SBG bridge form that does more than any other to bind Oregon's, and indeed the nation's, road system together.

PART 1.0 HISTORIC OVERVIEW

Part 1 follows the standard historic context format and provides a general overview of the historic development of SBG bridges with emphasis on Oregon. Special emphasis is placed on concrete examples, the most numerous of the type. Additional discussion briefly covers the history and development of timber and steel slab, beam, and girder bridges as found in Oregon.

1.1 GEOGRAPHIC BOUNDARIES

This statewide context is focused upon a specific resource type in the state of Oregon. All such resources share an essentially similar history, characterized by a linear evolution in technology and improved safety designs. That many of the local government-owned SBG bridges were in fact designed by the Oregon Department of Transportation or its predecessor, the Oregon State Highway Department, further unifies the resource from an evaluatory standpoint. Examples of SBG bridges can be found along all Oregon's Federal and State highways, in each of its 36 counties, and in the vast majority, if not all, of its incorporated cities.

1.2 TEMPORAL BOUNDARIES — 1900-1966

The earliest surviving SBG bridge in Oregon is among those dated 1900 by the Oregon Bridge Inventory (OBI) but may well have been built slightly earlier.[2] For the purposes of this project, however, since no individual resource can be conclusively dated earlier than the turn-of-century, 1900 will suffice as the beginning temporal boundary for the study.[3]

The typical National Register evaluation process would establish the ending temporal date at 50 years, or in the case of this document, 1953. While this may be appropriate for any formal evaluation based upon this context, major national and statewide events beginning in 1956 and culminating a decade later with Oregon's completion of its portions of the Interstate Highway, played a key role in the development of bridge technology and design and so are considered relevant here. In order to establish this context and the evaluation process it recommends as a useful tool for the next decade of bridge evaluation projects in Oregon, the temporal boundaries are extended to 1966, based upon the completion of Interstate 5, the major route in Oregon's transportation system. Given the standardized and mass-produced bridge designs that are located along

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[2] The Oregon Bridge Inventory, maintained by the Oregon Department of Transportation, is based upon and includes the Oregon entries in the National Bridge Inventory, the nation-wide database maintained by the Federal Highway Administration. Oregon's inventory includes spans less than 20 feet in length, which the NBI does not, and so is a more complete document. The OBI serves as the basis for all quantitative data in this context statement.

[3] The OBI dates four spans (and more than 90 total structures, including culverts) at 1900. Bridge No. 23C151 in Grant County is dated as 1899 and classified as a pre-stressed concrete girder but this actually refers to a 1982 reconstruction.

most of the Interstate system, the closing of the period of significance in 1966 is based upon the essential continuation of design processes that began earlier, within the standard 50-year period.

Specific individual bridges not utilizing standard, often replicated, designs, may not be appropriately evaluated under this context, as is made evident in Part 3 (Evaluation). Construction of the Interstate system, along with various local bridges built after 1966, essentially represent the same continuation of technology in place by that date and so it is anticipated the majority of post-1966 slab, beam and girder bridges in Oregon may well be evaluated under this context as well.

1.3 SLAB, BEAM AND GIRDER BRIDGE CONSTRUCTION

Since the dawn of engineering, various basic structural forms have been developed to allow passage over waterways, canyons or other impasses to travel. Among the most basic is the proverbial log across the creek, a primitive “beam” bridge. SBG bridges, all related forms that build upon that basic log, have been constructed in a variety of materials that offer strength in tension between two fixed abutments. The subject of multiple definitions from an engineering standpoint, *Historic Highway Bridges of Oregon,* the primary study of Oregon bridges, separated slab bridges from beam and girder bridges by defining the latter as those with structural members below the road-deck whereas slab bridges are single sections that essentially extend the roadbed through space between two fixed points (see Figure 1.1). Beam bridges have only longitudinal members below the roadway, while girder bridges additionally have transverse members extending from one longitudinal elements to the next. These related forms, among the most basic bridge types, are the focus of this context.

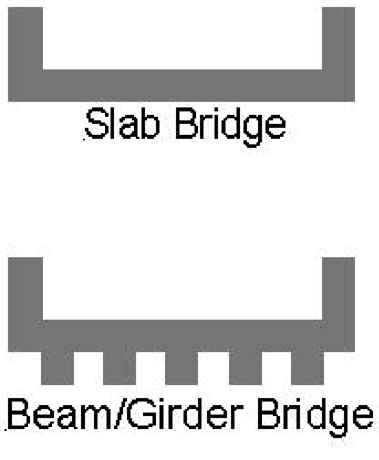

Figure 1.1. Slab, Beam, and Girder Bridges, in Section

> One of the most widely used yet least appreciated types of bridges is the girder. In simple terms, girders are solid beams that extend across a small-span crossing.… Although often overlooked by bridge historians, the girder bridge has been around for hundreds of years and will continue to be the most common type of bridge in America for decades to come (Jackson 1988:38).

SBG bridges are, as noted, essentially similar and related designs, building upon the same basic structural principal, with a single member in tension that spans a void between two fixed points. Structurally a "slab" is the simplest, relying solely upon the inherent strength of a single member for both structure and road surface. A beam bridge is, in essence, a slab (the road deck) that is additionally strengthened by some number of longitudinal members as shown in Figure 1.2. A girder bridge is a beam bridge with additional transverse supports between the beams.[4]

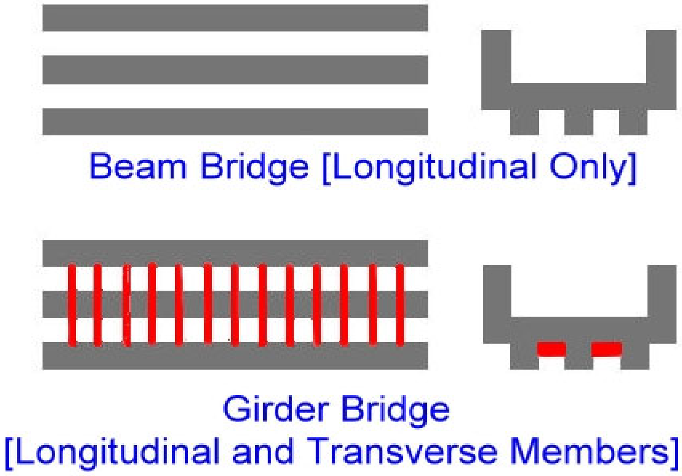

Figure 1.2. Beam and Girder Bridges, in Plan and Section

Similar from a structural standpoint and largely indistinguishable to the untrained eye visually, SBG bridges occur in three basic materials — wood, steel, and reinforced concrete, or in some combination of them.[5] These materials, in the above order, serve as logical sub-categories for the following discussion.

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[4] Other variants within this basic framework are discussed in Part 2 of this document.
[5] Such combination forms are classified by the OBI, and as a result here, based on their "predominant" material.

1.4 TIMBER

Beginning with the proverbial fallen log, wood, or timber, was likely the first material used for bridge construction and up through the mid-19th century remained the predominant bridge-building material in the United States (Figure 1.3). In 1859 the English engineer David Stevenson, touring America's bridges, wrote "The American bridges are in general constructed entirely of wood…" (Whitney 1983:192). Soon after that statement was written, however, improvements in steel and iron technology, coupled with various patented truss designs, ended the dominance of wooden bridges. This situation was furthered by the rapid development of the nation's railroad system in the last third of the 19th century, which served to hasten the end of wood as the material of choice for most bridge construction. Of course, wood did not disappear completely as a bridge material. Its lower costs, easy working characteristics, and plentiful supply still made it a logical choice for many bridge projects. "Although in the 20th century concrete and steel replaced wood as the major materials for bridge construction, wood is still widely used for short- and medium-span bridges" (Ritter/USDA 1997:1-1).

Figure 1.3. Log bridge, Klamath-Falls-Lakeview Highway over the Sprague River, 1930
Source: ODOT Archive

Today interest in wooden bridges is generally focused upon covered bridges, wooden truss structures with various decking forms that are protected from the elements by a picturesque wooden "house." But many other timber forms are identified in the Oregon Bridge Inventory, which includes nearly 550 bridges of predominately wood or timber construction. More than 99 percent of these are of SBG construction.[6]

Wood or timber SBG bridges may be constructed entirely of wood or, as is common, of some wood elements with concrete or asphalt road surfaces. Simple slab bridges built of timber are, by virtue of the limitations of materials, generally short spans, as pointed out by Ritter. In Oregon, according to the Oregon Bridge Inventory, there are 88 wood slab bridges, dated from 1940 to 2000 all spanning between 22 and 100 feet.[7]

Wooden multi-beam or girder bridges (Figures 1.4 and 1.5), by far the most plentiful form of wooden bridges in Oregon with more than 450 examples, range in date from 1922 to 2003 and boast main span lengths up to 100 feet. The multi-span construction of these structures includes 82 bridge structures with overall lengths of more than 100 feet and, in once exceptional case, of more than 1,500 feet.[8]

Several technological innovations in the mid-20th century greatly increased the utility and longevity of timber bridge designs and resulted in something of a resurgence of interest in the use of the material that continues today. Chief among these was the development of "glu-lam," or laminated beams that increased the carrying capacity and durability of the members. Additional improvements occurred during the same period in the area of chemical wood preservatives.

> [I]t was not until the mid-1940s that the biggest single advancement in timber bridges occurred with introduction of glulam as a bridge material. In the 1960s and 1970s, glulam continued to develop and became the primary material for timber bridge construction (Ritter/USDA 1997:1-17).

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[6] The OBI documents 548 bridges where the first digit of the Structural Type field is a "7," denoting wood or timber. Of these 545 are categorized as either "slab" or "girder" bridges (Structural type equals either "701" or "702").

[7] This data summarizes bridges identified as Structural Type "701" in the OBI.

[8] This data summarizes bridges identified as Structural Type "702" in the OBI. The "Million Dollar Bridge" over the Little Pudding River, in Marion County (Bridge No. 05419A), has 37 individual spans for a total structural length of 1593 feet, although the "main span" length is just 19 feet.

Figure 1.4. Bridge 1084, Timber Stringer Construction (undated), Photo circa 1930
Source: ODOT Archive

Figure 1.5. Bridge 29C77, Rapp Road at Wagner Creek (Jackson County Bridge No. 57)
Timber, Stringer/Multi-Beam Girder (OBI Code #702), 46 feet long, built 1955
Source: Author Photograph, August 2003

1.5 STEEL

Like wood, steel bridge construction is typically associated in the general public mindset with various truss bridge forms, particularly the through-truss bridges that were popular for highways prior to WW II and the earlier, but still prevalent, steel truss railroad bridges that were mass-constructed during the late-19th and early-20th centuries. Steel, however, like wood, is also well suited to SBG bridge design and, both on its own and in combina-tion with wood or concrete decking, remains a fairly common bridge type. "The visual prominence of large [steel] truss bridges obscure the fact the overwhelming majority of American bridges are small girder spans of steel or concrete…." (Condit 1968:225).

Steel bridges, evolving from the early cast and wrought iron designs of the mid-19th century, rose to prominence with the railroad. Often manufactured from standardized plans and utilizing patented truss designs, steel bridges developed a mixed reputation by the turn of the 20th century — fireproof and longer-lasting than wood, they were often poorly designed, without regard for the specifics of the site, and so prone to failure. Less than scrupulous sales techniques, often aided by the collusion or simple ignorance of engineering on the part of the local officials in charge of awarding bridge contracts to out-of-town companies, in part influenced the original creation of the Oregon State Highway Commission in 1913 (Hadlow 2001:40).

Figure 1.6. Pudding River (Red) Bridge on Arndt Road, Bridge No. 6521, c. 1950s
(presumed razed)
Source: ODOT Archive

Still, steel is a useful, strong, and when maintained, durable material that found appropriate and long-lasting expression in numerous SBG bridges that remain important elements of the Oregon road system. While no bridges in the Oregon Bridge Inventory are described as steel slabs (structural type "301" or "401"), nearly 670 steel multi-beam or girder bridges are documented.[9] Steel SBG bridges range in date from 1899 to 2003 with main span lengths of up to 240 feet. Approximately two-thirds of Oregon's steel SBG bridges were built prior to 1966.

One type of bridge, the so-called "steel deck girder," is of particular note within this context, as it was a common alternative to reinforced-concrete spans during the development of the Interstate Highway system (Figure 1.7). Such bridges, almost universally with a concrete roadbed and, typically, concrete abutments and supporting piers, employ large section steel beams and girders for the substructure but are otherwise indistinguishable from similar concrete beam and girder bridges. Single steel deck girder spans are common as overpasses and shorter crossings while continuous forms were used for viaducts and similar elevated roadways in and around Oregon's urban centers.

Figure 1.7. Haunched Steel Deck Girder Bridge, John Day Highway, 1955
Source: ODOT Archive

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[9] The OBI includes 563 bridges as Structural Type "302" (Steel-Stringer/Multi-Beam or Girder) and 103 bridges as "402" (Steel Continuous-Stringer/Multi-Beam or Girder).

There are 29 steel girder bridges in Oregon that boast total structural lengths (including the approach spans) of 1,000 feet or more and, with the exception of four, all were erected between 1955 and 1966. The longest of these, the Medford Viaduct portion of Interstate 5 (Figure 1.8), was completed in 1962.[10] With a total length of more than 3,200 feet, including the approach spans, the recently renovated Medford Viaduct is nearly 900 feet longer than the southbound ramp to the Marquam Bridge, Oregon's second longest steel deck girder structure.

Figure 1.8. The Medford Viaduct, Looking NE over downtown, c. 1963
Source: ODOT Archive

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[10] It should be noted that the Medford Viaduct is comprised of multiple spans, the majority of which are considered abutments and that most of these are of pre-cast concrete construction. The Viaduct contains eight steel deck girder spans that are considered its "main spans" in the OBI and it is under this category (402) the bridge is documented.

1.6 CONCRETE AND ITS APPLICATION IN BRIDGE CONSTRUCTION

The third, and most prevalent, material used in the construction of SBG bridges is concrete. The use of concrete as a building material, made by combining aggregate (sand and gravel), a cementing agent, and water, was known to the ancient Egyptians and provided the foundation for the famous Appian Way of the Romans. Concrete's lack of strength in tension and the uneven quality of natural cement substantially reduced its utility in many applications until the mid-19th century. Then, with the English invention of Portland cement, concrete became an increasing popular, and reliable, material throughout Europe.[11] Portland cement is "…obtained by pulverizing clinker (a partially fused product) consisting essentially of hydraulic calcium silicates [and containing] un-ground calcium sulfate" (Harris 1975:374).

Portland cement was first imported to the United States in 1865 and seven years later, in 1872, David O. Saylor initiated the nation's first manufacturer of the material at Coplay, Pennsylvania. In 1876 Saylor exhibited his product at the Centennial Exhibition held in Philadelphia. "This was the small beginning of the present enormous American Portland cement industry.…Not, however, until twenty years or more passed, did the industry in this country begin to show any very substantial increase…" (Radford 1910:14-15).

A major stride in the acceptance of concrete as a building material occurred in 1885, when Ernest L. Ransome of San Francisco invented a twisted iron bar that could be used within concrete. A short time later expanded wire mesh and other metal elements were introduced. The result, with a steel "rebar" encased in concrete, is known as "reinforced concrete." With the steel elements providing support in tension, and the malleable structural capacity of concrete in compression, reinforced concrete was quickly adopted by architects and engineers for a wide variety of construction projects that almost overnight led to general acceptance of the material and an significant expansion in concrete production. "Between 1890 and 1895 the production [in the United States] of Portland cement progressed from 335,000 barrels to 999,000 barrels" (Radford 1911:20).

By the early 20th century The Radford Architectural Company, a nationally influential building publisher, opened its five-volume *Cyclopedia of Concrete Construction* with an essay entitled "The Dawning Age of Cement."[12]

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[11] Joseph Aspdin, a brick mason of Leeds, is generally regarded as the "father" of the modern Portland cement industry. Aspdin patented his formula of so-called hydraulic cement in 1824. While probably unnecessary, it should still be noted in an Oregon context that Aspdin named his invention after the similarity of its color to a famous stone that had been long quarried on the Isle of Portland in the English Channel.

[12] Founded by William Radford, the Radford Architectural Company published books of house plans that were sold nationwide as well as a large series of publications such as *Radford's Bungalows*, *Radford's Garages*, *Radford's Cement Houses and How to Build Them* as well as construction guides such as *Radford's Details of Building Construction*, *Cement and How to Use It* and the 12-volume *Cyclopedia of Carpentry, Building and Architecture*. Radford also published *American Carpenter & Builder* and *Cement World*, both popular monthly publications in the pre-WWI United States. Radford remained in business at least through the mid-1920s.

> Concrete has come to be a dominating factor in the building world. Its invasion of the modern structural field, and triumphal progress therein, have already wrought a revolution; and its present widespread and rapidly increasing application to construction work of all kinds is the marvel even of this age of wonderful engineering achievement (Radford 1910:1).

The development and acceptance of reinforced concrete predated, if only by a short while, the advent of another new technology that would create a huge demand for new structures — the automobile. A voluminous subject on its own, it must suffice to state here that during the first decade of the 20th century, as the result of numerous social, economic, and technological factors, the private automobile was beginning its meteoric rise from the frivolous plaything of a few well-to-do adventurers to a commonly owned convenience. This trend was particularly evident after October 1, 1908, when Henry Ford sold the first Model T, an inexpensive, barebones design that made automobiles affordable, and reliable, for the first time. As automobiling became increasing popular, first as a pastime and then as a necessity, pressure for improved roads and highway networks developed.

> Despite its idiosyncrasies, a Model T in operation proved as indefatigable as a well-constructed work boot, and its down-home qualities quickly endeared it to farmers and ranchers. Nothing did more to increase the pressure on legislatures to provide better roads than that ever-widening circle of automobile owners…. (Schwantes 2003:125).

Soon to supplant the railroad as the dominant form of first passenger, and later freight, transport nationwide, more automobiles meant improved roads, without ruts or steep grades. To the subject at hand, in the mountainous and river-crossed, terrain of Oregon, improved roads and highways meant bridges. Lots of them.

In the first few years of the 20th century, Oregon's counties individually struggled to meet the demand for a road network adequate to the growing automobile "craze." It was clear that eventually the State government would have to take the lead were there to be a coordinated, statewide road or highway system. As a result, the Oregon State Highway Department (OSHD) was created by the legislature in 1913 and was charged with the development of Oregon's overall road system. Early limited funding, at both the state and Federal levels, would grow exponentially, responding to an effort to "Get Oregon out of the Mud."

1.6.1 EARLY CONCRETE BRIDGES IN OREGON

The first documented use of concrete for a bridge in the United States occurred in 1889, with the construction of the Alvord Lake Bridge in San Francisco, California (Smith 1989:25). The first use of concrete, reinforced or otherwise, for bridge construction in Oregon was not documented for this project but likely occurred in the late 19th century. The oldest *surviving* concrete bridge in the state, as distinct from concrete culverts, according to the OBI appears to be the Nice Creek Bridge (Bridge No. 09C01), a six-span, 243-foot-long structure in Columbia County, built in 1911.[13]

In 1913, following the department's creation, OSHD's State Engineer Henry L. Bowlby and State Bridge Engineer Charles Purcell began the process of designing the state's road system.[14] "Along the way, they found deplorable bridges at many locations and concluded that 'customary bridge [building] methods' needlessly cost Oregon's taxpayer's thousands of dollars annually" (Hadlow 2001:41).

> Bridge companies employed the smoothest talker for their salesman that can be secured. This is part of the selling end of the business, and does not differ from the selling end of any other commercial business. The trouble has been that the County Courts 'fall for' the talk…(OSHD 1914:168).

The State Highway Engineer's office provided free bridge designing for the counties and enabled skilled engineers to work with the various counties to improve bridge quality and reduce costs. Quickly faced with the task of building literally hundreds of bridges from one end of the state to the other, the department at various locations would utilize almost every material and bridge design available to it — wood, steel and concrete — depending upon local conditions and available funding. Steel trusses were typically used for early large spans and timber, certainly plentiful and affordable in much of Oregon, was a common choice for small and large bridge construction prior to World War I. But, for many of the smaller spans along the State's newly designated primary north-south route, the Pacific Highway, small standardized concrete spans were used (Figure 1.9).
In the first report of the Highway Engineer the department documented its progress, county-by-county, for work undertaken prior to November 1914.

> There were thirty-one steel and reinforced concrete bridges built in 1914 by the State Highway Department in Clackamas, Clatsop, Columbia,

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[13] The OBI lists 6205 bridges or culverts (generally defined as short spans of less than twenty feet, often covered with embankment) as being built of concrete. Ninety-two, mostly culverts, are dated at "1900" and *none* are dated earlier. Bridge OM263, a 14'-7" long slab span over an irrigation ditch on the I-5 frontage road at MP 41.18 in Jackson County, is dated at 1900 but appears to be an error.

[14] C. H. Purcell left Oregon and eventually became an engineer with the California Department of Highways. In that capacity he is credited as the chief engineer of the San Francisco-Oakland Bay Bridge. In 1931 Purcell served as the designing consultant for the Bixby Creek Bridge, near Carmel, California, an influential fixed arch design.

> Multnomah, Yamhill, and Marion counties….Forty bridges were built during the 1917-1918 biennium…" (ODOT-Carrick 1993:3).

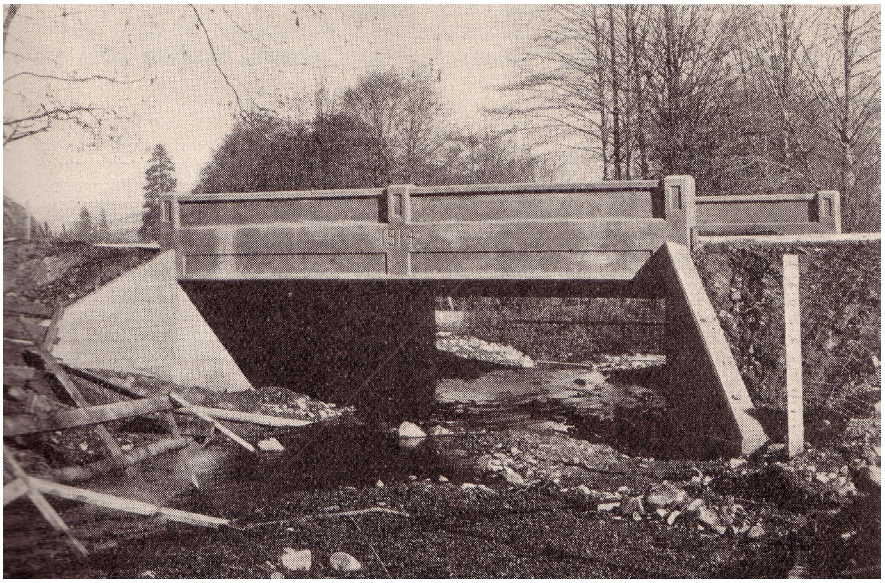

Figure 1.9. "Type of Concrete Bridge Erected Along Pacific Highway in Jackson County"
Source: *Medford Mail Tribune,* 1-January-1915

Many of the early concrete bridges were simple structures, few of length greater than forty feet. A typical example, one of what was apparently a standard early concrete bridge type, is the slab bridge over Wagner Creek (Figure 1.10), in Talent, Oregon (completed in 1914 and dated on its western bridge rail).[15] These early Pacific Highway bridges were of simple design, spanning small creeks and ravines along the route.

While simple concrete slabs were favored for the shorter spans of the Pacific Highway, concrete was also used in more elaborate fashion for the Columbia River Highway, running east toward Pendleton and west toward Astoria from Portland. The portion of the Columbia River Highway overlooking the Columbia River Gorge is highly regarded and considered the earliest scenic highway corridor in the nation (Hadlow 2000:4). Many concrete bridges were constructed within the corridor and certain elements designed for the Columbia River, particularly evident in bridge rails, saw use elsewhere in the state. Compare, for example, the delicate arched elements of the 1914 Horsetail Falls Bridge in Multnomah County with the similarly designed railing of the Steinman

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[15] The Wagner Creek Bridge (No. 5057) is a 26' long continuous Tee Beam span and was reconstructed in 1971 according to the OBI. As shown in Figure 1.10, the bridge is currently being rehabilitated as a part of Talent's Urban Renewal program and is considered a key feature in downtown's revitalization.

Figure 1.10. Wagner Creek Bridge, former Pacific Highway, Talent, Oregon
Source: Author Photograph, May 2003

Overcrossing, built the same year, but located more than 300 miles to the south in Jackson County (see Figure 1.11).

As the result of growing automobile use and increased demand for better roads, Oregon enacted several funding mechanisms, highlighted by the 1919 establishment of the nation's first gasoline tax, to help pay for road construction. With stable funding, the Oregon State Highway Department continued its massive road building campaign, including dozens of new bridges. Conde B. McCullough, an Iowa-trained engineer of national renown who had been teaching at Oregon Agricultural College (now Oregon State University) was named as the State Bridge Engineer that year, a position he would retain until 1935 (ODOT-Carrick 1993:7).

McCullough has become an almost legendary figure in the history of Oregon highways and bridge building. His major works, particularly the concrete bridges he designed for the Oregon Coast Highway (US 101), are frequently cited among the best examples of the form in the nation. An innovative designer who employed new technologies and established practices later used throughout the country, McCullough's impact and significance are well-documented and outside the scope of this context.[16] So too are the bridges, though of concrete, on which the bulk of McCullough's reputation is based.

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[16] The most authoritative and in-depth of the several studies of McCullough and his major works, which include in addition to the coastal bridges, concrete spans at Gold Hill, over the Rogue River; at Oregon City, over the

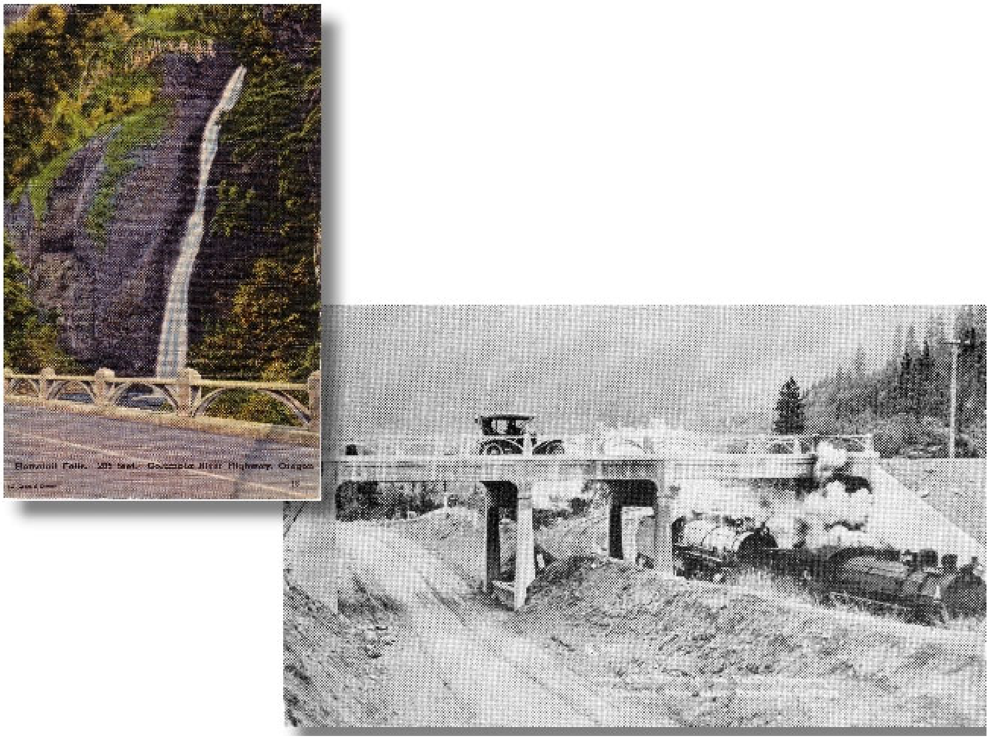

Figure 1.11. Horsetail Falls Bridge (left) and Steinman Overcrossing (right)
Source: Postcard images, Author Collection

But while McCullough is best known for his large arched spans, he served as State Bridge Engineer and oversaw the Bridge Department during much of its first period of major highway construction. As a result, McCullough was responsible either directly or indirectly for the design and construction of hundreds of other lesser spans in concrete, steel, and timber. These bridges, naturally, include many of SBG construction that do fall within the scope of this context. "During [McCullough's] sixteen years of service as bridge engineer and later as assistant state highway engineer, he planned and supervised the design and construction of literally thousands of bridges…." (American Society of Civil Engineering 1947). While they are generally ignored due to their sheer quantity and standardized design, McCullough, as Oregon's bridge engineer during the pre-WWII period, logically oversaw the construction of hundreds of SBG bridges throughout the state. As Oregon's primary bridge study noted, "…the majority of early bridges in Oregon are of the slab, beam, and girder type" (Smith 1989:121).

Willamette; and at Winchester, over the North Umpqua, among others, is *Elegant Arches, Soaring Spans*, by Robert Hadlow, published by the OSU Press in 2001.

From its inception in 1913, the State Highway Department prepared biennial reports to the Legislature documenting its activities and the growing Oregon road system. This source, which by design contains summaries and highlights of the activities of the Bridge Department, offers bi-annual data on the scope of bridge work during the preceding period. Typical is the 1925-1926 period.

> During the period covered by this report, designs have been prepared for 169 bridge structures, which exceeds by sixty the number of structures for which plans were prepared during the next preceding biennium… Of the total above [there were] forty-six bridges on the State Highway System having span lengths in excess of 20 feet; …seventy-three structures on the State Highway System having spans less than 20 feet; and …forty-two structures on County and Market Roads…(OSHC 1927:75).

Detailed analysis of the bridges built on the State Highway system during this biennium provides some indication of the growing reliance on SBG designs for shorter spans and approaches. Table No. 24 in the Commission's Seventh Biennial Report, documenting only spans of more than 20 feet, shows that steel and concrete arch bridges still predominate for larger bridges but reinforced concrete had become almost universal for approach spans, viaducts, and virtually every single span of less than 50 feet in length. Atypical, if somewhat impressive, are the 19 bridge projects built by the Department in Josephine County, 18 of which were on the Redwood Highway (now U.S. 199). These bridges ranged in length from 20 to 180 feet and every single span under 100 feet in length was of reinforced concrete.[17]

The OSHD's expanding bridge program continued into the late 1920s (Figure 1.12). The Department's *Eighth Biennial Report*, covering 1927-1928, shows that fewer bridges—48--were completed on state highways than in the prior biennial period, partially reflecting the completion of the Pacific Highway but also a function of the fact that most of the bridge work now remaining was for larger, and more expensive, spans. Steel truss bridges, many with reinforced-concrete approach spans remained the primary design for many of the larger spans. Continuous and rigid frame concrete construction, again predominantly for shorter spans, was considered by the bridge department to be an important new and economical technology.

> While engineers have realized for many years the inherent economy in rigid-frame construction, the mathematical difficulties involved in the design of such a type rendered its adoption by engineers in general rather slow. …Early in the biennium the Bridge Department purchased [new

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[17] The nineteenth bridge built in Josephine County, was Bridge No. 1144, a 30-foot reinforced-concrete span over Chapman Creek on the Oregon Caves Highway. All the larger, 100 feet or longer, spans were of steel.

> testing equipment] and during the period covered by this report considerable experimentation had been done and several reinforced concrete structures of the rigid-frame type have been designed and constructed on the State Highway System…The bridge over Parrott Creek on the Pacific Highway …is of this type (OSHC 1929:72).

Figure 1.12. Parrott Creek Bridge on the Pacific Highway at New Era, 1928
Source: ODOT Archive

Continued evidence of the reliance upon reinforced-concrete spans is found in Table 25 of the Eighth Biennial Report. Of the 48 bridges built on state highways during the biennium, 16 are entirely reinforced-concrete spans and the majority of the larger spans, though of concrete arch or steel truss design, utilized concrete SBG approach spans.

Still, as the result of technology, and to some extent economics, in the these earliest years of the Oregon Highway Department's existence, the use of reinforced-concrete SBG bridges was generally limited to shorter spans. As the need for bridges grew during the 1920s in response to the nation's expanding highway system, various technological improvements were developed with impact on concrete bridge design. Chief among these was the work of University of Illinois professor Hardy Cross, who developed the moment distribution theory for continuous frame bridges in the 1920s. "As the theory applied to multiple span structures with integral deck and supports (continuous frame), the advent of the moment distribution theory resulted in an economic and efficient bridge design that could accommodate bridge spans up to 150 feet in length" (ODOT-Schwab 2002).

1.7 SLAB, BEAM AND GIRDER BRIDGES: A SIMPLIFIED TYPOLOGY

The specific classifications and accompanying nomenclature surrounding SBG bridges, like most specialized technological terms, is somewhat confusing to a non-engineer and is further complicated through varied and conflicting usage of the three terms over time. This section provides illustrated definitions of the *major* structural systems that define the basic bridge types covered by the SBG context, with particular focus on the various forms using reinforced-concrete which constitute the majority of the SBG bridges. This typology makes no pretense toward entirely differentiating the various structural permutations of the various bridge spans that are found in Oregon or anywhere else.

The Oregon Bridge Inventory includes 41 numeric codes to differentiate various bridge span types. Seventeen of these forms can be reasonably considered within the basic slab, beam, and girder rubric, not counting the 'Composite" span, which may or may not contain SBG elements (ODOT Bridge Log 2002:7). Such specialized categorization is surely appropriate for the analysis of safety and repair of bridges, the primary purpose behind the OBI. It is, however, unnecessarily specific for the purposes of historical evaluation. As a result, for the purposes of this discussion, more general terms should be considered for that group of bridges.

In 1919 Arthur H. Blanchard, editor-in-chief of the American *Highway Engineers' Handbook,* which served as a standard reference work during the early years of highway construction in the United States, took such a simplified approach to the issue of bridge design. Although Blanchard focused on concrete, his terminology is useful here and applies equally well to steel and timber structures, providing a framework for the appropriate model for grouping SBG bridges irrespective of the subtle structural differences that are used to classify them for more technical analysis.

> [Reinforced-concrete] beam bridges may be divided into two classes. First those bridges of short span, not exceeding about 20 feet…which are reinforced concrete slabs bearing…on each abutment…The second class is made of similar reinforced concrete slabs, but bear not only on the abutments, but also on two or more reinforced concrete beams which in turn bear also on the abutments…. (Blanchard 1919:1434).

As is noted below in Section 1.7.1, a "slab" bridge historically has also been known as a simple "beam" bridge. In the SBG terminology of Oregon bridges, however, the term "Slab Bridge" refers to spans *without support* below the deck, "Beam Bridges" refers to bridges *with only longitudinal support* below the deck and "Girder Bridges" refers to bridges with *longitudinal and transverse* structural members below the deck (Smith et al. 1989:121). These categories, already illustrated in Figures 1.1 and 1.2, are considered the standard structural categories for this context, as detailed below.

1.7.1 Slab Bridges

A slab bridge—a span with no support below the deck--is simply the concrete expression of the simplest form of bridge, a fixed horizontal member that spans between two points over an obstruction (Figure 1.13). Historically slab bridges are also, if somewhat confusingly, known as “beam bridges” since in structure the slab functions as a beam — little more than the evolution of a fallen tree that allowed passage over the creek. Limited by capacity, simple concrete slab bridges are generally found only in smaller spans. “Slab bridges are well adapted for spans of from 10 feet to about 25 feet. They are simple in design and give maximum head room…” (Ketchum 1920:273).

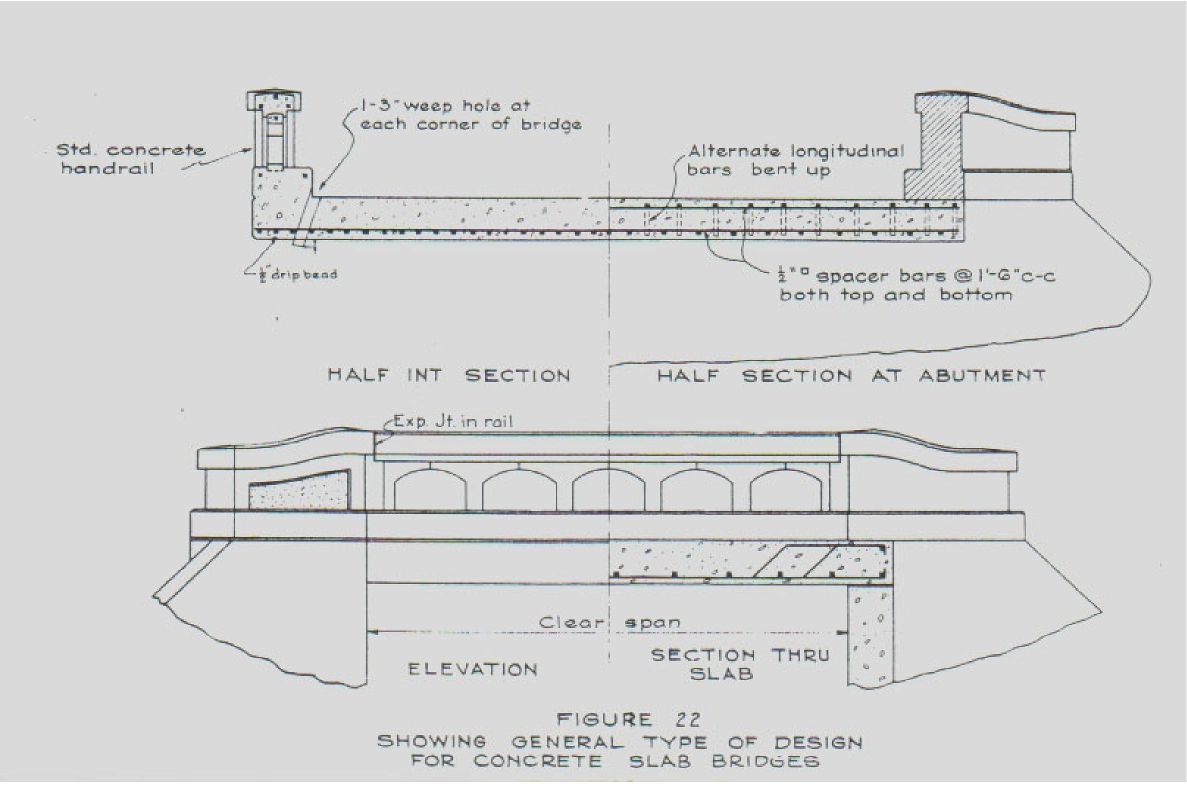

Figure 1.13. Typical Slab Bridge Design, Oregon Examples, 1929
Source: McCullough (1929:55)

Since they can only span short distances, slab bridges are often used in series, with interior posts or vertical supports between the bridge abutments to allow a longer length. Such series of shorter slab spans are called “multiple span” slab bridges. When a non-segmented *single* slab is used for a long span and requires interior piles or additional

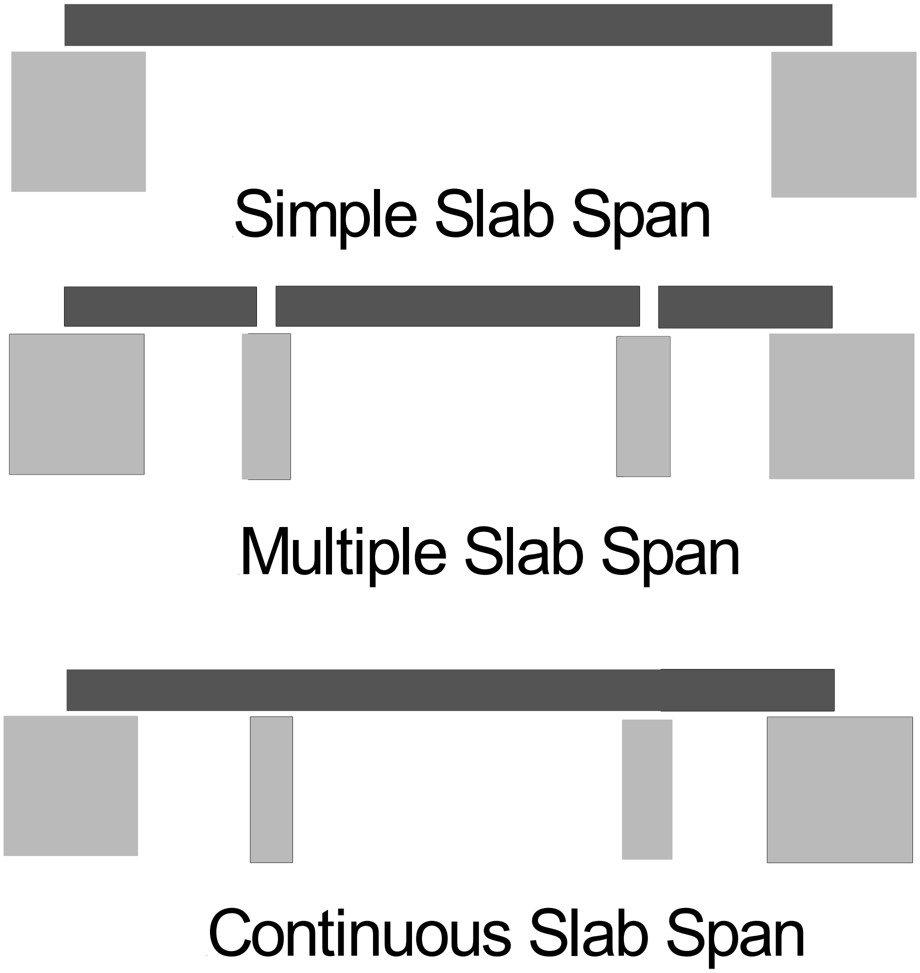

Figure 1.14. Common Concrete Slab Bridge Types

vertical supports, the structure is referred to as a “continuous slab bridge” to differentiate it from a multiple span slab bridge (Figure 1.14). Use of this bridge type expanded significantly following Hardy Cross’s development of the moment distribution theory mentioned previously. Continuous slab bridges are common for viaducts and over crossings.

1.7.2 BEAM AND GIRDER BRIDGES

Following Blanchard’s simple two-element classification system for early concrete bridges, beam bridges and girder bridges are essentially treated as the same, and form the

second, major category of SBG bridges, as differentiated from slabs.[18] Beam bridges are spans with only longitudinal support below the deck, and girder bridges are those with longitudinal and transverse structural members below the deck (Smith et al, 1989:121).

Beam and girder bridges are also often sub-classified by specific designs related to differences in the girder section (I-beams, T-beams), integrated on-site casting (deck girders) vs. pre-cast girders and pre-cast decks, and finally differences between girders in elevation, that recognize simple horizontal members from those that flare or are "haunched" at the abutment or vertical support. This latter design both increases strength at the horizontal/vertical connection but also allows increased vertical clearances over the center of the roadbed or waterway. Additional differentiation is made with regard to interior, transverse, elements between the beams, called "diaphragms," which in Oregon nomenclature serves as the primary difference between "beam" and "girder" bridges. In some cases, both beam and girder bridges are further categorized by whether sidewalks are cantilevered from the main span or supported by it.

As basic structural elements, beam and girder supports can be built of steel or wood, or virtually any other material capable of carrying load, although reinforced concrete is by far the most commonly used material. Concrete roadways supported by steel deck girders or timber slab roadways overlaid with asphalt or concrete are all comparatively common forms in Oregon, particularly for larger spans, and remained in use throughout the post-WWII period.[19]

As differentiated from slab bridges, beam and girder bridges, including the various sub-types enumerated below, for the purposes of this context may be taken to include any bridge with additional structural members below the deck that increase stiffness and deviate from a simple rectangular section (see Figures 1.15 and 1.16).[20]

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[18] From a non-engineering standpoint, as Blanchard's definitions recognize, beam and girder bridges are more similar than different. Adding to the confusion is that girder bridges, like slab bridges, are sometimes referred to as "beam bridges" in the historic literature and the two terms are often used interchangeably. Harris' *Dictionary of Architecture & Construction,* a standard reference, describes a *beam* "…as a structural member whose prime function is to carry transverse loads, as a joist, **girder**, rafter or purlin." Harris then defines a *girder* as a "large or principal **beam** of steel, reinforced concrete or timber used to support concentrated loads at isolated points along its length" (Harris 1975:46, 228, *emphasis added*). A girder then, at least according to Harris, is a specific sort of beam while a beam is also a girder.

[19] The OBI lists 60 steel deck girder bridges in the state (Code 303), ranging in date from 1908 to 1999.

[20] This does *not* include box girders, which are generally rectangular in section but are described later under post-war bridge technologies.

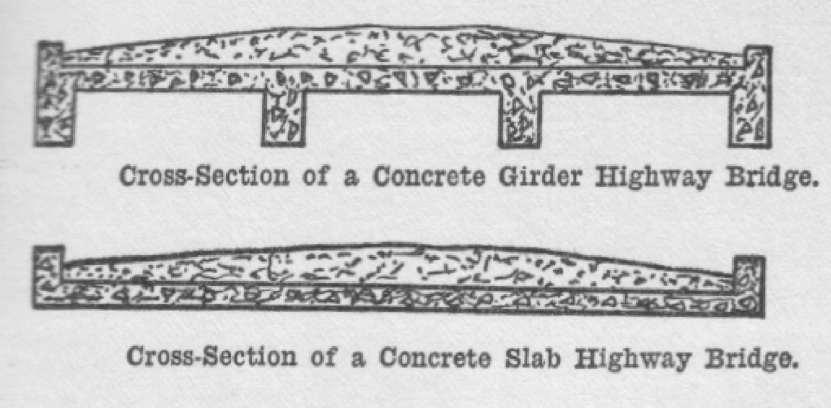

Figure 1.15. Girder and Slab bridges in Section
Source: Radford (1910:95)

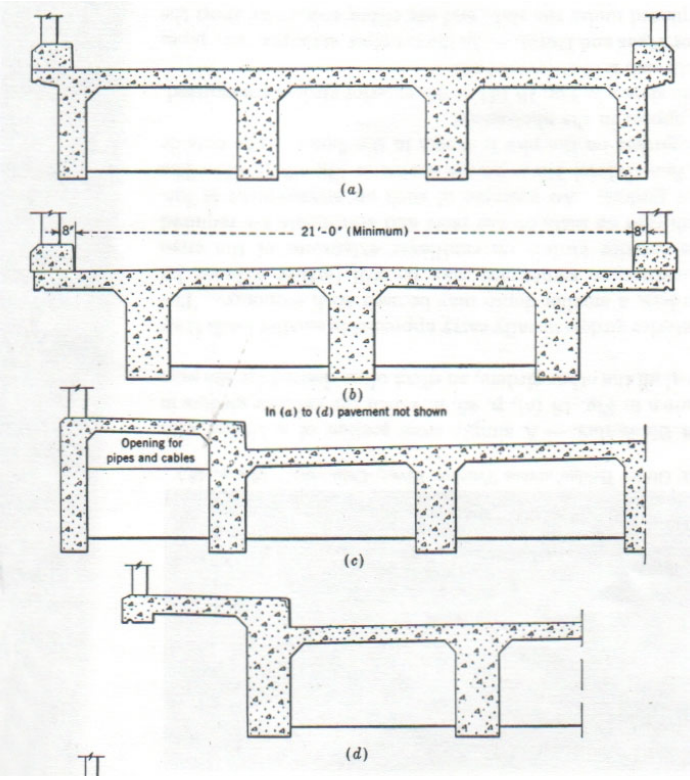

Figure 1.16. Typical Concrete Deck Girder Sections
Source: Taylor (1939:45)

1.7.3 PRE-CAST AND PRE-STRESSED CONCRETE

Within the Oregon Bridge Inventory, concrete bridges, including SBGs, are separately classified as pre-cast and pre-stressed concrete. This refers not to any visual design, but rather to the nature of the material. Pre-cast and pre-stressed reflect two different concrete construction technologies, each of which became increasingly popular after WW II.

Pre-cast concrete construction is exactly as its sounds and refers to the production of standardized elements that are built off-site and then transported and installed whole. “Pre-cast” is the opposite of “cast-in-place” when referring to bridge construction and was first developed as an economical cost- and time-saving process, particularly for non-structural, and standardized elements such as bridge railings. As early as 1914, Oregon Highway Department designs for standard Type “A” bridge rails include the use of pre-cast elements (Figure 1.17). Cement mixer trucks were very rare until the 1930s, which may have made precasting railing components a popular construction method for railings (Robert Hadlow, personal communication, 2003).

Later, however, with the advent of larger and more powerful trucks and cranes, entire bridge decks might be pre-cast at a central location and then moved to a job site as needed. Such pre-casting, all originating from the same contractor or manufacturing site, naturally led to increasingly standardized bridge designs, improved quality control, and otherwise differed little in appearance from a traditional cast-in-place bridge.

A larger technological change in the way bridges were designed related to the development of *pre-stressed* concrete elements. While first postulated in the late 1880s, the technical difficulties of pre-stressing were not fully solved until the 1920s, largely as the result of work by the French engineer, Eugène Freyssinet.

> This valuable invention entails little change in form of framing members but greatly increases the efficiency of their action. Pre-stressing is a method of inducing a controlled stress in the member during construction to counteract undesirable stresses resulting from the imposition of the working load. In the fundamental case — that of a simple beam under deflection — cables are embedded in the lower or tension half of the beam and stretched tightly against the end plates by means of screws or jacks after the member has set. ” (Condit 1968:247).[21]

Generally also pre-cast, pre-stressed concrete members saw increased use in building construction after WWII.

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[21] Freyssinet is of note in Oregon through his connection with Conde B. McCullough’s design for the Isaac Lee Patterson [Rogue River] Bridge at Gold Beach, the first structure in the United States to use Freyssinet’s method for pre-compression of reinforced-concrete arches (Hadlow 2001:4).

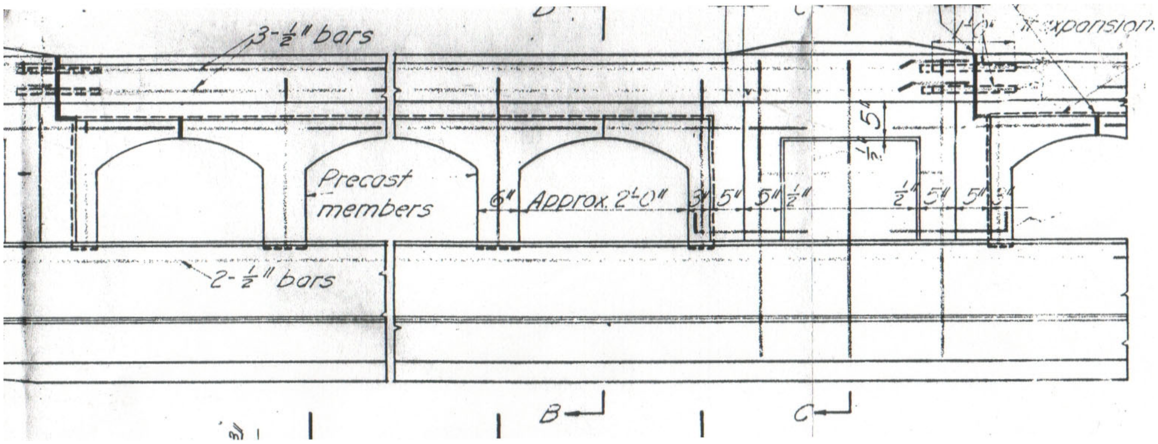

Figure 1.17. OSHD Standard Handrail Type "A" 17-Feb-1921
Drawing No. 1528 (note use of pre-cast members)
Source: ODOT Bridge Correspondence File #1

> The application of pre-stressing to bridges has grown rapidly and steadily, beginning in 1948 with high-strength steel wires in the Walnut Lane Bridge in Philadelphia, Pennsylvania. According to the National Bridge Inventory…from 1950 to the early 1990s pre-stressed concrete bridges have gone from being virtually nonexistent to representing over 50 percent of all bridges built in the United States (TRB 2002).

Pre-stressed, and pre-cast, concrete elements do not inherently result in different design or visual character in bridge construction. However, as the result of the standardization of elements and the replication of hundreds of bridges from what amounts to the same mould, bridges built with these materials are easily recognizable as a particular "type" differentiated from their earlier, site-built, counterparts. This is due, in part, to the adoption of standardized engineering practices by the American Association of State Highway Officials (AASHO). In 1956 this group developed standard pre-cast beam sections that became the defacto starting point for all subsequent highway bridge work (Dean 1959:64). Perhaps more important was the massive demand for new highway bridges that resulted from the passage of the Federal-Aid Highway Act of 1956, what is generally known as the Interstate Highway Act.

> Probably the most spectacular advance in short-span bridge practice in recent years has been the development of pre-cast, pre-stressed, and pre-tensioned concrete girders, slabs and channels… (Paxson 1960).

As the result of standardized construction, typical pre-stressed concrete beams typically are "I" shaped in section as shown in Figures 1.18 and 1.19). When the upper element is extended to form a "T," the cantilevered top portions are joined to form the bridge deck. This latter form is usually referred to a Tee Beam Bridge.

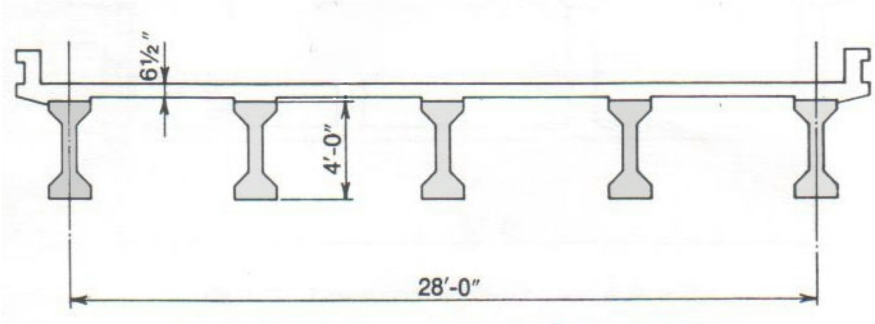

Figure 1.18. Typical Pre-cast "I" Girder/Beam Bridge Section
Source: Libby & Perkins (1976)

Figure 1.19. Typical Pre-cast I-Beam Overpass, Interstate 5, Lane County, OR
Source: Author Photograph, May 2002

1.7.4 BOX GIRDERS

As mentioned earlier, slab bridges are easily differentiated visually from beam or girder bridges by their essentially rectangular section, with a flat or smooth underside. Box girders, a much later design, also have smooth undersides and became popular for bridge construction in the late 1960s. As shown in Figure 1.20 below, a box girder bridge, in section, is simplistically a girder bridge with a bottom. Box girders are often used for curved overpasses and similar installations, given their particular structural capabilities

(Figure 1.21). The OBI recognizes single and multiple box beams as individual structural types. Even more recent developments include multiple pre-cast individual box girders placed in parallel series —a bridge type known as "adjacent pre-cast box girders."

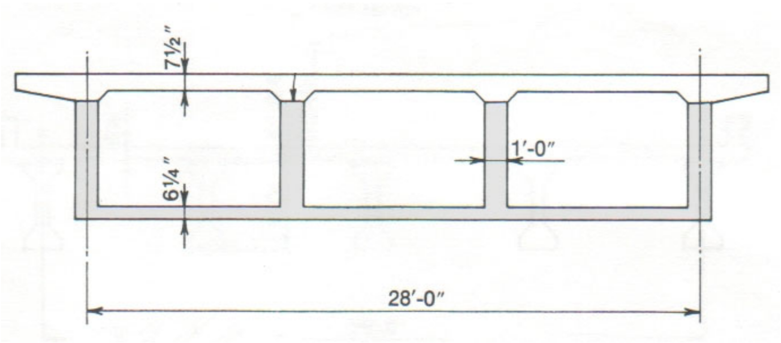

Figure 1.20. Typical Box Girder Bridge Section
Source: Libby & Perkins (1976)

Figure 1.21. Box Girder Overpass on Interstate 5, Douglas County
Source: Author Photograph, May 2002

1.7.5 FRAME BRIDGES

Frame bridges (Figure 1.22), identified independently from frame culverts in the OBI, are essentially "U-section" structures where the slab deck is integrated into the vertical abutments forming a single unit. "If the slab forming the superstructure is rigidly connected with the abutments, the structure becomes a rigid frame…" (Taylor et al.

1939:29). Frame bridges are typically of smaller spans than other forms and temporally were more common in the earlier years of the period of significance.

Figure 1.22. Perry Overcrossing, Baker-Unity Highway, Photo Date 1939
Source: ODOT Archive

1.8 CONCRETE BRIDGE DESIGNS, POST-WWII AESTHETICS

During the 1920s and 1930s Oregon's highways, like most in the nation, relied heavily on steel truss bridges of varying design and also, under the guidance of Conde McCullough, benefited from his particular skill in the use of concrete arches for the design of major spans. As already noted, concrete SBG bridges were generally smaller, and often simply designed structures.

With the war's end in 1945 and the rapid increase in population and automobile travel throughout the West, Oregon's highways underwent a second major wave of construction and expansion. In 1947 Oregon's "Legislative Interim Committee for the Study of Highway, Road, and Street Needs, Revenue and Taxation" embarked on a year-long

analysis that culminated with a report entitled “Highway and Transportation System in Oregon — Present and Future Needs.” At that time the State anticipated future funds over more than $66 million for road improvements over the next ten years. As reported in the Commission’s *Biennial Report*, The State Bridge Department was responsible for over 177 new structures, including the following (OSHC 1948:101):

101	New culverts and bridges
7	New highway-railroad grade separations
7	New highway-highway grade separations
4	City and county bridges

By the early 1950s national efforts were underway to completely revamp the existing system of highways and Federal routes, which were considered woefully inadequate to the county’s post-war transportation demands. Oregon’s State Highway Engineer Robert H. Baldock, writing in 1954, stated:

> Nationally, the noisy, nerve-wracking traffic jam is rapidly growing worse. Each day as the volume of movement over roads and streets grows higher — it has nearly doubled since 1945 — travel delays, congestion, and accidents are also on the rise….During the next decade about half of our existing main roads will wear out — many of them already are functionally obsolete….Our highways badly need modernization and expansion… (Baldock 1954).

In 1956, after massive political wrangling, President Dwight D. Eisenhower signed the Federal-Aid Highway Act and initiated the beginning of the Interstate Highway System, what would become the single largest construction project in history.

The construction of the Interstate Highway system represents the heyday of concrete SBG bridges, as evidenced by the sheer number of these structures found along the new highway corridors. Although previously relegated to smaller spans, both by technology and, to a degree, aesthetics, SBG bridges were perfectly suited to the mid-1950s and later construction of the Interstate. The Interstate System, by design, required countless underpasses and overpasses to separate “surface street” auto travel (a term coined to differentiate streets from the controlled access of the “freeway” — a roadway free from stop signs or other impediments) and rail travel.[22]

With so many bridges being required, the aesthetics of bridge design, fueled by both economy and new ideas about beauty, changed. Before WWII, nationally recognized

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[22] Generically over- and underpasses, both for auto or rail, are termed “grade separations” and such were a required component of the “freeway” limited access Interstate concept.

bridge engineers such as Conde McCullough and Wilbur Wilcox had developed technologies for constructing cost-effective but still highly detailed structures. McCullough in particular was known for his recognition of the important visual role a bridge could play in the landscape. In the pre-WWII era such sentiments, though not always successfully achieved, guided bridge design nationwide. In the mid-1920s the Portland Cement Association, representing the industry, wrote on the subject of "Bridge Beauty" that;

> Bridges form a dominate feature in any landscape in which they occur. In addition to being structurally sound and efficient for their purpose, the appearance they present to the eye should be an essential part of the problem of designing (Portland Cement c. 1925:4).

In the late 1930s, responding in no doubt to new ideas regarding modern architectural design and "function," the Portland Cement Association published a entire treatise on the design of concrete bridges, illustrating new and appropriate design trends in America and reflecting a belief that design and structure should be integrated and bridges should not be subject to "applied" aesthetics after the fact.

> Most of the volume in bridge construction is in the type of bridges of intermediate size, such as simple and continuous deck girder bridges, rigid frames, and arch bridges. A great many of the structures built are strictly utilitarian and lacking in architectural qualities. The last decade or two has fortunately shown a very great improvement in this field and few bridges are now designed without at least some regard to architectural effect (Portland Cement c. 1937).

The prevalence of this idea, however, and in a larger sense the entire relationship between engineering and architecture, faced three not entirely unrelated challenges by the mid-1950s. The first, obviously, was the sheer number of bridges and grade separations that the new limited-access Interstate System would require, an issue that made cost and speed of construction overwhelming concerns. The second was the increasing standardization associated with highway design as the result of growing Federal funding and the continually strengthened regulatory framework of the American Association of State Highway Officials.

The third, and perhaps most telling, was the rise of new architectural ideas that found increased favor in simplicity and unadorned functionality. Growing out of the so-called "International Style" that first took hold in pre-war Europe and was exported to the United States as many of its leading proponents fled Nazi Germany, the leaders of modern architecture in the United States had turned their "form-follows-function" approach to bridge design by the late 1940s. *The Architecture of Bridges*, a publication

of the New York-based Museum of Modern Art, was written by Elizabeth Mock, an associate of Frank Lloyd Wright, and published in 1949. Mock found bridges an exceptional type, in a way the epitome of melded form and function.

> Bridges are architecture, but architecture of a very special kind, unique in its single-mindedness….the function of a bridge is simply the continuation of the roadway over a void, its structure is both means and end … (Mock 1949:7).

In scathing prose, Mock lambastes the designs of reinforced-concrete bridges of the previous era as inept, vulgar and in one case absurd, noting that "steel reinforced concrete is a patient material, all too tolerant of torture. The plasticity that is its great advantage is also a weakness, for it permits all kinds of gross indignities…" (Mock 1949:84-85). Instead, Mock's new aesthetic promoted simple lines that accurately expressed structural members and little more. The decorated concrete bridges of the earlier era, were, in her view, grotesque.

Ideas such as Mock's found sway with much of the engineering community — it allowed concentration of public funds on the structural systems, not the "frills." This functional focus independent of aesthetics hastened an unfortunate disconnect between engineering and architectural concerns that would become standard practice for much of the latter 20th century. The general public abrogated whatever role it may have once played in bridge aesthetics in favor of fast construction schedules, lower costs, taxes, and, ultimately, the safety-based standardization preferred by ASSHO and similar engineering-focused organizations. All these factors, cost, ease of construction, speed, safety, and simple functional design were perfectly met by reinforced-concrete bridges, particularly following the development of pre-cast and pre-stressed girders.

But not everyone remained convinced that this new approach to bridge construction was entirely successful in all situations. Glenn S. Paxson was Oregon's Assistant State Highway Engineer, having risen from a start as a field engineer in the Bridge Department under McCullough, his former teacher at Oregon Architectural College. Paxson had served as acting Bridge Engineer during construction of the Coos Bay Bridge and would later succeed McCullough as the State Bridge Engineer, serving for many years.

Paxson played a significant role in Oregon's bridge programs for nearly four decades and was nationally known for his work, serving as Chair of the AASHO Bridge Committee. His comments regarding bridges, particularly their design characteristics, are of particular interest. In January 1960 Paxson lauded the technological improvements developed as the result of Interstate projects nationwide, including new welding techniques, high-tensile bolts, composite bridge construction and pre-cast bridge members. But, perhaps as the result of years working with McCullough, he also saw a certain loss in the direction bridge engineering had taken since the end of World War II.

> The trend in bridge design, as in architecture, is toward simplicity. Plain surfaces and straight lines have largely superceded the ornamentation so common in earlier structures. In general, this is good. A bridge is primarily to carry traffic from here to there, yet perhaps functionalism can be overdone. Perhaps in our worship of efficiency and utilitarianism we are neglecting the properties of our materials, particularly concrete, by not molding them into more pleasing shapes. After all, the structures we build today will still be serving many years from now (Paxson 1960).

PART 2.0 SBG BRIDGES IN OREGON

SBG bridges are among the most basic structural forms available for bridge building and, built first in wood, then steel and concrete, remain a common component of the nation's transportation system. Since its first use in the United States as a bridge building material in the late 19th century, concrete has become the primary choice for bridge construction in Oregon and throughout the nation. The nature of the material, its malleability, cost-effectiveness, and durability and, especially since WWII, pre-casting and pre-tensioning, all serve to make it the nearly ideal choice for highway and local road situations. As a result, concrete bridges, the majority of which are variants of SBG girder design, today form the virtual backbone of Oregon's transportation network. Wood and steel SBG bridges, though not as prevalent as concrete, form a second major element in the Oregon system.

2.1 THE OREGON BRIDGE INVENTORY

According the Oregon Bridge Inventory, updated as of March 2004, there are approximately 10,440 bridges, grade separations, and railroad, pedestrian, and culvert structures of all types and materials located within the State of Oregon. Like the National Bridge Inventory (NBI), the OBI, which includes all state and locally owned bridges, employs a three-digit system to describe individual bridge construction type where the first digit defines the primary construction material and the second two digits relate the predominate design form. This system, while very specific in defining individual aspects of bridge design, complicates the analysis of larger groups of resources as required by this context. That said, the primary or main material descriptors that appropriately fall within the scope of this context are:

1	Concrete
2	Concrete, Continuous
3	Steel
4	Steel, Continuous
5	Pre-stressed Concrete
6	Pre-stressed Concrete, Continuous
7	Wood or Timber

For the second and third digits, the OBI contains 23 separate categories for describing predominant bridge designs. Many of these bridge types may belong within the parameters of this context; however, only limited quantitative analysis was undertaken.

NBI STRUCTURE TYPES, 3 DIGIT DESIGNATION SYSTEM

Material/Design (1st Digit)
1-Concrete
2-Concrete, Continuous
3-Steel
4-Steel, Continuous
5-Pre-stressed Concrete*
6-Pre-stressed Concrete Continuous*
7-Wood or Timber
8-Masonry
9-Aluminum, Wrought/Cast Iron
0-Other

Predominant Design (2nd & 3rd Digit)
01-Slab
02-Stringer/Multi-beam or Girder
03-Girder and Floorbeam System
04-Tee Beam
05-Box Beam or Girders, Multiple
06-Box Beam or Girders, Single
07-Frame (except culverts)
08-Orthotropic
09-Truss-Deck
10-Truss-Thru
11-Arch-Deck
12-Arch-Thru
13-Suspension
14-Stayed Girder
15-Movable, Lift
16-Movable, Bascule
17-Movable, Swing
18-Tunnel
19-Culvert (incls frame culverts)
20-Mixed Types
21-Segmental Box Girder
22-Channel Beam
00-Other

*Post-tensioned concrete should be coded as pre-stressed concrete.

While not entirely exclusive, in general this context focuses on bridges categorized within the OBI nomenclature as “x01,” “x02” and “x03”, defining slab, stringer/girder and girder/floorbeam spans, respectively. Bridges identified under these three predominant design descriptors, including concrete, steel, pre-stressed concrete, and wood or timber primary materials[1] account for 4,962 bridges in Oregon. Several other predominant design descriptors are essentially variants or evolutionary successors to the basic SBG types and, as such, are also appropriately covered by the basic discussion here. These types, identified in the OBI as of predominant designs “x04,” “x05,” “x06” and “x07,” represent Tee Beams, Box beams (in both single and multiple spans) and Frame bridges. Predominant design types “x21” and “x22,” being segmental box girder

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[1] i.e., all Main Material designations “1” through “7” from the above table.

bridges and channel beam bridges, are the latest technological evolutions of the basic SBG type.[2]

Including all nine predominant design forms (1 through 7, 21 and 22) related to the basic SBG technology, and all the possible materials in which such bridges are constructed--four concrete forms (types 1, 2, 5 and 6), two steel forms (3 and 4) and wood/timber (7)--a total of 6,080 SBG bridges have been identified in the Oregon Bridge Inventory as of March 2004.[3]

Broken down by "Main Material" in the OBI, the following table documents all SBG bridge forms in Oregon.

Main *Material* Code	**# of SBG Bridges**	**% of SBG Bridges**
1 -- Concrete	507	8.3%
2 -- Concrete Continuous	1301	21.4%
3 -- Steel	626	10.3%
4 -- Steel Continuous	155	2.5%
5 -- Prestressed Concrete	2731	44.9%
6 -- Prestressed Concrete, Continuous	212	3.5%
7 -- Wood or Timber	548	9.0%
TOTAL	**6080**	**100.0%**

Main *Design* Code	**# of SBG Bridges**	**% of SBG Bridges**
1 -- Slab	2143	35.3%
2 -- Stringer Multi-Beam/Girder	2707	44.5%
3 -- Girder and Floorbeam System	112	1.8%
4 -- Tee Beam	332	5.5%
5 -- Box Beam or Girders, Multiple	572	9.4%
6 -- Box Beam or Girders, Sgl/ Spread	33	0.5%
7 -- Frame	52	0.9%
21 -- Segmental Box Girder	0	0.0%
22 -- Channel Beam	129	2.1%
TOTAL	**6080**	**100.0%**

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[2] Although NBI Design Type "21" (Segmental Box Girders) are logically related to the SBG form, no such bridges are identified in the OBI and so are not reflected in this quantitative analysis.

[3] This total (6080) represents 58% of Oregon's total population of 10,440 bridges of all types according to the OBI data.

Finally, SBG Bridges are classified by date of construction, reflecting those built within the overall temporal period covered by this context (1900-1966) and then, secondarily, within the two major sub-periods (pre-1946 and then 1946-1966, reflecting the post-war and Interstate periods). The breakdown of Oregon's 6,080 SBG bridges by date of construction is as follows.

Date of Construction (OBI "Year Built")	# of SBG Bridges	% of SBG Bridges
SBG Bridges, built pre-1946	569	10%
SBG Bridges, built 1946-1966	2419	40%
SBG Bridges, built post-1966	3092	50%

Further analysis of the above data, representing all 10,440 bridge structures included in the Oregon Bridge Inventory shows that more than 6 out of 10 (58%) Oregon bridges are of SBG designs. And, according to the OBI, there are 2,988 SBG bridges in Oregon that were built in 1966 or earlier, meaning that this context statement is appropriately applied to nearly three out of every 10 bridges in the state. It is these 2,988 bridges that constitute the primary focus of this context. However, due to the essentially similar technological history and continuation of design that characterizes the majority of post-1966 SBG bridge construction, many of these bridges as well may be logically evaluated within this contextual framework.

2.2. PREVIOUS IDENTIFICATION OF HISTORIC SLAB, BEAM AND GIRDER BRIDGES

As noted earlier, the primary historical study of concrete bridges has naturally been focused upon the major coastal structures designed by Conde McCullough, along with several other examples of his work from the pre-WWII period. Few of these structures, although concrete, are of SBG design. Concrete bridges constructed as a part of the Columbia River Highway, now designated as a National Historic Landmark, include several examples of the SBG form. "The bridges of the Columbia River Highway comprise one of the finest collections of early twentieth century reinforced concrete structures in America" (Smith et al. 1989:133). As a type, very little effort has been directed toward any comprehensive analysis of Oregon's steel or wood SBG bridges, or even any minor geographic grouping of such bridges, prior to this study.

While many individual bridges in Oregon have been evaluated as a part of the Section 106 process of the National Historic Preservation Act or as part of other compliance work, the only systematic inventory of bridges in that state has been Historic Highway Bridges of Oregon, based on fieldwork and archival study completed in the early 1980s. With few exceptions this inventory specifically limits its focus to bridges 50 years or older, and established 1941 as the cutoff date for study. "The cutoff date was set to include Depression-era structures approaching 50 years of age" (Smith et al. 1989:41, emphasis added).[4]

As to the SBG bridge as a design type, Historic Highway Bridges of Oregon notes that:

> The majority of early bridges in Oregon are of the slab, beam and girder type…this bridge type has not received much historic attention because of the normally common design, the relative uniformity of appearance, and the large numbers (Smith et al. 1989:121).

Even with a cut-off date that by definition excludes the Interstate and the numerical majority of bridges constructed in the state, Historic Highway Bridges of Oregon does document selected SBG structures and so remains the only attempt at a statewide evaluation of the type. Specific SBG bridges identified in that study as "outstanding historic bridges" are as follows.

Bridge Name	Bridge No.	County	Bridge Type	Date
Dollarhide	3781	Jackson	Concrete Deck Girder	1914
Old Mill Race	24T04	Umatilla	Concrete Slab	1914
Steinman	3780	Jackson	Concrete Deck Girder	1914
Beaver Creek/Sandy River	4522	Multnomah	Conc Deck Girder	1915
Fifteenmile Creek (Seufert)	308	Wasco	Concrete Deck Girder	1920
Mill Creek [West 6th Street]	464	Wasco	Concrete Deck Girder	1920
Pringle Creek [Liberty St SE)	1357	Marion	Concrete Deck Girder	1928
Pringle Creek [Church St SE]	608	Marion	Concrete Deck Girder	1929
Chasm [Neahkanie Mountain]	2733	Tillamook	Concrete Deck Girder	1937
Necarney Creek	2311	Tillamook	Steel Deck Girder	1937

(source: Smith et al. 1989:121)

Historic Highway Bridges of Oregon additionally identifies 14 SBG bridges in the "reserve category" as examples of the type that might be considered historically significant in the future. These bridges are shown in the following table.

Bridge Name	Bridge No.	County	Bridge Type	Date
N.E. Grand Ave Overcrossing	7040	Multnomah	Steel Deck Girder	1907
N.E. 12th Ave Overcrossing	7039	Multnomah	Steel Deck Girder	1910
McCarthy Creek	n/a	Multnomah	RF Concrete Deck Girder	c1914
Johnson Creek	51C02	Multnomah	RF Concrete Slab	1915
Columbia Slough (NE Union)	1377C	Multnomah	Steel Deck Girder	1916
Rhea Creek	49C23	Morrow	RF Through Girder	1916
Mosier Creek (State Road)	118	Wasco	RF Concrete Deck Girder	1917
Beltline Overcrossing	2418	Clatsop	RF Concrete Slab	1921

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[4] The nature of studies like *Historic Highway Bridges of Oregon*, and this context statement, requires that they are fixed in time and this means that any fixed date, be it 1941 or 1966, will eventually require revision. It is largely in recognition of this fact that the temporal boundaries of this context are extended to a logical "cutoff date" rather than strictly adhering to the somewhat arbitrary 50-year rule of the National Register evaluation process.

Euchre Creek Bridge	15C31	Curry	RF Concrete Deck Girder	1927
Pringle Creek (Commercial St)	1340	Marion	RF Concrete Deck Girder	1928
Mill Creek (Summer St NE)	1357S	Marion	RF Concrete Deck Girder	1929
Elk Crk (Second Crossing)	1601	Douglas	RF Concrete Deck Girder	1931
Link River	1579	Klamath	RF Concrete Deck Girder	1931
Portland Rd NE, Undercrossing	2131	Marion	Steel Deck Girder	1936

(source: Smith et al. 1989:267-268)

Although evaluated largely through association with the Columbia River Highway, as opposed to their structural types, 17 more SBG bridges, all of reinforced concrete, are included in Historic Highway Bridges of Oregon as historically significant. Including these spans, the total number of SBG bridges identified in this study as either being historically significant or as having potential for such with additional review, equals 40.[5]

The State Inventory of Historic Places, a compilation of local city and county-based inventories of historically significant resources maintained by the Oregon State Historic Preservation Office, also includes a limited number of bridges that appropriately fall within the SBG definition. Query of the state inventory reveals 42 individual bridges of possible SBG design, including 27 of bridges documented as a part of Historic Highway Bridges of Oregon. The SIHP-listed bridges are located in ten different Oregon counties and none post-dates 1940.[6]

While not comprehensive by any means, the following table cross-references the SIHP listings for Jackson and Douglas counties, both of which have resource inventories that include bridges to a greater degree than other counties. Outside the Columbia River Highway, Jackson County's inventory, prepared in 1979 and updated in 1991, contains the largest single SIHP-listed collection of documented SBG bridges in Oregon.[7]

Bridge Name	**Bridge No.**	**County**	**Bridge Type**	**Date**
Myrtle Creek Bridge	19C514	Douglas	Concrete Tee Beam	1930
Elk Creek, 2nd Crossing	1601	Douglas	Continuous, Multi-Beam	1932
Sardine Creek Bridge	1937	Jackson	Continuous, Multi-Beam	1938
Crater Lk Hwy/Prospect	Unknown	Jackson	Concrete (unknown)	1923
Bybee Bridge	3460	Jackson	Concrete, Multi-Beam	1932
Jackson Creek/Hwy 99	29C105	Jackson	Pre-stressed Concrete Slab	1939
Millers' Gulch Bridge	413	Jackson	Continuous Multi-Beam	1920
Birdseye Creek Bridge	412A	Jackson	Continuous Multi-Beam	1920
Neil Creek	380	Jackson	Continuous Multi-Beam	1920

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[5] At least some of these spans have been removed or replaced since the publication of *Historic Highway Bridges of Oregon*.

[6] SIHP data was provided by SHPO's Kimberly Dunn based on a query of resources meeting the following criteria — "Function=Bridge (and) Framing=Concrete (and) PMaterial=Concrete" (May 2003). The SIHP data does not include fields for structural type.

[7] Bridge Number and Bridge Type information are taken by cross-reference with the NBI.

It can be assumed, based on the above admittedly inadequate sample, that some small portion of Oregon's SBG bridge inventory, particularly the pre-WWII structures, have been previously evaluated and are represented in the SIHP. Based on available Oregon Bridge Inventory data, it is considered entirely likely that far more such structures remain but are as yet unevaluated from the standpoint of historic significance.

2.3 POST-WAR SBG BRIDGES

As noted in Section 2.1 above, the vast majority of all bridges in Oregon are dated 1946 or later in the Oregon Bridge Inventory. During the post-war period, concrete bridges are far and away the most numerous form, a reflection of the cost-effectiveness of the material for bridge use and the increased standardization of pre-stressed concrete girder bridges for much of the Interstate Highway System (Figure 2.1).

As a result of their numbers, comparatively recent construction, and uniformity in design and appearance, this large group of resources has been largely unexamined from a historical perspective other than as elements in specific Federally-funded transportation projects. The primary purpose of this context is largely to provide a reasoned and context-sensitive framework to aide such evaluation as more and more post-war reinforced concrete SBG bridges achieve 50 years of age. Such a comprehensive evaluation tool is additionally timely as a result of functional and safety-related issues that will see many of Oregon's concrete SBG bridges scheduled for replacement or modification in the coming decade.

Although bridges are categorized by structural type, various other elements form the overall visual character. These may be broken down into three basic strata: (1) roadway (including the actual wear surface), (2) superstructure (the girders or slab structure by which the bridge is categorized) and (3) substructure, such as piers and abutments. Bridge rails are a separate entity and, as the most visible element of the SBG type in most cases, play a key role in character definition.

Although the actual evaluation framework is developed in the following Part 3 discussion, an integral element in such a process is to establish a common nomenclature and list of character defining features that allow such evaluation to occur in a systematic and consistent manner. Given the large numbers of post-WWII SBG bridges in Oregon and their fairly standardized design and appearance, it is often only these discrete elements that serve to differentiate one bridge type or group from another. Integrity issues, being consistency with the original design, play a key role as many SBG elements, particularly bridge rails, have been altered by changes in safety standards that once adopted can lead to wholesale retrofits that serve to further homogenize the resource type.[8]

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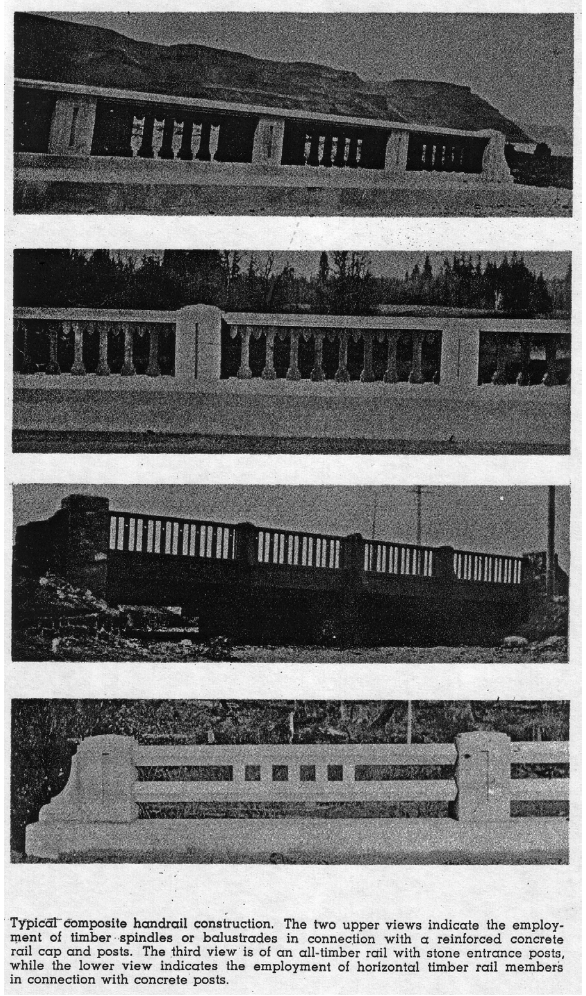
[8] Typical of this latter trend is the replacement/retrofit of early bridge rail designs with the modern "Type F" style, as documented in Section 2.3.1 or the installation of protective screening on overpasses.

With this stated, the following sub-sections identify key elements to be used in both describing and, ultimately, analyzing and differentiating the various forms of SBG bridges built in Oregon after WWII. These specific design and construction features serve as a preliminary lexicon of "as built" characteristics that, along with available information on the history and development of any specific bridge example, will assist in the evaluations of significance and integrity.

Figure 2.1. Post-1966 Concrete Overpass, Interstate 5, Lane County
Source: Author Photograph, May 2003

2.3.1 BRIDGE RAIL DESIGN

As noted previously, Oregon first adopted a "standard" bridge rail in 1914. As a highly visible and traditionally somewhat decorative feature, bridge rail design serves as an initial categorizing element in identifying bridge construction periods. While pre-WWII bridges utilized cast concrete column rails, wood-composite panels, iron straps and many other designs (Figure 2.2), post-war bridges, largely as the result of increased safety testing, appear to rely on a limited menu of fairly modest designs that sequentially became "standard" for new work. For many SBG bridges, particularly post-WWII examples, the bridge rails are the most, if not the only, decorative feature.



Typical composite handrail construction. The two upper views indicate the employment of timber spindles or balustrades in connection with a reinforced concrete rail cap and posts. The third view is of an all-timber rail with stone entrance posts, while the lower view indicates the employment of horizontal timber rail members in connection with concrete posts.

Figure 2.2. Typical Oregon Bridge Rails of the late 1930s
Source: OSHC, Technical Bulletin No.1, 1941:142

A) The "Picket Fence" Steel and Concrete Rail

The initial ODOT design for a steel bar bridge rail was developed in 1937, as shown on ODOT Drawing No. 6436. This version included all full height verticals and was apparently only used once, on the Nahalem River (Miles) Bridge, a 120-foot-long steel through truss built in 1938. In 1939 the design was revised (Drawing No. 6818) with alternate rails shortened to create a staggered effect. Known as the "Picket Fence" bridge rail, the first Oregon bridge known to utilize this rail was No. 6524, the North Fork

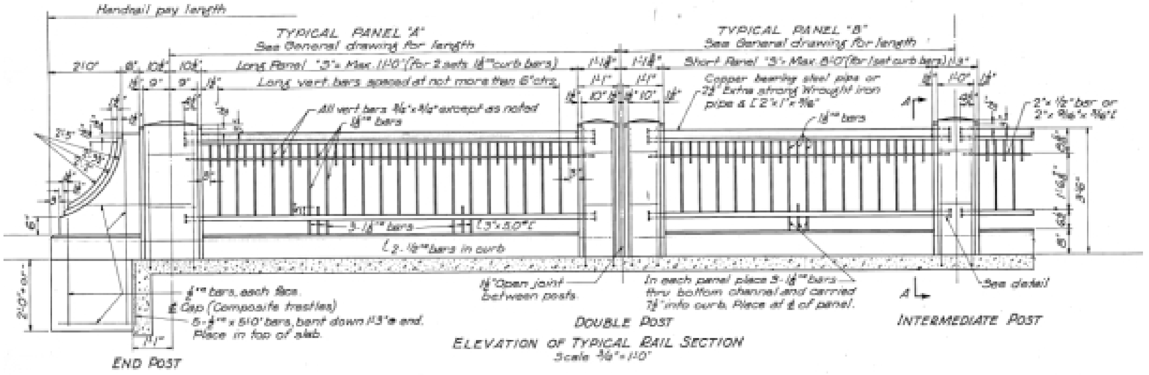


Figure 2.3. Standard Steel Handrail, August 1939 (revised January 1940)
Source: ODOT Drawing 6818

Necanicum River Bridge, in Clatsop County.[9] Later ODOT would adopt this rail as its "Standard Steel Handrail" (Figure 2.3).

Characterized by a balustrade panel of staggered steel bar stock set between cast concrete posts, the picket fence rail appears to be the form associated with Oregon's initial post-war concrete bridge construction. An example of a post-war bridge (albeit an arch bridge) using the picket fence railing is the Pudding River Bridge, completed in 1947, and illustrated in the 18th Biennial Report (reproduced in Figure 2.4).[10]

Figure 2.4. Pudding River Bridge, with "Picket Fence" Type Bridge Rail
Source: OSHC 18th Biennial Report (1949:13)

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[9] See ODOT Drawing No. 7443, dated June 5, 1941.

[10] With a singular exception, every bridge illustrated in the 18th Biennial Report includes a "picket fence" bridge railing, an indication that it had become the Department "standard" for new construction by this time.

Sometimes painted “bridge” green, the steel bars of the picket fence were topped with a painted metal “handrail” element and had strong intermediary horizontal bars, creating an attractive design. Concrete piers that divided the steel panels had chamfered tops moderately reminiscent of earlier wooden railing designs such as that found on the Columbia River Highway. Concrete was also used at the transition to guard railings, either at the end of the bridge span or the approach. A typical example of this stepped detail, also built in 1948, is illustrated below in Figure 2.5.

Figure 2.5. Original Picket Fence Bridge Rail and Concrete Transition Detail
Isaac Constant Bridge, Central Point, Oregon, 1948
Source: ODOT Archive

B) ODOT ‘Types “A” and “B” (Three Stripe)

Apparently replacing the picket fence in the early 1950s, ODOT’s Type A and Type B bridge rails are similar in design. “Type A has a wider curb (greater than 6”) or even a sidewalk and Type B comes with a 6” curb” (Stratis 2002). Types A and B are differentiated from earlier, smooth-sided, cast balustrades, by a pattern of three incised vertical bars, regularly spaced on both the inner and outer faces of the railing. This features lends the design its colloquial name of “Three Stripe” or “Three Bar” Bridge Rail (Figure 2.6).

Figure 2.6. “Three Stripe” Bridge Rail, Mohawk Bridge, Lane County, 1958
Source: ODOT Archive

Type A/B Three Stripe first appears on Oregon bridges in the early 1950s and appears to have remained the defacto standard for much of the remaining temporal study period, through 1966. ODOT Drawing #20340 (Figure 2.7), dated November 1964, identifies the railings as “Standard Concrete Parapet Rail” and a casual review of bridges dated 1966 shows the type was still in use.

Type A/B Three Stripe seems particularly prevalent for Interstate overpasses and grade separations (Figure 2.8) although many examples have been retrofit on the interior face with Type F protection (see Subsection “E,” below).

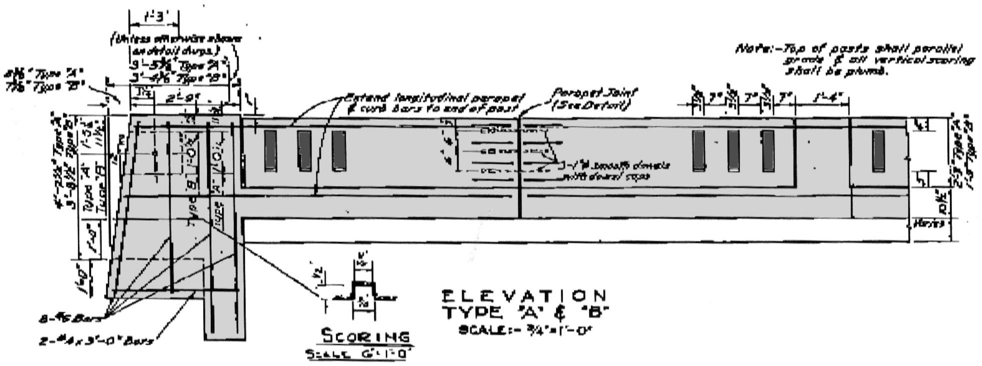

Figure 2.7. Type A/B Bridge Rail
Source: ODOT Drawing 20340 *(shaded for clarity),* 1964

Figure 2.8. Type A/B Bridge Replacement Rail
Isaac Constant Bridge, Central Point, Oregon
Source: Author Photograph, November 2002

C) Standard One-Pipe Rail – ODOT Types "C" and "D"

Replacing Type A/B rails and apparently common by the mid-1960s and continuing into the 1970s or later, this design is documented on ODOT Drawing No. 23185 (Figure 2.9), dated 1971, but was clearly used earlier (Stratis 2002). Also referred to as Types C and D, dependent upon curb designs, Standard One-Pipe Rail consists of 5-inch-diameter aluminum or steel tubes set on round-profile cast aluminum or iron posts (Figure 2.10). The entire metal assembly is bolted to a concrete parapet detailed with two incised groves on either side of each post. A simple curved end at the bridge rail transition, also with incised lines, is mildly reminiscent of the Picket Fence form.

Several variants of Type C/D One-Pipe Rail have been noted, the most prevalent being of essentially the same design but with a second parallel pipe, as shown in Figure 2.11 below. This style, sometimes known as "Two Pipe," retains the incised bands in the concrete parapet and is identical to the above. It is not clear if these two forms were used concurrently or whether one preceded the other. At least one other version of the pipe railing set on metal or cast standards occurred, this with square section rails, but does not appear to have been as common as the rounded forms. In some forms, postdating 1935, square section rails are set within concrete vertical supports at a 45-degree angle, creating a "diamond"-like section that roughly approximates a "split rail" fence type (see ODOT Drawing #5735).

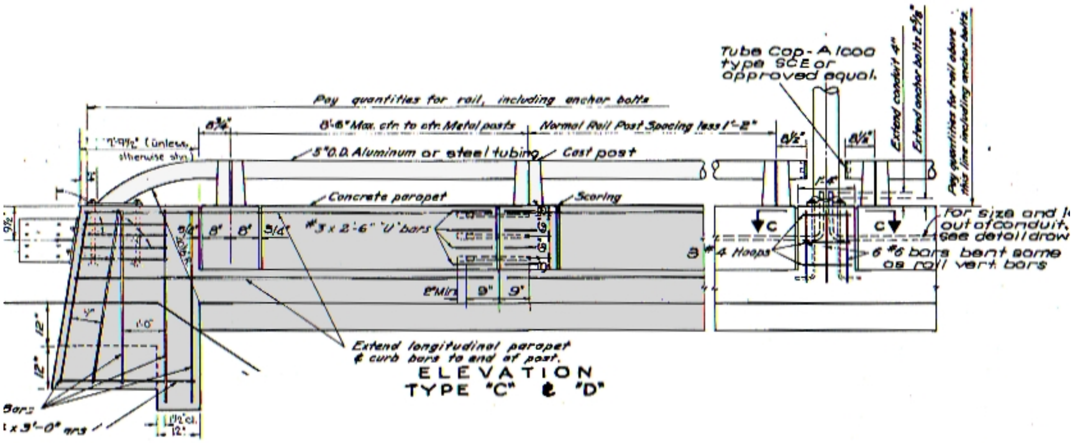

Figure 2.9. Standard One-Pipe Parapet Rail
Source: ODOT Drawing 23185 *(shaded for clarity),* 1971

Figure 2.10. One-Pipe Parapet Rail, Bear Creek/I-5 Bridge #8890N, 1962
Source: Author Photograph, May 2003

Figure 2.11. "Two Pipe" Variant, Rail Type C/D
Medco Lumber Haul Road/Biddle Road Overpass, Jackson County, Oregon
Source: Author Photograph, May 2003

D) Steel Tube Rails (2-Tube and 3-Tube)

Also used to replace the Type A/B bridge rail but seemingly not as prevalent as other forms, are a series of metal square-section rails that are mounted on steel posts and set directly on the concrete deck or curb. This design is differentiated from Types C and D (above) in being constructed entirely of steel members. ODOT Drawing 43497 (Figure 2.12), dated September 1987, refers to the "Standard 2-Tube Curb Mount Rail," while Drawing 43498 (Figure 2.13) documents the "Standard 3-Tube Curb Mount Rail."

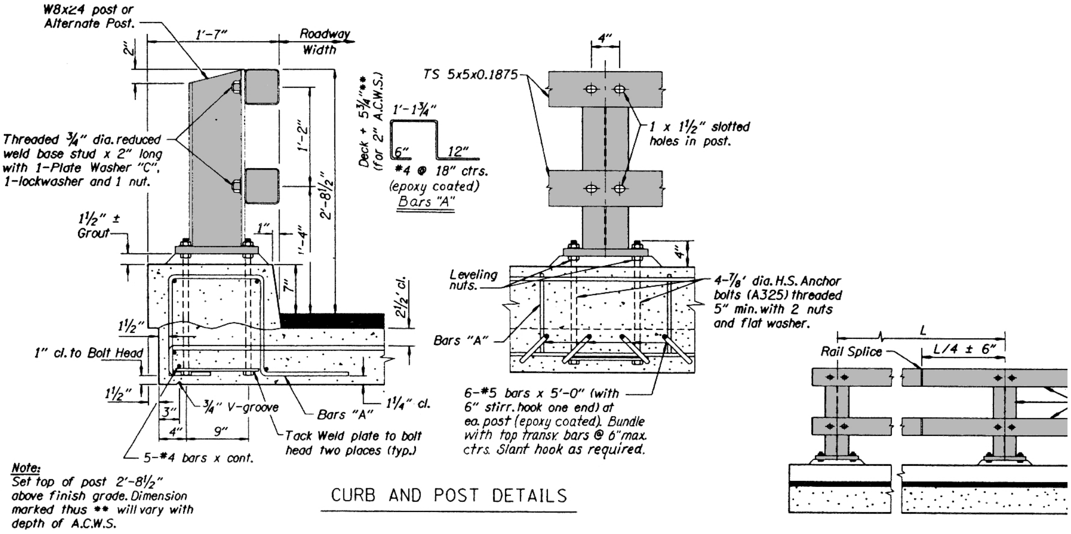

Figure 2.12. Standard 2-Tube Curb Mount Rail, Details
Source: ODOT Drawing 43497 *(shaded for clarity),* September 1987

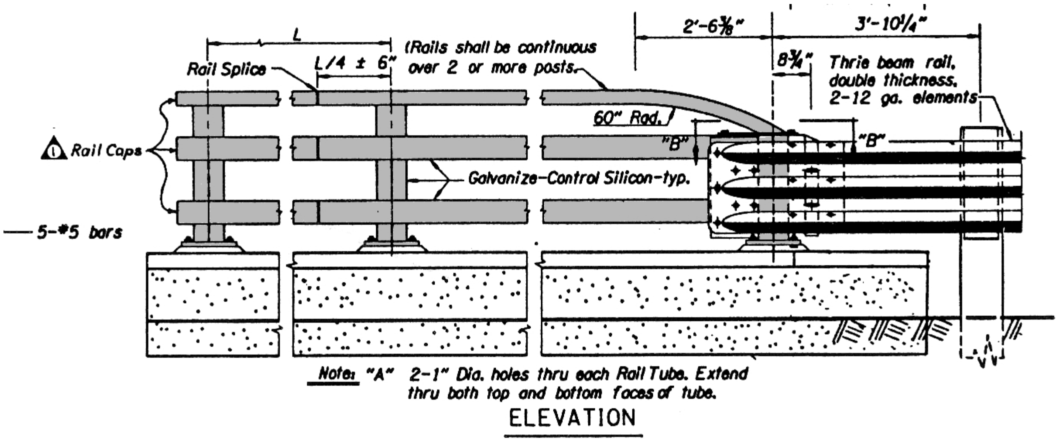

Figure 2.13. Standard 3-Tube Curb Mount Rail, Elevation
Source: ODOT Drawing 43498 *(shaded for clarity),* August 1991

E) Type "F" (New Jersey) Bridge Rail

The current standard bridge rail design for Oregon bridges, as well as an often-used retrofit to existing bridge railings, is the "Type F" rail (Figure 2.14), a direct lineal descendent of what are generally referred to as the New Jersey Median Barricade, first developed in that state in the late 1960s and reaching its perfected, widely-copied, form in the late 1980s.[11] The "F Shape" barrier is slightly taller than the original New Jersey but retains its basic, smooth-face pre-cast character. "It should be mentioned that [the New Jersey forms] are commonly used on single-faced roadside barriers, such as bridge parapets…" (Kozel 2002).

The Type F barrier, both for bridge railing and guard rails, has a proven safety record and is among the most common designs in the nation. "In terms of safety performance….the F-shape is currently our best technology [and] is clearly superior to the New Jersey shape…" (Kozel 2002). As a result, earlier bridge rail forms are often modified as a part of other bridge work via the application of an F-Shape facing, drastically altering the original character of the structure and reducing integrity (Figures 2.15 and 2.16).

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[11] As differentiated from the original New Jersey type, the Type F is higher overall and has slightly different geometry while retaining the essential, unadorned, smooth concrete flared design.

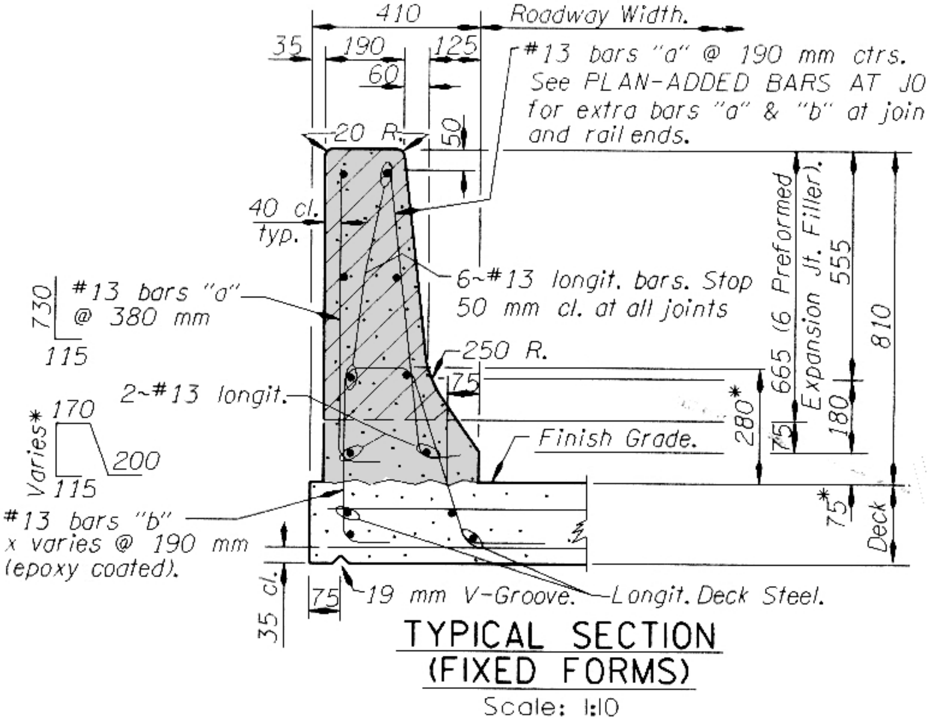

Figure 2.14. "Type F" Bridge Rail, Typical Section
Source: ODOT Drawing BR200 *(shaded for clarity),* 2002

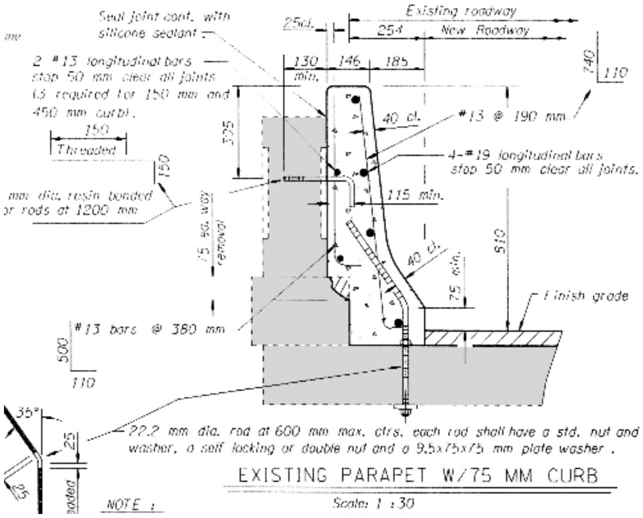

Figure 2.15. Type F Retrofit of Existing Bridge Rail (shown in shade clarity)
Source: ODOT Drawing, BR283

Figure 2.16. Type A Rail, Retrofit
Bridge No. 7572A, Curtis Creek Bridge/I-5, Douglas County
Source: Author Photograph, May 2003

F) Other Bridge Rail Modifications

In addition to the above Type F retrofit, the other major example of alteration to bridge rails result from the addition of protective fencing on overpasses, to shield debris or projectiles from being dropped to the roadway. Most of these alterations are chain link or similar mesh-type materials, mounted on posts or other vertical standards bolted to the top or outside edge of the original rail. These modifications somewhat detract from the original bridge character but, as clearly later alterations, do not seriously reduce overall integrity. Typical is the "Type A" protective fence, shown in Figure 2.17 below.[12]

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[12] Figure 1.19 illustrates an example of Type "C" protective fence, which is flat in section, as opposed to the inward curve of Type "A."

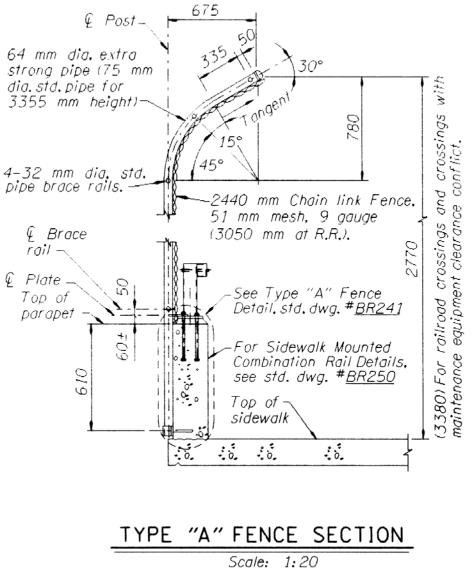

Figure 2.17. Protective Fencing, "Type A"
Source: ODOT Drawing BR 240

2.3.2 GIRDER AND BEAM DESIGNS

Girders and beams, the structure that includes the support elements below the deck, were developed in two basic categories, each with sub-variants that create minor visual differentiation. The major categories relate more to structural and construction issues, being the cast-in-place construction that was later superceded by pre-cast (and generally pre-tensioned) designs. It should be clear that these are the major categories and even in casual review of Oregon bridges numerous variations exist. The following provides visual examples of the major types with several additional sub-categories.

A) Standard Cast-in-Place

Typical of almost all the pre-1946 bridges, standard cast-in-place horizontal beams and girders also appear in some of the early post-WWII SBG bridges. This design is characterized by simple rectangular designs in both section and elevation, presenting a straight, unadorned line underneath the deck and bridge rails (Figures 2.18).[13]

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[13] For an additional example of standard cast-in-place girders see Figure 2.5, above.

Figure 2.18. Standard Cast-in-Place Design, Umatilla River Bridge at Echo,
Umatilla County, Bridge #1165, Built 1926
Source: ODOT Archive

B) “Haunched” Cast-in-Place

Haunched beams, as a type, are distinguished by the flared lower line as it connects with the vertical support piers. This design offered a stronger connection to the vertical members and additionally allowed increased vertical clearance over a streambed or roadway. Most haunched bridges have cantilevered sidewalks, supported by small, projecting, “corbel-like” elements.[14] These later features are detailed from a design standpoint in similar fashion to the terminus of the “Picket Fence” type bridge rail or, as in Figure 2.19, the Type A (Three Stripe) rail.

Several variants of the haunched girder form can be identified with the two main types illustrated in Figures 2.20 and 2.21. The first presents substantially less angle between the verticals, creating what essentially appears a gentle curve over each “bay” rather than the clear three-line geometry shown in Figure 2.19. A typical example of the latter is the Luckimute Bridge in Polk County (Figure 2.20). The second form, apparently the earlier, presents an accentuated haunch that visually approaches an arch (Figure 2.21).

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[14] Some bridges, presumed to be earlier examples, have multiple “corbelled” supports at both the piers and mid-spans while others, such as Anlauf-Elkhead Bridge, are only so detailed at the piers.

Figure 2.19. Haunched Cast-in-Place Beams, Pacific Highway (I-5) Overpass at Anlauf-Elkhead, Lane County, Bridge #2594, July 1953
Source: ODOT Bridge Files

Figure 2.20. Luckimute Bridge from Downstream, February 1956
Source: ODOT Bridge Files

Figure 2.21. Haunched Girder, Isaac Constant (Bear Creek) Bridge (Eastbound)
Jackson County, Bridge #697, 1948
Source: Author Photograph, November 2002

C) Pre-cast I-Beams (Panel-sided)

As noted earlier, pre-cast construction came into particular favor after 1956 with the adoption of AASHO standard precast girder sections and the rapid construction pace required to build the Interstate system. Pre-cast bridge I-Beam girders, typically pre-tensioned to reflect the improved technologies of the day, almost entirely superceded earlier cast-in-place designs for all but the longest or most challenging of spans. From the outer edge of the span the I-Beam section, boxed out at the intersection with vertical support piers, creates a character-defining framed panel that visually allows for easy identification of the type (Figure 2.22).

> Refinements in the manufacture of the principal materials used in bridge construction; namely concrete, metal reinforcement, and structural steel, permits the use of design types and construction not generally in use in the past. Developments in the manufacture and use of concrete and high stress stranded steel wire permit the use of precast, pretensioned or post-tensioned concrete structures with lengths considerable longer than those using conventional materials (ODOT 23rd Biennial Report 1958:114).

Figure 2.22. Typical Pre-Cast I-Beam with "Panel" Sides, Mountain Ave Overpass, I-5
Jackson County, Bridge #8739, 1963
Source: Author Photograph, May 2003

D) Box Girders

Box girders are a structural evolution of the standard beam and girder form, with the lower chords of the interior beams connected with a flat panel, providing additional rigidity and, as a by-product, creating a smooth, streamlined, underside (Figure 2.23). Used later and perceived as not only structurally, but aesthetically, superior, in many ways to the earlier open girder bridge form, box girder bridges are the archetypal bridge of the modern "superhighway" in the public mind. The form is particularly well-suited to overpasses, where the underside is entirely visible, and allows for graceful arc bridges and curved or skewed roadways that are typically used for on-ramps and interchanges.

Figure 2.23. Scholls Ferry Overcrossing at Highway 143
Washington County, Bridge #9672, Built 1968
Source: ODOT Bridge Files Photo, May 1970

E) Timber Decks

As noted in Section 1.4, timber bridges rely on typical beam and girder sections to support laminated wood floor decks or, in composite designs, decks of concrete or other materials. Timber decks are generally of laminated small-dimension materials laid perpendicular to the supporting elements and are typically visible along the bridge edges, below the bridge rails (see Figures 1.4 and 1.5). Modern timber decks of glu-laminated material may include webs, or hollow-sections. All timber work benefits from a variety of steel or iron straps, bolts, and other fasteners that help tie members together in a positive fashion. Timber bridges often utilize a wooden bridge railing with vertical supports face-mounted to the supporting beams and projecting above the roadway. Horizontal wood members, usually painted white for visibility, are used as the rails (Figure 2.24). Similarly designed crash rails were first developed for the Columbia River Highway, becoming a regional standard in the western United States during the 1920s.

Mill Creek Bridge on Mill Creek Rd., in Milwaukie 10/13/61

Figure 2.24. Timber Beam Bridge with Typical Wood Bridge Rail
Source: ODOT Archive

F) Timber Beams

Independent of length and dimension, the primary variation for timber beams as used in bridge construction is between solid stock and stacked laminated beams. Some early, smaller spans that used full-round logs as the support beams are likely present in Oregon, although it is assumed that these are primarily private or purposely "rustic" designs in parks of limited traffic loads.

Figure 1.4 shows a typical solid timber beam design while Figure 1.5 shows an early laminated structure. This is primarily a dating device, glu-lams being far more common in the post-WWII period as the result of improved glues. Modern laminated beams are often characterized by shorter sections, laminated both in length as well as "stacked lams" that are simply a series of equally long pieces of wood glued layer-cake style to form the necessary section. Modern, stacked laminated beams are often characterized by rounded-over edges, as opposed to sharp 90-degree corners of the earlier types.

Timber beams, whether solid or laminated, can additionally be found in girder bridges, with transverse supporting elements extending between the longitudinal members to provide additional strength and stiffness to the structure.

G) Steel Beams and Girders

Steel as used in bridge construction can be divided into two basic categories that reflect temporal advances in construction technology — rolled section beams versus the later use of welded members. Rolled sections refer to "H" or "I" or other shapes that are manufactured whole, the earlier of the technologies. Welded section beams are made of flat plates, welded into various shapes. "We have come a long way since the days of the old rolled beam. Incidentally, rolled beams are virtually a museum piece in the West…steel girders are welded and fabricated from steel plates" (Elliott, 1969:98). Like timber, steel supported bridges often utilize transverse members, either as solid elements or diagonals, for additional support (Figure 2.25).

Like welded versus rolled beam design, bridge connections (how the individual members are tied together into a unit) serves as a temporal guide as well. Early steel bridge are connected by rivets, while later designs are bolted or welded.

H) Composite Design

Steel, wood, and concrete, each have individual strengths and weaknesses for use in bridge design. These range from weight capacity, durability, and, of course, cost. In Oregon noted bridge designer Conde McCullough achieved his national reputation in no small part due to his facility for recognizing cost-effective designs based on long-term maintenance costs. His *Economics of Bridge Design* was a well-received treatise on this subject when published in 1929.

Figure 2.25. Mills Bridge, over Wilson River, (Bridge #1868)
Source: ODOT Archive

The nature of materials often leads to their combination in bridge construction, where steel deck girders support a concrete floor or a timber bridge that rests upon a steel or concrete series of piers or abutments. These structures are referred to as "composite" design and by and large most bridges utilize more than a single material, if only for the wearing surface of the roadbed. For purposes of categorization bridges are coded in the OBI by their primary or "main" material, usually in reference to the structural support system. As a result a steel beam bridge with laminated wood deck and concrete piers is deemed a steel beam bridge and coded as "302" OBI.

2.3.3 VERTICAL COLUMNS AND PIERS (BENTS), CONCRETE

Support columns or piers, forming the "substructure" provide interior support to all forms of SBG bridges, can initially be broken down into two basic categories — square section columns and round section columns.

Unlike bridge rails, no specific "standard" for this portion of bridge construction was developed in Oregon that created a temporal guide as to which pier is usually associated with what period. In general, however, square section columns precede round, more the result of improvements in fabrication technology than any particular design decision.

A secondary difference includes the use of a horizontal element that forms a visual "trestle," or bent, where the deck girders sit on a transverse beam, supported by posts, versus posts that continue directly to the deck girder. Examples of both forms are shown below (Figure 2.26), with the "bent" on the left.[15]

Figure 2.26. Isaac Constant Bridge #697, Central Point, Oregon
showing two different variants of square section support piers.
(Note pre-stressed I-Beam girders on left, haunched, cast-in-place girders on right.)
Source: Author Photograph, November 2002

Round section columns, generally 24 inches in diameter, occur both with and without horizontal beams (i.e., as bents). Both round and square section piers are used in different combinations, with up to four individual vertical elements noted per lane in casual review, as shown at the extreme left of Figure 2.27. Some square section piers are set diagonally to the diaphragm panels. Smaller (12-inch) round piers were commonly noted for in-stream usage.

In addition to these basic types, bridge piers or other substructure elements occur in two other forms — panel piers and what may be thought of as monolithic piers. Panel piers, common for a wide variety of bridge forms including wooden and steel trusses, were

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[15] The interior horizontal panels between the girders of the bridge at right are called "diaphragms" and provide lateral support to girders or beams.

Figure 2.27. Round Section Piers, Bridge No. 8738N
Interstate 5 over Eagle Mill Road, Jackson Cty, 1962
Source: Author Photograph, May 2002

often used for instream work and consist of round section columns with an interior connecting wall. These piers, sometimes called "bar-bell" piers based on their section, provide the substructure support for many SBG forms (Figure 2.28). Later versions (as well as extremely early examples) are simple flat panels (Figure 2.29).

Finally, as concrete bridges moved toward more steamlined designs, various types of monothic bridge sub-structure elements came into use in Oregon. Figure 2.30 provides a far-from-complete illustration of these sub-structure elements, all taken from the various overpasses on Interstate 5.

Figure 2.28. "Barbell" Type Piers Supporting a Rolled Steel Beam Bridge with Cantilevered Sidewalks.
Benke Bridge, Nehalem Hwy, c1934
Source: ODOT Archive

Figure 2.29. Flat Panel Concrete Pier, Pudding River and Butte Creek Overflow, 1970
Source: ODOT Archive

Figure 2.30. Various Monolithic Concrete Bridge Pier Designs
Interstate-5 Examples
Source: Author Photographs, May 2002

2.3.4 TIMBER SUBSTRUCTURAL ELEMENTS

Timber substructures occur in several forms, including cribbing, piles and trestles. Cribbing, stacked round- or square-section members arrayed Lincoln-log style in open-box frames, was an early type of bridge support and few examples likely remain in the Oregon Bridge Inventory. Figure 1.3, in Part 1.0 (Historic Overview), shows an example of timber crib supports.

Piles are simply vertical wooden posts, set directly into the ground, and typically tied together by cross-bracing at mid-span and terminating in a cross-beam. In appearance, the substructure of a pile-supported bridge is much like that of a concrete pier, with the exception of significantly more bents (or groups of supports) due to the lesser capacity of wood versus concrete. Wooden piles, by nature, are often subject to severe weathering and require frequent replacement.

A trestle, according to Webster's, is a framework of timbers, piles, or steel for carrying a road over a depression. Dictionaries of construction often specify that trestles include diagonal supports to strengthen or tie together the main load-carrying verticals (Figure 2.31). Timber trestles occur in a variety of forms and remain a typical support solution in many short-span or low-load situations. Trestles may be of square or round section members, almost always with steel connections for added strength. Improvements in wood-preservation technology have maintained the timber trestle as a viable option for substructure support and within the wooden bridge population it remains an alternative to concrete.

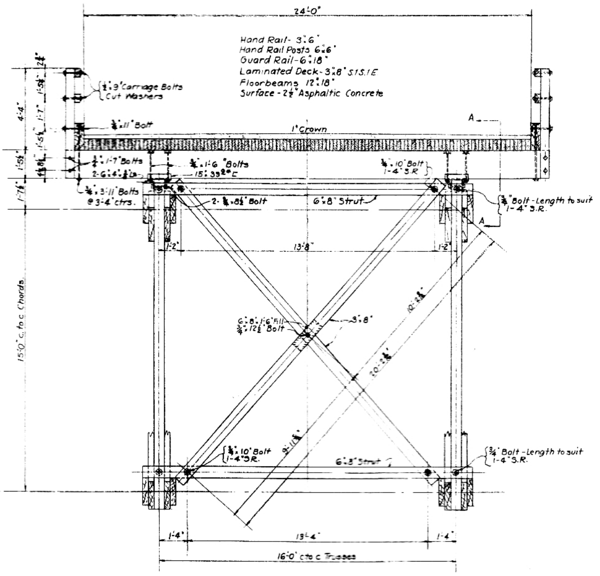

Figure 2.31. Timber Trestle Section
Source: *Highway Structures of Douglas Fir*, c. 1935

PART 3.0 EVALUATION

Given the narrow focus of this context and the nature of SBG bridges, many of the standard aspects of the National Register evaluation process are inherently uniform and straightforward. The assumptions below apply to all properties or resources appropriate for evaluation under the following registration requirements.

3.1 ASSUMPTIONS

This context statement will aid Section 106 and National Register evaluations of slab, beam and girder highway bridges in Oregon. It assumes the following:

1. While applicable to the review of all SBG bridges in the State of Oregon, this context is primarily focused upon the evaluation and review of such bridges built prior to 1967.

2. All resources evaluated under this context are assumed to be owned or managed either by the State of Oregon or other governmental or private entities subject to the requirements of Section 106 of the National Historic Preservation Act and/or Section 4(f) of the National Transportation Act.

3. Anyone employing these evaluation tools is assumed to be entirely familiar with the standards and processes of the National Register as outlined in NR Bulletin 15 and to meet all pertinent professional standards established for such work through education or training as stipulated in the Secretary of the Interior's Professional Qualification Standards of 36 CFR Part 61 Appendix A in the fields of architectural history and/or history.

3.2 APPLYING THE EVALUATION PROCESS TO SBG BRIDGES

For any review National Register eligibility of SBG bridges under this context statement, the following standard National Register evaluation categories apply. Any resource not fitting these evaluation categories must be individually evaluated to account for specific significance.

Standard National Register/State Inventory of Historic Places Data Categories:

Function & Use: TRANSPORTATION; ROAD-RELATED

Primary or "Main" Material: CONCRETE, STEEL, or WOOD

Area of Significance: ENGINEERING and/or TRANSPORTATION

Architectural Classification/Types: BRIDGE

Appropriate Subcategories to the above are:[1]

Reinforced Concrete: Slab
Reinforced Concrete: Slab, Continuous
Reinforced Concrete: Deck Girder
Reinforced Concrete: Box Beam
Reinforced Concrete: Multi-Beam
Reinforced Concrete: Rigid Frame
Reinforced Concrete: Box Girder
Steel: Deck Girder
Wood/Timber: Concrete Deck Girder

3.2.1 INTEGRITY

The National Park Service defines integrity as the ability of a property to convey its significance. Evaluations of bridges under Criterion C focus on integrity of original design. Integrity *is not equivalent to condition,* and it is acknowledged that many of the SBG structures appropriately evaluated under this context will largely be done so in direct response to issues related to their condition or structural capacity. While the replacement of bridges based on condition is certainly a frequent and entirely justifiable necessity for resources of this type, poor condition or failure to meet current design standards does not directly relate to or inherently diminish the integrity of a particular structure.

The evaluation of integrity recognizes and accepts the comparative application of seven aspects — *location, design, setting, materials, workmanship, feeling, and association.* Since this context presupposes that resources will primarily be determined significant under Criterion C for engineering and technological characteristics, certain of the seven aspects are more critical to the integrity of SBG bridges than others. The National Park Service elaborates on historic integrity as follows:

> To retain historic integrity a property will always possess several, and usually most, of the (seven) aspects. The retention of specific aspects is paramount for a property to convey its significance. Determining which of the seven aspects are most important to a particular property requires knowing why, where, and when the property is significant (NPS 1997:44).

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[1] It is noted that the National Register categories for bridge structure descriptions do not entirely coincide with the terms used in the OBI or NBI, reflecting the more technical structural differentiation inherent in the bridge inventories. Refer to Section 1 of this historic context statement for definitions of these subcategories.

In the case of SBG bridges evaluated under this context statement, only those structures retaining substantial connection to the original design in the following aspects should be considered to retain sufficient integrity to relate their historic significance. Evaluators are referred to the nomenclature and partial typology of Part 2.0 to determine original character-defining elements for bridge rails, girder sections, and piers appropriate to the SBG types used in Oregon.

Critical aspects and standards for the evaluation of integrity for the following evaluation criteria are as follows. A specific bridge *has integrity* only when it meets the following:

Location: The bridge should remain on its original location and continue, in general, to serve as originally intended. Bridges relocated during the historic period (i.e., prior to 1967) should be treated as if in their original locations for integrity purposes.

Design: All visible aspects of the design, including elements of the superstructure (e.g., bridge rails) and substructure, should be as original, with only minimal and essentially compatible alterations that do not obscure the original design. Examples may include attached water pipes, electrical conduit and similar minor systems, particularly when located away from the exterior girders, or modifications to the bridge railings, transition elements, or approach guard rails that do not seriously diminish the ability to covey the original character.

Setting: The bridge should retain aspects of its physical setting or environment that are reminiscent of its period of significance. Significant modifications to the built or natural landscape surrounding the bridge that encroaches upon its relationship to the larger transportation network and landscape compromise the bridge's integrity.

Materials: The bridge must remain entirely of its original construction materials, be they concrete, steel, wood or a mixture thereof in composite construction. It must substantially retain its original design form without any intrusively retrofitted structural features, such as added bracing, cross-ties, strengthening bolts, etc.

Workmanship: As above, the bridge should be largely, if not entirely, "as built."

Given the Criterion C emphasis, the above aspects of integrity, related strongly to design, construction and technology of SBG bridges are considered key. That is not to say, however, that the other two aspects (feeling and association) are entirely irrelevant.

3.2.2 PERIODS OF SIGNIFICANCE, 1900-1945 AND 1946-1966

The National Park Service requires that a fixed temporal window, or "period of significance," be defined as a part of the National Register evaluation process as follows:

> Period of significance is the length of time when a property was associated with the important events, activities or persons, or attained the characteristics which qualify it for National Register listing (NPS 1991:42).

To a large degree the construction of SBG Bridges represents a continuum of improvement in structural design, occurring concurrently with the streamlining of exterior ornamentation and standardizing of forms. A fixed period of significance, even when limited only to Criterion C evaluations, is therefore somewhat problematic.[2] For the purposes of evaluation, however, SBG bridges can be divided into two temporal groupings reflecting technology shifts.

A. FIRST PERIOD OF SIGNIFICANCE: 1900-1945

This period represents the earliest identified examples of SBG bridges known to remain in Oregon and continues through the various technological improvements that characterize the construction of bridges through the end of the WWII period. By and large, bridges dated from this period are entirely site-built and, while they become increasingly standardized toward the end of the period, they tend toward more elaborate and individualized design than those to follow. Integrity issues for bridges of this period, many of which demonstrate serial retrofit, are somewhat less than for the post-WWII structures, but still must meet the basic assumptions of the evaluation criteria.

To provide thorough and appropriate evaluation of those bridges surviving from Oregon's earliest highway and road-related development period, an informal subsection of the 1900-1945 period of significance recognizes the increased potential value associated with bridges built prior to 1924.[3] This year is admittedly arbitrary, established to coincide with the completion of Oregon's section of the Pacific Highway, the first paved border-to-border route in the United States located west of the Mississippi River; it also reflects the end of the first burst of highway and bridge activity under the direction of the State Highway Commission. As used in connection with the evaluation criteria presented below, 1923 serves not as a definite point at which design or technology relative to SBG bridges changed, but more as a cue, or a temporal pause, to suggest an opportunity for additional review for potential significance. Again, wise judgment on the part of the

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[2] Significance under Criterion A, for example, which might consider association with the development of Oregon's highway system or the Interstate, is on-going for many bridges, which remain functional elements of that system. Establishing a fixed temporal boundary for a continuing significant use presents unique challenges within the standard evaluation process (see Sebastian 2003).

[3] The OBI documents 140 slab, beam and girder bridges built prior to 1924 that remain in use, including many that have been reconstructed and may retain little or no integrity.

evaluator is assumed to assure that the significance of each resource analyzed under this context is appropriately, and entirely, considered.

B. SECOND PERIOD OF SIGNIFICANCE: 1946-1966

This second period, from the end of WWII to the completion of Oregon's segment of Interstate 5, encompasses the majority of SBG bridges in Oregon. It is characterized by mass production of standardized forms, differentiated only modestly in response to improved technology and safety-related design. Most bridge designs of this period tend toward simple utilitarian functionality, independent of the aesthetic considerations that characterized the earlier period.

Interestingly, nearly three thousand bridges in Oregon, constituting almost half the entire SBG bridge population in the state, were built *after* 1966. It is explicitly stressed that for the most part there is little technological difference between post-1966 structures and their earlier, immediate predecessors, other than the actual date of construction. This is a testament to the maturity and standardization of design and construction as the result of increased knowledge regarding safety, augmented to no small degree by the various regulatory patterns connected to Federal funding. While some additional review will be required as more and more of the post-1966 structures become 50 years of age and older, this context, with only minimal modification, should provide a substantially complete basis for the evaluation of all but the most unusual or technologically distinctive SBG bridges built in the latter portion of the 20th century.

3.2.3 BRIDGE TECHNOLOGY & CONSTRUCTION MILESTONES

The development of slab, beam and girder bridge design includes advancements in technology and material use that have improved load capacity, reduced costs, and allowed for longer spans and longer life. Like many technological improvements, many of these are evolutionary improvements and few can be conclusively dated or ascribed to a particular event or individual in any meaningful way. As a result, a "timeline" of SBG bridge design is more a reflection of the order of events than a specific dating of them. That said, the following provides a temporal list of construction and social issues that are of significance to the understanding and evaluation of SBG bridges in Oregon.

1885	Ransome reinforcing bar invented to strengthen concrete.
1889	Alvord Bridge, San Francisco, first reinforced concrete bridge in United States is built.
1905	First cantilevered concrete girder span built at Marion, Iowa (Condit 1968:257).
1908	First concrete roadway in the United States built in Detroit, Michigan
1911	Nice Creek Bridge (#09601) in Columbia County constructed, the oldest standing reinforced concrete bridge in Oregon.

1913	Oregon State Highway Department established with Henry L. Bowlby as State Highway Engineer and C. Purcell as Bridge Engineer (February).
1914	Thirty-one steel and reinforced concrete bridges built by State Highway Department in Clackamas, Clatsop, Columbia, Multnomah, Yamhill and Marion counties.
1914	American Association of State Highway Officials [AASHO] formed.
1918	Forty bridges built between 1917-1918 by State Highway Commission.
1919	Conde B. McCullough appointed State Bridge Engineer.
1920	[circa] Moment Distribution Theory, developed by University of Illinois professor Hardy Cross is published.
1920	Eugène Freyssinet develops theories resulting in the successful construction of prestressed beams.
1923	Pacific Highway completed from Washington to California border, making Oregon first state west of the Mississippi River with a paved highway for entire length.
1928	Parrott Creek Bridge, Oregon's first use of new rigid frame reinforced concrete construction, completed on Pacific Highway.
1928	Welded connections for steel bridge design introduced by Westinghouse company (Condit 1968:226).
1928	First true rigid-frame steel girder bridge in the US constructed at Mount Pleasant, NY (Condit 1968:226).
1932	Robert H. Baldock appointed State Highway Engineer.
1932	Conde B. McCullough promoted to Assistant State Highway Engineer, remaining Bridge Engineer.
1937	Continuous Hollow Box Girder, introduced by Freyssinet, first used in the United States by Washington State Dept. of Highways (Condit 1968:258).
1937	"Picket Fence" bridge railing appears on ODOT Drawing No. 06436 and is subsequently used on many projects, including North Fork Necanicum River Bridge (ODOT Drawing No. 7443, 1941).
1944	United States Congress passes Federal Highway Act of 1944, proposing a 40,000-mile national system of interstate highways.
1947	Oregon legislature adopts controlled-access law in anticipation of freeway construction.
1947	Walnut Lane Bridge, the first pre-stressed concrete girder bridge in United States, completed in Pennsylvania.
1951	[circa] Type A/B "Three Stripe" bridge rail first used in Oregon.
1952	[circa] Glu-laminated beams gain in popularity for bridge work.
1953	AASHO adopts standard pre-cast concrete beam sections.
1956	United States Congress passes Federal-Aid Highway Act of 1956, marking the beginning of the Interstate Highway program.
1956	Fords Bridge Unit (Myrtle Creek-Canyonville) is first Interstate Highway

	section under contract (Sept 27, 1956).
1959	[circa] Type C/D "Standard One-Pipe" bridge rail first used in Oregon.
1964	First Orthotropic bridge in United States built over Mississippi River at St. Louis (Condit 1968:228).
1966	Interstate 5 completed (July 29).
1969	Historic American Engineering Record [HAER] established.

3.3 EVALUATION CRITERIA

The following registration requirements are intended to serve as the initial screening criteria for SBG bridge evaluations under this context statement. Using the preliminary field data gathered on project bridges, augmented by whatever additional materials are deemed appropriate by the evaluator, the intent of these criteria are specifically to easily and accurately limit additional study to only those SBG bridges appropriately suited to evaluations of potential National Register eligibility. This process seeks to concentrate staff time and funding where it is most beneficial. In a resource base with literally dozens, if not hundreds, of resources that are identical in all but location, such a screening model is entirely warranted and appropriate.

To qualify for listing on the National Register, a bridge must be an intact example of the SBG structural type constructed during one of the periods of significance covered under this context. Integrity of design is the primary consideration for eligibility of this type of structure. The following list serves as a guideline for identifying structures that are potentially eligible for the National Register.

Criterion A

A bridge built between 1900 and 1966 may be evaluated under Criterion A only if it retains integrity of original location, design, setting, materials, and workmanship. In addition, the bridge must have a clear association with the development of transportation resources that have made a noteworthy contribution to the broad patterns of history to be considered potentially eligible under this criterion.

Criterion B

A bridge built between 1900 and 1966 maybe evaluated under Criterion B only if it retains integrity of original location, design, setting, materials, and workmanship. In addition, the bridge must have a clear association with the lives of persons significant in history, architecture, or engineering.

Criterion C

Bridges are eligible under Criterion C if they meet the following requirements and retain integrity of location, design, setting, materials, and workmanship.

Bridges constructed prior to 1924:

- Bridges built during this early period of highway development automatically require an evaluation of eligibility, if they possess the elements of integrity listed above and are comparable in significance to bridges of this era previously determined eligible for the National Register.

Bridges constructed between 1924 and 1945:
To be eligible, a bridge constructed during this period must be comparable in significance to bridges of this era previously determined eligible for the National Register, must possess intact original railings (including, but not necessarily limited to, standard railings) and decorative elements (e.g., piers, pylons, pedestrian overlooks), and at least one of the following:

- Special structural design features associated with a particular site.
- A design that overcame significant engineering obstacles.
- Has no historic-period alterations that obscure character defining features above the road deck.

A bridge utilizing standard designs for the substructure and road deck will not be forwarded for further analysis of eligibility unless it meets the registration requirements for Criterion A, listed below.

Bridges constructed between 1946 and 1966:
To be eligible, a bridge constructed during this period must completely retain original design integrity (i.e., substructure, deck, railings), and at least one of the following:

- A design that has special or unusual engineering design elements (i.e. significant scale, significant engineering obstacles, or aesthetic considerations).
- The bridge must have been completed during the earliest iterations that a design type appeared on Oregon highways (if the design type does not predate 1946 in Oregon).
- An example of a design incorporating significant technological advances (i.e. prestressed beams, post-tensioning, or segmental construction) that was completed within the first two years of the innovations appearing on Oregon highways.

If a bridge does not completely retain original design integrity, it may only be eligible if it is the oldest remaining example of its design type or if it is the oldest design incorporating one of the significant technological advancements listed above.

PART 4.0 TREATMENT

Following the standard format for historic context statements, Part 4.0 “Treatment” generally outlines appropriate strategies, policies, and future work that will protect and enhance any resource determined to be significant under the parameters of the study. Part 4.0 additionally is intended to point out information needs, related topics, and potential for further academic study.

The Slab, Beam and Girder Bridges in Oregon context represents one of the first attempts to look at this very large bridge population from a historic standpoint in anything even approaching a comprehensive manner. Such a process suffers from the normal complexity and variation inherent in the evaluation of more than 6000 individual OBI resources, built of three vastly dissimilar materials and the related, though individualized, structural forms that fall within the general SBG type. The development and, ultimately, adoption of this context as the primary evaluation tool for SBG bridges logically represents a turning point in their future treatment and establishes the parameters by which the best examples will be identified and, hopefully, preserved.

Still, it is the underlying assumption of this study, as stated explicitly in the Introduction, that the vast preponderance of SBG bridges, particularly those built after 1945, will and should be determined *not eligible* to the National Register of Historic Places. This will initially result from lack of distinction as a type and, even where such distinction may have once been present, through lack of integrity as the result of modifications that destroyed, or at minimum, obscure character-defining features.

This is not to say that all SBG bridges are, or should be treated as, insignificant and inherently not eligible resources. Nothing in this context is intended, in any way, to eliminate the conscientious review of SBG bridges under the requirements of Federal cultural resource law. Rather it is to focus compliance efforts on only those intact SBG bridges that most merit it, by eliminating the assumed majority that do not.

Such a focus, backed by meaningful efforts to retain those bridges that meet the standards for eligibility or preservation as laid out in this context statement, is entirely appropriate. While acknowledging the simple, utilitarian and functional design of post-WWII slab, beam, and girder bridges, we must also recognize that they epitomize not only a particular period in bridge design but an entire period in the course of American history. Those SBG bridges from the Interstate Highway period of Oregon’s bridge construction history that do retain substantial integrity are by definition rare and should be acknowledged as such. Each is an exemplar of what in many cases may well be dozens, if not hundreds, of bridges that no longer survive in any recognizable form.

By format, this context limits its temporal focus to the first 66 years of the 20th century and treats bridges built within its two periods of significance (1900-1945 and 1946-1966) as distinct, if related, groups. It is also noted that bridges built after 1966 share essentially similar designs, and in most cases represent direct continuations of trends first established with the initial construction of the Interstate. It is therefore anticipated and recommended that all but the most individually designed post-1966 SBG bridge can be appropriately evaluated using the tools presented here.

Though specifically focusing upon bridges built before 1967, in the larger sense of evolving technology, this context encompasses virtually an entire century of commonplace SBG bridge design.

Figure 4.1. Gervais Road Undercrossing, Northbound Interstate 5
Source: ODOT General Files Photo, January 1971

4.1 PRESERVATION OF SELECTED SLAB, BEAM, AND GIRDER BRIDGES

Following the evaluation guidelines in Part 3.0 (Evaluation), once intact examples of various SBG bridges are identified and determined to be eligible for listing on the National Register of Historic Places, they will be afforded the protection of the Section 106 and Section 4(f) process. In some cases this will likely mean mitigation or documentation prior to replacement or major reconstruction — the nature of bridges and the required structural and functional safety issues associated with public transportation logically taking precedence over preservation.

There will be, however, SBG bridges that do retain integrity and, because of location, facility carried, average loading, and other factors, prove to be logical candidates for preservation and sensitive rehabilitation that allows their retention with a continued ability to reflect their original design and character. That such will occur, even when such is not necessarily the lowest-cost alternative, is the implicit expectation of this document.

Just as this context statement assumes most SBG bridges, specifically those built after 1945, will prove not eligible for listing on the National Register, it also assumes that some will and should. Bridges so identified are important, if not necessarily beautiful, examples of bridge technologies that enabled the quick, cost-effective, and timely construction of Oregon's transporation infrastructure during the 20th century, a period in which automobile travel and highway construction formed a major element of the state's economic focus.

4.2 FUTURE STUDIES AND INTERPRETATION OPPORTUNITIES

Historical evaluation of SBG bridges suffers from the same technological vs. historical disconnects that have long plagued the review of other forms of industrial and utilitarian resources, though perhaps to an even higher degree. Much of the internal process of cultural resource management and compliance with related Federal and State laws largely fails in dealing with what amounts to mass-produced, essentially similar, resources such as post-war SBG bridges, even when such features play an integral role in what clearly forms a major theme in 20th century American life — the development of a statewide road and highway network.

Such a disconnect is not atypical. Early resources, including Oregon's covered bridges and later its steel truss bridges, were once so prevalent and unremarkable as to make efforts toward their preservation initially suspect. Over time, with considerable study and renewed appreciation for the ever-diminished examples of those forms that survived, their preservation has become accepted as an appropriate, if not always feasible, practice. This is particularly true of covered bridges and, of course, the Oregon Coastal Bridges of Conde McCullough.

In the near future, given the anticipated replacement or major structural upgrade of many of Oregon's SBG bridges to maintain public safety and functional transportation systems that play a vital role in the state economy, this context statement will serve as the primary historical document of these resources. Hopefully it will function as intended and allow the expeditious review of their historical significance. Over time, however, as ODOT's

Critical Bridge Project winds to completion, our understanding and appreciation of the role of the SBG bridge in Oregon history will increase in inverse proportion to the number of such structures that remain standing unaltered in the state. Future historical analysis, more in depth than that offered here, will compliment both this context statement and the concurrent work on the history of the Interstate Highway System in Oregon. Potential areas for future academic study concerning SBG bridges include the following:

1. Further refinement and development of the bridge rail typology in Part 2.0, to include earlier Oregon forms and provide clarity on the design history of this feature. This is particularly true of the Picket Fence Bridge Rail, which may or may not have been an in-house Oregon State Highway Department Design. Similar studies that provide non-engineer focused “bridge watcher’s” guides to discrete elements of bridge construction would both improve academic understanding and, potentially, help the public gain appreciation for Oregon’s bridges.

2. Improved coordination of the Oregon Bridge Inventory with the historic review process and, ultimately, the State Inventory of Historic Places. The OBI, regularly maintained by ODOT, represents a wealth of comparative information that with additional analysis could serve as a valuable tool for understanding patterns of development in Oregon’s transportation history.

3. A comprehensive history of Oregon’s road system and the history of the State Highway Commission’s role in Oregon economy has not been written. Most historical accounts of the State Highway Department and its successor, the Oregon Department of Transportation, tend to focus upon administrative issues. The economic impacts of Oregon’s century-long commitment to comprehensive road systems and its frequent role as a national leader in their development is documented only in disconnected pieces of various other studies and reports.

4. As noted above, a historic context on the development of the Interstate Highway System in Oregon is currently underway. This document will by definition include a discussion of the role of SBG bridges in that system. A similar study of the Pacific Highway/ U.S. Highway 99 and the other pre-WWII highway routes, their economic impacts, and the standardized bridges associated with their construction, would improve understanding and provide valuable information on Oregon’s transportation history.

5. Additional study is recommended on the role of Oregon’s State Bridge Engineers such as Glenn Paxson, Ivan Merchant and Charles Purcell to augment the already prepared information on Conde McCullough. Similar reseach regarding the roles

of individuals such Henry Bowlby, R. H. Baldock and other State Engineers would also add to our understanding of the individuals who helped shape Oregon's road systems and its bridges.

6. Interpretative opportunities for SBG bridges, particularly those associated with the post-war period, should be considered as a mitigation strategy. Publications, roadside materials associated with rest stops or visitor information centers, and similar installations could document the history of the highway system and the important role of concrete bridges and overpass development in creating a "limited access" system.

4.3 SBG BRIDGES —LINKS IN HIGHWAY HISTORY

> The most disquieting thing about the theories of Function, Fitness and Truth is that they have given rise to no general guides or rules for good appearance….the endeavor to make the bridge a 'materialized stress diagram' may produce orderly design, but it is not apt to convey delight to the mind of the observer (Portland Cement Association 1939:10).

Post-war SBG bridges result from the concentration of several forces — demand, cost limitations, and modern architectural design theories — that make them what they are: simple, utilitarian structures with little obvious detail or beauty, fulfilling their role in thousands of locations. But, as the dominant bridge form in the dominant transportation system of the 20th century, these structures played a significant role in the success of the Interstate System.

It is easy to dismiss most SBG bridges aesthetically, for there is typically only very little aesthetic about them. It is far harder, however, to discount them historically. Standardized SBG bridges were generally not designed or intended to be seen. Federal funding and regulations dictated their design based upon vertical clearances, sight lines and an underlying intent toward minimization of above-roadway features. This marked a major change from earlier bridges, which for decades had almost by definition served as a focal point in the otherwise unbroken corridor of any major road system if only by rising above it.

But these overwhelmingly commonplace structures, unseen and ignored by almost all who use them, do represent an important part of Oregon's history (Figure 4.2) and, for good or ill, typify an extended period in the late 20th century history of bridge design. Their modest cost and standardized construction enabled Oregon's post-war road system to develop as quickly and effectively as it did. Though generally unnoticed, surely underappreciated, and, as recent events are indicating, at least in some instances, underbuilt, SBG bridges form the backbone of Oregon's highway system. They have done so since the earliest days of the automobile.

Glenn Paxson, Oregon's longtime Bridge Engineer, wrote in the 1960s that "…the structures we build today will still be serving many years from now" (Paxson 1960). Today, just 40 years later, many if not most of the bridges to which Paxson referred are slated for replacement. Many are unlikely to survive the increasing demands of modern truck and automobile travel. As important elements in Oregon's history, however, some should and, with care and judicious management, some will.

Figure 4.2. Interstate 5 Ribbon Cutting, Medford, Jackson County, OR
Pre-stressed Multi-Beam/Girder Bridge with Type A/B "Three Stripe" Bridge Rail at Rear
Source: Southern Oregon Historical Society Image #15073

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APPENDIX A

Slab, Beam and Girder Bridge
Registration Requirements

Slab Beam and Girder Bridge
Registration Requirements

To qualify for listing on the National Register, a bridge must be an intact example of the Slab, Beam, or Girder structural type constructed during one of the periods of significance covered under this context. Integrity of design is the primary consideration for eligibility of this type of structure. The following list serves as a guideline for identifying structures that are potentially eligible for the National Register.

Criterion A

A bridge built between 1900 and 1966 may be evaluated under Criterion A only if it retains integrity of original location, design, setting, materials, and workmanship. In addition, the bridge must have a clear association with the development of transportation resources that have made a noteworthy contribution to the broad patterns of history to be considered potentially eligible under this criterion.

Criterion B

A bridge built between 1900 and 1966 maybe evaluated under Criterion B only if it retains integrity of original location, design, setting, materials, and workmanship. In addition, the bridge must have a clear association with the lives of persons significant in history, architecture, or engineering.

Criterion C

Bridges are eligible under Criterion C if they meet the following requirements and retain integrity of location, design, setting, materials, and workmanship.

<u>Bridges constructed prior to 1924:</u>

- Bridges built during this early period of highway development automatically require an evaluation of eligibility, if they possess the elements of integrity listed above and are comparable in significance to bridges of this era previously determined eligible for the National Register.

Bridges constructed between 1924 and 1945:
To be eligible, a bridge constructed during this period must be comparable in significance to bridges of this era previously determined eligible for the National Register, must possess intact original railings (including, but not necessarily limited to, standard railings) and decorative elements (e.g., piers, pylons, pedestrian overlooks), and at least one of the following:

- Special structural design features associated with a particular site.
- A design that overcame significant engineering obstacles.
- Has no historic-period alterations that obscure character defining features above the road deck.

A bridge utilizing standard designs for the substructure and road deck will not be forwarded for further analysis of eligibility unless it meets the registration requirements for Criterion A, listed below.

Bridges constructed between 1946 and 1966:
To be eligible, a bridge constructed during this period must completely retain original design integrity (i.e., substructure, deck, railings), and at least one of the following:

- A design that has special or unusual engineering design elements (i.e. significant scale, significant engineering obstacles, or aesthetic considerations).
- The bridge construction must have been completed during the earliest iterations that a design type appeared on Oregon highways (if the design type does not predate 1946 in Oregon).
- An example of a design incorporating significant technological advances (i.e. prestressed beams, post-tensioning, or segmental construction) that was completed within the first two years of the innovations appearing on Oregon highways.

If a bridge does not completely retain original design integrity, it may only be eligible if it is the oldest remaining example of its design type or if it is the oldest design incorporating one of the significant technological advancements listed above.

APPENDIX B

The following lists contain data gleaned from the March 2004 update of the Oregon Bridge Inventory relative to the various materials and design types that are considered under the Slab, Beam, and Girder Bridge historic context. These "top ten" lists are intended to provide a ready data reference for the longest and oldest of examples of each of the basic bridge types. No fieldwork, visual, or archival inspection beyond the OBI was undertaken and inclusion in the following lists in no way presupposes integrity or, ultimately, potential historic or technological significance.

Oregon Bridge Inventory: Number Analysis, SLAB BEAM and GIRDER Bridges

Main Design = **All SBG: 1 through 7, 21-22**

	Total- MAIN DESIGN	% of SBG Bridges
	6080	**100.00%**
1-Slab	2143	35.25%
2-Stringer, Multi-Beam or Girder	2707	44.52%
3-Girder and Floorbeam System	112	1.84%
4-Tee Beam	332	5.46%
5-Box Beam or Girders, Multiple	572	9.40%
6-Box Beam or Girders, Single or Spread	33	0.54%
7-Frame	52	0.86%
21-Segmental Box Girder	0	0.00%
22-Channel Beam	129	2.12%

Bridge #	Struct length ft.	Feature spanned	Hwy conveyed	Max span ft.	Date Built	StructType
		longest, struct length				
07949B	11200	COLUMBIA RIVER	US101(HWY009)	81	1966	2-Stringer-Multi Beam-Gird
09555	7434	COLUMBIA RIVER NO CHANN	I-205 (HWY 064)	601	1982	5-Box Beam-Gird-Multiple
16424	3433	COLUMBIA RIVER	I-82 (HWY 070) WB	660	1988	6-Box Beam-Gird-Single
08332	3229	MEDFORD VIADUCT	I-5 (HWY 001)	120	1962	2-Stringer-Multi Beam-Gird
16188	3115	COLUMBIA R./SO. CHANNEL	I-205 (HWY 064)	200	1982	5-Box Beam-Gird-Multiple
09382	2752	EAGLE CREEK VIADUCT	I-84 (HWY 002) WB	200	1969	2-Stringer-Multi Beam-Gird
09403	2717	WILLAMETTE RIVER	I-205 (HWY 064)	430	1970	5-Box Beam-Gird-Multiple
08958E	2457	I-5 NB TO I-405 SB	I-5 (HWY 001) CON	191	1973	5-Box Beam-Gird-Multiple
07253B	2393	WILLAMETTE RIV	OR 22 (HWY 030) WB	252	1953	3-Girder-Floorbeam Sys
09268S	2384	CITY STREETS	I-405 (HWY 061) SB	197	1972	5-Box Beam-Gird-Multiple
09268N	2367	CITY STREETS	I-405 (HWY 061) NB	191	1972	5-Box Beam-Gird-Multiple
08590C	2358	MARQUAM BRIDGE RAMP	I-5 (HWY 001) SB	177	1966	2-Stringer-Multi Beam-Gird
		oldest, by date				
06485	41	CANYON CREEK	CORBETT ROAD	40	1899	2-Stringer-Multi Beam-Gird
23C151	192	N.FORK JOHN DAY RIVER	C15-LONG CREEK RD	75	1899	22-Channel Beam
07034C	421	B-27 OVER UPRR	NE 28TH AVE	43	1908	3-Girder-Floorbeam Sys
02350A	464	HWY 2 & UPRR	OR 99E(HWY 001E)	90	1908	3-Girder-Floorbeam Sys
07040	352	UPRR & I-84	OR 99E(HWY 001E)NB	114	1908	3-Girder-Floorbeam Sys
09685	148	B-78 OVER BNRR	COLUMBIA BLVD	77	1909	3-Girder-Floorbeam Sys
07039	327	B-25 X BANFIELD AND UPRR	NE 12TH AVE	128	1910	3-Girder-Floorbeam Sys
02026A	180	B-50A X SPRR/OPEN FIELD	SE BYBEE BLVD	108	1910	3-Girder-Floorbeam Sys
06683B	304	STEEL BR. E. APPR.	OR 99W (HWY 001W)	61	1910	2-Stringer-Multi Beam-Gird
09C01	242	NICE CREEK	C STREET WEST	40	1911	2-Stringer-Multi Beam-Gird
25B33	110	B-33 X SEALED OFF RR ROW	NE GLISAN ST	18	1911	2-Stringer-Multi Beam-Gird
07035B	157	B-26 OVER UPRR	NE 21ST AVE	43	1912	4-Tee Beam

Oregon Bridge Inventory: Number Analysis, SLAB BEAM and GIRDER Bridges

Main Design = **Slab [NBI Code '1']**

	Total- MAIN DESIGN	% Struct. Type	% of SBG Bridges
	2143	100%	35.25%
1-Concrete	84	3.92%	1.38%
2-Continuous Concrete	231	10.78%	3.80%
3-Steel	0	0.00%	0.00%
4-Steel Continuous	0	0.00%	0.00%
5-Prestressed Concrete	1735	80.96%	28.54%
6-Prestressed Concrete, Continuous	5	0.23%	0.08%
7-Wood or Timber	88	4.11%	1.45%

Bridge #	Struct length ft.	Feature spanned	Hwy conveyed	Max span ft.	Date Built	Material
		longest, struct length				
R7026A	930	LRT TRACKS	US 30B(HWY 059)CON	57	1984	2-Conc Cont
00841	861	E MULTNOMAH FALLS VIADUC	HWY 100	10	1914	2-Conc Cont
11226A	671	SKIPANON RIVER	HWY 105	60	1978	5-Pre-Stress Conc
15149A	529	FIDDLE CREEK	CANARY ROAD SOUTH	29	1987	5-Pre-Stress Conc
18593	515	O'FLOW BR	WILSON RIVER LOOP	52	2000	2-Conc Cont
16231	500	GARRISON SLOUGH	US101(HWY009)	50	1976	5-Pre-Stress Conc
671246	491	TUALATIN RIVER	GOLF COURSE ROAD	51	1974	5-Pre-Stress Conc
00360A	474	SANTIAM R OFLOW	HWY 164	25	1960	5-Pre-Stress Conc
18592	463	O'FLOW BRIDGE	WILSON RIVER LOOP	52	2000	2-Conc Cont
11138A	444	BLIND SLOUGH	BARENDSE RD	50	1972	5-Pre-Stress Conc
07964	419	PARTIAL VIADUCT	OR 22 (HWY 162)	25	1947	2-Conc Cont
		oldest, by date				
00840	402	W MULTNOMAH FALLS VIADUC	HWY 100	20	1914	2-Conc Cont
00841	861	E MULTNOMAH FALLS VIADUC	HWY 100	10	1914	2-Conc Cont
04543	62	HORSETAIL FALLS	HWY 100	20	1914	2-Conc Cont
25B41	331	B-41 SEMI-VIADUCT	SW VISTA AVE	14	1914	2-Conc Cont
00234	60	OLD VAN DINE CREEK	I-5 (HWY 001) CON	20	1918	2-Conc Cont
00144	60	BEAVER CREEK	OLD HWY 30	29	1918	2-Conc Cont
02667	28	HONEYMAN CREEK	US 30 (HWY 02W)	28	1919	1-Concrete
00366	20	CHEHULPUM CREEK	HWY 164	20	1919	1-Concrete
00420A	28	JACKSON CREEK	OR 99W (HWY 001W)	14	1919	2-Conc Cont
55C002	34	HAY CANYON	HAY CANYON ROAD	33	1919	1-Concrete
27C35	50	GORTON CREEK	WYETH RD #605	20	1919	1-Concrete
04444	21	BOCKLER CREEK	OR 214 (HWY 140)	20	1920	1-Concrete

Oregon Bridge Inventory: Number Analysis, SLAB BEAM and GIRDER Bridges

Main Design = **Stringer, Multi-Beam or Girder [NBI Code '2']**

	Total- MAIN DESIGN	% Struct. Type	% of SBG Bridges
	2707	100%	44.52%
1-Concrete	211	7.79%	3.47%
2-Continuous Concrete	738	27.26%	12.14%
3-Steel	563	20.80%	9.26%
4-Steel Continuous	103	3.80%	1.69%
5-Prestressed Concrete	563	20.80%	9.26%
6-Prestressed Concrete, Continuous	72	2.66%	1.18%
7-Wood or Timber	457	16.88%	7.52%

Bridge #	Struct length ft.	Feature spanned	Hwy conveyed	Max span ft.	Date Built	Material
		longest, by struct length				
07949B	11200	COLUMBIA RIVER	US101(HWY009)	80	1966	5-Pre-Stress Conc
08332	3229	MEDFORD VIADUCT	I-5 (HWY 001)	120	1962	3-Steel
09382	2752	EAGLE CREEK VIADUCT	I-84 (HWY 002) WB	200	1969	4-Steel Cont
08590C	2358	MARQUAM BRIDGE RAMP	I-5 (HWY 001) SB	177	1966	3-Steel
08590D	2319	MARQUAM BRIDGE RAMP	I-5 (HWY 001) NB	177	1966	3-Steel
S8588E	2249	UPRR	I-5 (HWY 001) SB	215	1963	3-Steel
N8588E	2249	UPRR	I-5 (HWY 001) NB	217	1963	3-Steel
00123K	2218	WILLAMETTE RIV	OR 22 (HWY 030) EB	235	1953	4-Steel Cont
08589B	2031	CONN 3 TO HWY 1 NB	BELMONT TO HWY 1	145	1963	3-Steel
S8958A	2013	FREMONT VIADUCT	I-5 (HWY 001) SB	140	1963	3-Steel
08591C	1900	MARQUAM RAMP SB	I-5 (HWY 001) SB	190	1966	3-Steel
N8958A	1885	FREMONT VIADUCT	I-5 (HWY 001) NB	140	1963	3-Steel
		oldest, by date				
06485	41	CANYON CREEK	CORBETT ROAD	40	1899	3-Steel
06683B	304	STEEL BR. E. APPR.	OR 99W (HWY 001W)	61	1910	3-Steel
25B33	109	B-33 X SEALED OFF RR ROW	NE GLISAN ST	18	1911	2-Conc Cont
09C01	243	NICE CREEK	C STREET WEST	40	1911	2-Conc Cont
470206	42	MILL CREEK	N.E. LIBERTY ST	41	1913	1-Concrete
03781	86	CENTRAL ORE RR	OR 238 (HWY 273)	31	1914	2-Conc Cont
03780	78	HWY 273 & SPRR	OR 238 (HWY 273)	29	1914	2-Conc Cont
65C34	31	EIGHTMILE CREEK	OLD DUFUR SOUTH	30	1914	1-Concrete
00823	118	BRIDAL VEIL FALLS	HWY 100	31	1914	2-Conc Cont
65C19	32	EIGHTMILE CREEK	DAVIS CUTOFF	31	1915	1-Concrete
02762	120	BEAVER CREEK	US101(HWY009)	40	1916	2-Conc Cont
05290	217	UPRR	OR 99E(HWY 001E)	25	1916	2-Conc Cont

Oregon Bridge Inventory: Number Analysis, SLAB BEAM and GIRDER Bridges

Main Design = **Girder and Floorbeam System [NBI Code '3']**

	Total- MAIN DESIGN	% Struct. Type	% of SBG Bridges
	112	100%	1.84%
1-Concrete	5	4.46%	0.08%
2-Continuous Concrete	25	22.32%	0.41%
3-Steel	60	53.57%	0.99%
4-Steel Continuous	19	16.96%	0.31%
5-Prestressed Concrete	2	1.79%	0.03%
6-Prestressed Concrete, Continuous	0	0.00%	0.00%
7-Wood or Timber	1	0.89%	0.02%

Bridge #	Struct length ft.	Feature spanned	Hwy conveyed	Max span ft.	Date Built	Material
		longest, by struct length				
07253B	2393	WILLAMETTE RIV	OR 22 (HWY 030) WB	252	1953	4-Steel Cont
05789A	2216	WILLAMETTE R/RIVERSIDERD	COUNTY RD 53	152	1951	4-Steel Cont
02758A	1723	OR 99E (HWY 001E)	BELMONT ST	123	1958	3-Steel
08590Y	1131	HWY 1 NB TO HWY 2 EB	CITY STREETS/OMSI	161	1992	4-Steel Cont
02254A	1111	WILLAMETTE RIVER	I-5 (HWY 001)	250	1953	3-Steel
08156	1092	WILLAMETTE RIVER	HWY 140	250	1958	3-Steel
06758	1002	S YAMHILL RIVER	OR 18 (HWY 039)SP	120	1951	3-Steel
04330A	910	SNAKE RIVER AT WEISER	201 HWY 455	141	1953	4-Steel Cont
00511B	849	EAST BURNSIDE APPROACH	BURNSIDE ST	106	1927	2-Conc Cont
06875A	772	SANDY RIVER	I-84 (HWY 002) WB	160	1959	4-Steel Cont
06875	772	SANDY RIVER	I-84 (HWY 002) EB	160	1949	3-Steel
04518	693	COLUMBIA BLVD & UPRR	OR 99W (HWY 001W)	71	1929	2-Conc Cont
		oldest, by date				
02350A	464	HWY 2 & UPRR	OR 99E(HWY 001E)	90	1908	3-Steel
07034C	421	B-27 OVER UPRR	NE 28TH AVE	43	1908	1-Concrete
07040	352	UPRR & I-84	OR 99E(HWY 001E)NB	114	1908	3-Steel
09685	148	B-78 OVER BNRR	COLUMBIA BLVD	77	1909	4-Steel Cont
02026A	180	B-50A X SPRR/OPEN FIELD	SE BYBEE BLVD	108	1910	3-Steel
07039	327	B-25 X BANFIELD AND UPRR	NE 12TH AVE	128	1910	3-Steel
04522	40	BEAVER CREEK	HWY 100	40	1912	2-Conc Cont
06757A	620	BROADWAY ST CONN	NW BROADWAY RAMP	125	1913	3-Steel
25T01	230	B-81 OVER SW BERTHA BLVD	SW CAPITOL HIGHWAY	46	1915	2-Conc Cont
11086	42	B-80 OVER JOHNSON CREEK	FOSTER RD	40	1915	1-Concrete
01377C	304	COLUMBIA SLOUGH	OR 99E(HWY 001E)	76	1916	3-Steel
04517	675	COLUMBIA SLOUGH	OR 99W (HWY 001W)	75	1916	3-Steel

Oregon Bridge Inventory: Number Analysis, SLAB BEAM and GIRDER Bridges

Main Design = **Tee Beam, [NBI Code '4']**

	Total- MAIN DESIGN	% Struct. Type	% of SBG Bridges
	332	100%	5.46%
1-Concrete	57	17.17%	0.94%
2-Continuous Concrete	123	37.05%	2.02%
3-Steel	0	0.00%	0.00%
4-Steel Continuous	0	0.00%	0.00%
5-Prestressed Concrete	144	43.37%	2.37%
6-Prestressed Concrete, Continuous	8	2.41%	0.13%
7-Wood or Timber	0	0.00%	0.00%

Bridge #	Struct length ft.	Feature spanned	Hwy conveyed	Max span ft.	Date Built	Main design
		longest, by struct length				
19C488	913	UMPQUA RIVER @ ELKTON	MEHL CR RD #11	130	1967	5-Pre-Stress Conc
09737A	905	TUALATIN RIVER	I-205 (HWY 064) SB	140	1970	5-Pre-Stress Conc
09737	805	TUALATIN RIVER	I-205 (HWY 064) NB	140	1970	5-Pre-Stress Conc
18370	800	CORP	MCANDREWS RD	128	1986	1-Concrete
18661	738	UPRR	US 30 (HWY 067)	92	2002	6-Pre-Stress Conc Cont
19C358	725	UMPQUA RIVER	BULLOCK RD	144	1986	5-Pre-Stress Conc
01923A	562	WB S.UMPQUA RV (WINSTON)	OR 42 (HWY 035) WB	182	1976	6-Pre-Stress Conc Cont
01352A	542	MOLALLA RIVER	OR 213 (HWY 160)	120	1975	5-Pre-Stress Conc
17982	532	SOUTH UMPQUA RIVER	COUNTY RD 387	200	2000	6-Pre-Stress Conc Cont
07758C	521	HWY 1W NB TO HWY 1 NB	OR 99W (HWY 001W)	137	1985	5-Pre-Stress Conc
19C491	512	S.UMPQUA RIVER	DOLE ROAD CR.#14	130	1969	5-Pre-Stress Conc
14444	444	WILLAMETTE RIVER ARM	SE KIGER ISLAND DR	74	1963	5-Pre-Stress Conc
		oldest, by date				
07035B	157	B-26 OVER UPRR	NE 21ST AVE	43	1912	1-Concrete
05057	26	WAGNER CR./TALENT AVE.	TALENT AVE	26	1914	2-Conc Cont
00001	28	MILL RACE CANAL	SOUTH 2ND STREET	28	1914	1-Concrete
00140	60	BEAVER CREEK	OLD HWY 30	30	1918	2-Conc Cont
00138	70	BEAVER CREEK	OLD HWY 30	35	1918	2-Conc Cont
00136	70	BEAVER CREEK	OLD HWY 30	35	1918	2-Conc Cont
00142	70	BEAVER CREEK	OLD HWY 30	35	1918	2-Conc Cont
00155	102	BEAVER CREEK	OLD HWY 30	35	1918	2-Conc Cont
9C158	30	SOUTH BEAVER CREEK	OLD HWY 30	30	1918	1-Concrete
00157	70	BEAVER CREEK	OLD HWY 30	35	1918	2-Conc Cont
09C57	35	BEAVER CREEK	OLD HWY 30	35	1918	1-Concrete
19C512	64	PASS CREEK	CURTIN ROAD #212	31	1919	2-Conc Cont

Oregon Bridge Inventory: Number Analysis, SLAB BEAM and GIRDER Bridges

Main Design = **Box Beam or Girders, Multiple [NBI Code '5']**

	Total- MAIN DESIGN	% Struct. Type	% of SBG Bridges
	572	100%	9.41%
1-Concrete	13	2.27%	0.21%
2-Continuous Concrete	165	28.85%	2.71%
3-Steel	3	0.52%	0.05%
4-Steel Continuous	21	3.67%	0.35%
5-Prestressed Concrete	254	44.41%	4.18%
6-Prestressed Concrete, Continuous	116	20.28%	1.91%
7-Wood or Timber	0	0.00%	0.00%

Bridge #	Struct length ft.	Feature spanned	Hwy conveyed	Max span ft.	Date Built	Material
		longest, by struct length				
09555	7434	COLUMBIA RIVER NO CHANN	I-205 (HWY 064)	600	1982	6-Pre-Stress Conc Cont
16188	3115	COLUMBIA R./SO. CHANNEL	I-205 (HWY 064)	200	1982	5-Pre-Stress Conc
9403	2717	WILLAMETTE RIVER	I-205 (HWY 064)	430	1970	3-Steel
08958E	2457	I-5 NB TO I-405 SB	I-5 (HWY 001) CON	191	1973	4-Steel Cont
09268S	2384	CITY STREETS	I-405 (HWY 061) SB	197	1972	4-Steel Cont
09268N	2367	CITY STREETS	I-405 (HWY 061) NB	191	1972	4-Steel Cont
09268A	2312	HWY 61 NB TO HWY 2W WB	HWY 2W WB	176	1972	4-Steel Cont
09600E	2238	1ST TO 7TH ST VIADUCT	I-105 (HWY 227) EB	166	1973	6-Pre-Stress Conc Cont
09600W	2238	1ST TO 7TH ST VIADUCT	I-105 (HWY 227) WB	166	1973	6-Pre-Stress Conc Cont
09268B	2206	HWY 2W EB TO HWY 61 SB	HWY 2W EB	190	1972	4-Steel Cont
08329	1800	WILLAMETTE R HWY015 UPRR	I-5 (HWY 001)	143	1962	2-Conc Cont
08958D	1578	61 NB CONN TO HWY 1 SB	I-405 (HWY 061)CON	160	1973	4-Steel Cont
		oldest, by date				
08194	643	HWY 1 & PORTER SREET	HWY 3 NB	75	1926	2-Conc Cont
08194R	118	HWY 1 SB & CONN	HWY 3 CONN	68	1926	2-Conc Cont
06671	519	UPRR CONN RT	I-84 (HWY 002) CON	60	1945	2-Conc Cont
07820	31	COPCO CANAL	BUTTE FALLS PROSPT	28	1954	1-Concrete
08002	57	HURRICANE CREEK	HURRICANE CR RD	37	1955	2-Conc Cont
00853A	315	SILETZ RIVER	OR 229 (HWY 181)	153	1956	1-Concrete
03139A	260	NEHALEM RIVER	OR 202 (HWY 102)	100	1956	2-Conc Cont
08063	439	S FK YAMHILL RIVER	OR 18 (HWY 039)	120	1956	2-Conc Cont
19C494	416	COW CREEK	COUNTY RD 20A	101	1956	2-Conc Cont
01492A	370	W FK MILLICOMA	HWY 241	100	1956	2-Conc Cont
02074	374	NEHALEM RIVER	HWY 103	107	1957	2-Conc Cont
05018A	344	JOHN DAY RIVER	OR 207 (HWY 390)	101	1957	2-Conc Cont

Oregon Bridge Inventory: Number Analysis, SLAB BEAM and GIRDER Bridges

Main Design = **Box Beam or Girders, Single or Spread [NBI Code '6']**

	Total- MAIN DESIGN	% Struct. Type	% of SBG Bridges
	33	100%	0.54%
1-Concrete	0	0.00%	0.00%
2-Continuous Concrete	8	24.24%	0.13%
3-Steel	0	0.00%	0.00%
4-Steel Continuous	0	0.00%	0.00%
5-Prestressed Concrete	15	45.45%	0.25%
6-Prestressed Concrete, Continuous	10	30.30%	0.16%
7-Wood or Timber	0	0.00%	0.00%

Bridge #	Struct length ft.	Feature spanned	Hwy conveyed	Max span ft.	Date Built	Material
		longest, by struct length				
16424	3433	COLUMBIA RIVER	I-82 (HWY 070) WB	660	1988	6-Pre-Stress Conc Cont
18480	1472	I-5 (HWY 001)	HWY 1NB TO HWY 144	194	2001	6-Pre-Stress Conc Cont
13516D	1301	HWY 2, HWY 64, LT RL	I-205 (HWY 064)CON	190	1985	6-Pre-Stress Conc Cont
13507B	1105	I-205 & AIRPORT WAY	I-205 (HWY 064)CON	170	1981	6-Pre-Stress Conc Cont
08197	710	IOWA STREET VIADUCT	I-5 (HWY 001)	100	1959	2-Conc Cont
16553	700	UPRR & LRT	43RD AVE OFF RAMP	194	1985	6-Pre-Stress Conc Cont
18647	604	HWY 29 CANYON RD	US 26 (HWY 047)CON	222	2002	2-Conc Cont
09370	431	FLORAS CREEK	US101(HWY009)	97	1967	6-Pre-Stress Conc Cont
11366A	428	NESTUCCA RIVER	PACIFIC AVE	96	1973	5-Pre-Stress Conc
09703	374	HWY 64	BROADWAY ST	146	1970	2-Conc Cont
17320	350	MARKET STREET	I-5 (HWY 001)	190	1996	6-Pre-Stress Conc Cont
07728A	347	I-5 (HWY 001)	UPPER BOONES FERRY	147	1975	2-Conc Cont
		oldest, by date				
01707A	101	SAGER CREEK	OR 202 (HWY 102)	100	1932	2-Conc Cont
08197	710	IOWA STREET VIADUCT	I-5 (HWY 001)	100	1959	2-Conc Cont
08202	188	I-5 (HWY 001)	SPRING GARDEN RD	101	1959	2-Conc Cont
06767A	129	HWY 1E	US 26 (HWY 026)	93	1966	5-Pre-Stress Conc
53C023	225	MILL CREEK	HARMONY ROAD	95	1966	2-Conc Cont
09370	431	FLORAS CREEK	US101(HWY009)	97	1967	6-Pre-Stress Conc Cont
09752	227	B-79 X N. COLUMBIA WAY	COLUMBIA BLVD	112	1968	2-Conc Cont
09671	232	HWY 144	HWY 141	119	1968	2-Conc Cont
19C407	205	SPRR	COUNTY RD 16	73	1969	5-Pre-Stress Conc
19C408	230	COPRR - SPUR RD 115B	COUNTY RD 115	87	1969	5-Pre-Stress Conc
09740A	253	PROSPERITY PARK ROAD	I-205 (HWY 064) SB	119	1969	6-Pre-Stress Conc Cont
09728A	141	10TH STREET	I-205 (HWY 064) SB	141	1970	5-Pre-Stress Conc

Oregon Bridge Inventory: Number Analysis, SLAB BEAM and GIRDER Bridges

Main Design = **Frame, except culverts [NBI Code 7]**

	Total- MAIN DESIGN	% Struct. Type	% of SBG Bridges
	52	100%	1%
1-Concrete	26	50.00%	0.43%
2-Continuous Concrete	11	21.15%	0.18%
3-Steel	0	0.00%	0.00%
4-Steel Continuous	12	23.08%	0.20%
5-Prestressed Concrete	1	1.92%	0.02%
6-Prestressed Concrete, Continuous	0	0.00%	0.00%
7-Wood or Timber	2	3.85%	0.03%

Bridge #	Struct length ft.	Feature spanned	Hwy conveyed	Max span ft.	Date Built	Material
		longest, by struct length				
09279	394	SB ON RAMP CONN 5	NW COUCH BURNSIDE	30	1968	1-Concrete
07695A	342	I-5 (HWY 001)	BOECKMAN ROAD	160	1969	4-Steel Cont
329	329	I-84 (HWY 006)	WESTLAND ROAD	101	1967	4-Steel Cont
07586A	316	HWY 1 I-5	SAGERT ROAD	104	1969	4-Steel Cont
09541	307	HERMISTON INT-BUCKS CORN	OR 207 (HWY 333)	90	1967	4-Steel Cont
07575A	293	PACIFIC HWY 1 (I-5)	NORWOOD ROAD	92	1969	4-Steel Cont
09577	292	I-84 (HWY 006)	OR 207 (HWY 320)	86	1968	4-Steel Cont
291	291	I-84 (HWY 006)	ECHO MEADOWS ROAD	87	1967	4-Steel Cont
09539	284	ORDNANCE INTERCHANGE	CONN 2 (6)	82	1967	4-Steel Cont
09640	265	I-84 (HWY 006)	PATTERSON FERRY RD	76	1967	4-Steel Cont
09743C	235	I-5 SB CONN TO I-205 NB	I-5 NB TO I-205 NB	115	1969	4-Steel Cont
09743A	226	I-5 SB CONN TO I-205 NB	I-5 (HWY 001) SB	110	1969	4-Steel Cont
		oldest, by date				
51C02	48	B-88 X FILLED STREAMBED	SE TACOMA ST	23	1915	2-Conc Cont
25B42	34	B-42 OVER SW TALBOT RD	SW GREENWAY AVE.	28	1926	1-Concrete
51C04	43	B-90 OVER JOHNSON CREEK	SE 45TH AVE	40	1927	1-Concrete
25B01	126	B-1 OVER UP/SPRR	N BURGARD ST	21	1930	2-Conc Cont
25B18	207	B-18 SEMI-VIADUCT	NW MAYWOOD DR	13	1934	2-Conc Cont
06896	35	WB HWY 26	HWY 1W	35	1946	1-Concrete
15C29	91	FOSTER CREEK	COUNTY RD 375	63	1947	2-Conc Cont
25B58	40	B-58 OVER JOHNSON CREEK	SE OCHOCO ST	38	1947	1-Concrete
05195B	36	HWY 1W	POINT TERR STREET	33	1949	2-Conc Cont
11C113	27	KENTUCK SLOUGH	COUNTY RD 45	26	1952	1-Concrete
07032A	42	OXNG I-84 CONN WB	I-84 (HWY 002)	42	1955	1-Concrete
72P01	57	LUCKIAMUTE ACCESS	FARM ENTRANCE	19	1956	7-Wood/Timber

Oregon Bridge Inventory: Number Analysis, SLAB BEAM and GIRDER Bridges

Main Design = **Channel Beam [NBI Code '22']**

	Total- MAIN DESIGN	% Struct. Type	% of SBG Bridges
	129	100%	2.12%
1-Concrete	111	86.05%	1.83%
2-Continuous Concrete	0	0.00%	0.00%
3-Steel	0	0.00%	0.00%
4-Steel Continuous	0	0.00%	0.00%
5-Prestressed Concrete	17	13.18%	0.28%
6-Prestressed Concrete, Continuous	1	0.78%	0.02%
7-Wood or Timber	0	0.00%	0.00%

Bridge #	Struct length ft.	Feature spanned	Hwy conveyed	Max span ft.	Date Built	Main design
		longest, by struct length				
00561A	323	CALAPOOIA BOTTOMS 2	OR 99E (HWY 058)	19	1954	1-Concrete
00361	294	SANTIAM RIVER OFLOW #4	HWY 164	21	1958	1-Concrete
57C23	272	WILSON RIVER	WILSON RIVER LOOP	93	1974	5-Pre-Stress Conc
23C151	193	N.FORK JOHN DAY RIVER	C15-LONG CREEK RD	75	1899	5-Pre-Stress Conc
39C577	154	SILTCOOS RIVER	WEST LAKE ROAD	64	1975	5-Pre-Stress Conc
06686C	154	VICTORY BLVD	OR 99W (HWY 001W)	31	1962	1-Concrete
04041	133	BEAR CREEK	HWY 200	19	1953	1-Concrete
12169B	129	BIG ELK CREEK	SALADO ROAD	72	1978	5-Pre-Stress Conc
12752	116	WAVERLY CREEK	WAVERLY DR. NORTH	19	1957	1-Concrete
01099A	115	LAKE CREEK	OR 36 (HWY 229)	23	1960	1-Concrete
00563A	114	CALAPOOIA BOTTOMS 3	OR 99E (HWY 058)	19	1955	1-Concrete
12411	114	OAK CREEK	LOCHNER RD	19	1959	1-Concrete
		oldest, by date				
23C151	193	N.FORK JOHN DAY RIVER	C15-LONG CREEK RD	75	1899	5-Pre-Stress Conc
06218	80	ABERNETHY CREEK	MAPLE LN	32	1932	1-Concrete
06661	45	COX CREEK FRONT RD	I-5 (HWY 001) FR	15	1940	1-Concrete
4041	133	BEAR CREEK	HWY 200	19	1953	1-Concrete
03291	51	POWELL BUTTE CANAL	HWY 371	17	1954	1-Concrete
03292	32	POWELL BUTTE CANAL	HWY 371	16	1954	1-Concrete
0M007	60	CRESCENT CREEK	HWY 429	23	1954	1-Concrete
00561A	323	CALAPOOIA BOTTOMS 2	OR 99E (HWY 058)	19	1954	1-Concrete
399	23	CREEK	OR 99E (HWY 058)	23	1954	1-Concrete
00552A	38	CREEK	OR 99E (HWY 058)	19	1954	1-Concrete
00553A	76	CALAPOOIA BOTTOMS 1	OR 99E (HWY 058)	19	1954	1-Concrete
00563A	114	CALAPOOIA BOTTOMS 3	OR 99E (HWY 058)	19	1955	1-Concrete