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BRIDGING ALASKA: HISTORIC CONTEXT FOR THE INVENTORY OF ALASKA'S HIGHWAY BRIDGES

by

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ABSTRACT

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I. INTRODUCTION

Historic road and highway bridges are an important component of Alaska's cultural heritage. Bridges cross many natural barriers in Alaska's varied landscape. They span waterways and terrain, frame views, open up vistas and create a sense of passage. Bridges can serve as landmarks that denote a sense of time and place, and are often understated testimonials to good design and engineering. They are important links in an expanding overland transportation system that has changed the character of Alaska from an isolated, rugged territory to a state with a diverse and growing economy dependent upon automobiles and trucks. Alaska had about 170 road and highway bridges in 2005 that were built prior to 1965. These early bridges are of various types and materials, ranging from simple timber and steel spans across small streams to multi-span steel and concrete structures that cross major rivers and canyons. Most of Alaska's pre-1965 bridges were designed and constructed during the territorial period, when cars and trucks were light and traffic was sparse. Most are simple, unadorned structures built for function, not form. All embody important aspects of Alaska's history.

Some of Alaska's historic bridges carry loads today that are in excess of their original design specifications, including large numbers of automobiles, heavy trucks, and large, bulky heavy equipment. A number of Alaska's older highway bridges cannot meet these demands, are considered obsolete, or are prone to environmental conditions that are unsafe. While increased traffic, road improvements and emphasis on highway safety will require replacement of some older bridges, historians and other members of the public are increasingly concerned that historically significant bridges are rapidly being torn down and replaced, contributing to the loss of Alaska's early structural heritage. To help plan for the future without losing sight of the past, Alaska needs to build new bridges that will serve the public while documenting and preserving bridges significant to its past.

The purpose of this study is to provide historic context to evaluate road and highway bridges built in Alaska from 1910 through 1964. In the Surface Transportation Act of 1987, Congress declared it to be in the national interest to "encourage the rehabilitation, reuse and preservation of bridges significant in American history, architecture, engineering and culture." Congress deemed that historic bridges are "important links to our past," can serve as safe and vital transportation routes in the present, and "can represent significant resources for the future." This report was prepared for the Alaska Department of Transportation and Public Facilities (ADOT&PF) to assist that agency and the Federal Highway Administration in fulfilling their historic preservation responsibilities as mandated by the National Historic Preservation Act, the Department of Transportation Act, and related amendments, laws and regulations.

The first step in evaluating historic bridges is to establish a historic context to understand the development of bridges and the role they have played in Alaska's history. Historic context is defined by the National Park Service's National Register Bulletin, *How to Apply the National Register Criteria of Evaluation*, as

> an organizing structure for interpreting history that groups information about historic properties that share a common theme, common geographic area, and a common time period. The development of historic contexts is a foundation for decisions about the planning, identification, evaluation, registration and treatment

of historic properties, based upon comparative historic significance" (USDI/ NPS:1991:53).

The history of Alaska's road and highway bridges from 1900 through 1964 is closely associated with the development of the territory's and state's trail, road, and highway system. Chapter II provides an overview of the development of overland transportation in Alaska. Chapters III through VII examine the development of bridge construction in Alaska through three important eras, the years before World War II, the pivotal World War II years, and the postwar years from 1946 to 1965. Chapters VIII, through XI provide historic contexts for the most common bridge types in Alaska: timber, steel truss, steel stringer/girder and concrete bridges. Chapter XII focuses on the unusual challenges of bridge design and construction in the harsh Alaska environment and Chapter XIII provides conclusions.

The study team, comprised of Rolfe G. Buzzell, Ph.D. (historian) and Christopher Chambers, B.A. (anthropologist) conducted research in a broad spectrum of primary and secondary sources to compile this historic context. They consulted the Alaska Heritage Resource Survey (the Alaska state-wide inventory of prehistoric and historic sites and structures), university and municipal libraries, the voluminous files in ADOT&PF's Bridge Design Section in Juneau, the files of the Alaska State Library in Juneau, the records of the National Archives and Records Center at the Pacific Alaska Branch in Alaska, and published sources on bridge design and construction. The study team also interviewed engineers who participated in the design, construction, maintenance and inspection of Alaska's roadway bridges. The team also made use of studies of historic bridges conducted by other states who completed their bridge inventories in the 1980s, 1990s and early 2000s. Particularly helpful was a study entitled *A Context for Common Historic Bridge Types*, prepared for the National Cooperative Highway Research Program (Parsons, Brinckerhoff and Engineering and Industrial Heritage 2005).

One of the objectives of this report is to assist readers in making significance evaluations of historic bridges in Alaska. Chapters I through VII summarize important events and trends that had a major impact on bridge development in Alaska. Bridges that possess physical integrity from the historic period and are associated with these historic events and trends will likely possess historic significance. Examples will include: early development of bridge types; early development of railroad bridges that were later modified for automobiles; bridges associated with the massive construction projects of World War II and the Cold War; bridges associated with the creation of bridge design sections in federal and state agencies in Alaska. Other bridges that retain physical integrity from the historic period may be significant for their association with events and trends in local history, but this type of significance falls outside the scope of this study. Chapters VIII through XI set forth the character defining features of common road and highway bridge types in Alaska and provide statements regarding the level of significance within the context of the most common bridge types described in this study. These four chapters also identify important activities in the field of bridge engineering in Alaska that have a bearing on evaluating the significance of bridges, such as bridges associated with prominent engineers, bridge designers or builders, development of standardized plans, and innovations in the use of bridge construction materials and design.

The State of Alaska uses the National Register of Historic Places (NRHP) as its criterion for determining historic significance. To be considered eligible for the NRHP, a bridge must be at least 50 years old or, if less than 50 years, it must possess exceptional importance. In addition, bridges

must be significant under one or more NRHP criteria of eligibility. That significance can derive from a national, state or local context. For example, a bridge may possess historic significance for its association with the development and growth of the state or a local area within the state, as the oldest or best example of a bridge type used in Alaska, as an example of a solution to a difficult engineering challenge, as an example of a new and innovative technology, as an example of the work of prominent bridge engineers, or for its architectural or artistic distinction.

Bridges associated with events that have made a significant contribution to the broad pattern of our history may be eligible under Criterion A. Under this criterion, bridges need to have an important and direct connection to a single event, a pattern of events or significant historic trends such as important events or activities in transportation, community planning and development or commerce. Bridges associated with the lives of a person or persons significant in our past may be eligible under Criterion B, although bridges determined eligible under this criterion are relatively rare. Bridges that embody the distinctive characteristics of a type, period, or method of construction, or represent the work of important engineers or designers, or possess high artistic values, may be eligible under Criterion C. This is the criterion under which most bridges would be eligible for the NRHP. Under this criterion a bridge must contain enough of the character defining features (distinctive characteristics of the bridge type) to be considered a true representation of a particular type, period or method of construction. This criterion applies to common types of bridges that are technologically significant or that illustrate design or engineering advances. For instance, early examples of bridge type may be eligible under Criterion C. An unaltered, well-preserved example of a bridge type may be NRHP eligible, regardless of whether it is more or less common within the context of this study. Bridges that are not likely to be significant include structures that were built later in a bridge type's development history that do not possess any extraordinary features and those that have been extensively altered by renovations or repairs.

To be individually eligible for NRHP listing, bridges must also have integrity as that word is defined by the NRHP. The structure must retain its historic appearance and materials, repairs must have used materials available during the period of significance, and the structure must continue to function as a bridge. The NRHP program defines integrity as "the ability of a property to convey its significance" through location (the place where the structure was constructed), design (elements that create form, plan, space and style), setting (the physical environment of a historic property), materials (physical elements that make up the form of the structure), workmanship (physical evidence of those who built the structure), feeling (the structure's expression of the aesthetic or historic sense of a particular period of time), and association (direct link between the structure and an important historic event or person). A bridge that retains integrity will retain the physical identity for which it is significant and will possess many or most of the seven aspects of integrity. Some elements of integrity may be more important for a given bridge than other elements. Setting, for example, may be less important than materials for a bridge that possesses engineering significance. Alterations to a bridge must be evaluated to determine if changes in appearance, design (character defining features), or the way a bridge functions compromises its historic significance. Alterations or repairs to a bridge in some cases may adversely change character defining characteristics, but in other cases may not be significant if replacement of a deck or elements of abutments was common during the period of historic significance. For the purposes of NRHP eligibility, integrity does not apply to a structure's state of repair or its functional inability to meet modern traffic needs.

II. DEVELOPMENT OF TRAILS AND ROADS IN ALASKA FROM 1800 TO 1965

Alaska's bridge heritage is closely linked with the growth of trails, wagon roads, automobile routes and modern highways. The development of Alaska's overland transportation is crucial to understanding bridge development during the twentieth century.

Primacy of Water Transportation in Nineteenth and early Twentieth Century Alaska

During the nineteenth and early twentieth centuries, access to most of Alaska was primarily by water. Alaska's massive size and rugged terrain made overland travel difficult. Access was primarily by water, using coastal access points and travel on rivers and lakes. The first highways were actually waterways - - oceans, rivers, creeks, and lakes. Alaskan Natives often traveled during the summer using dugout and birch bark canoes and baidaras. During the winter they traveled by foot or dog sled on frozen rivers and lakes while engaged in subsistence rounds, trade and warfare. They combined water transport with overland trails to reach terrain not accessible exclusively by water. Native pathways, both overland and on water, laid the ground work for the pack trails and wagon roads that miners and settlers built in the late nineteenth century and during the gold rush period.

Russian settlements in the early nineteenth century and early American settlements after the purchase of Alaska in 1867 clustered around tidal inlets and navigable rivers and creeks. Russian explorers and fur traders used water ways to access the interior, then used Native trails or created new overland trails to engage in trade and exploration. The first American settlers engaged in trade, and stayed close to tidal inlets or used primarily waterways to travel into the interior (Figure 1).

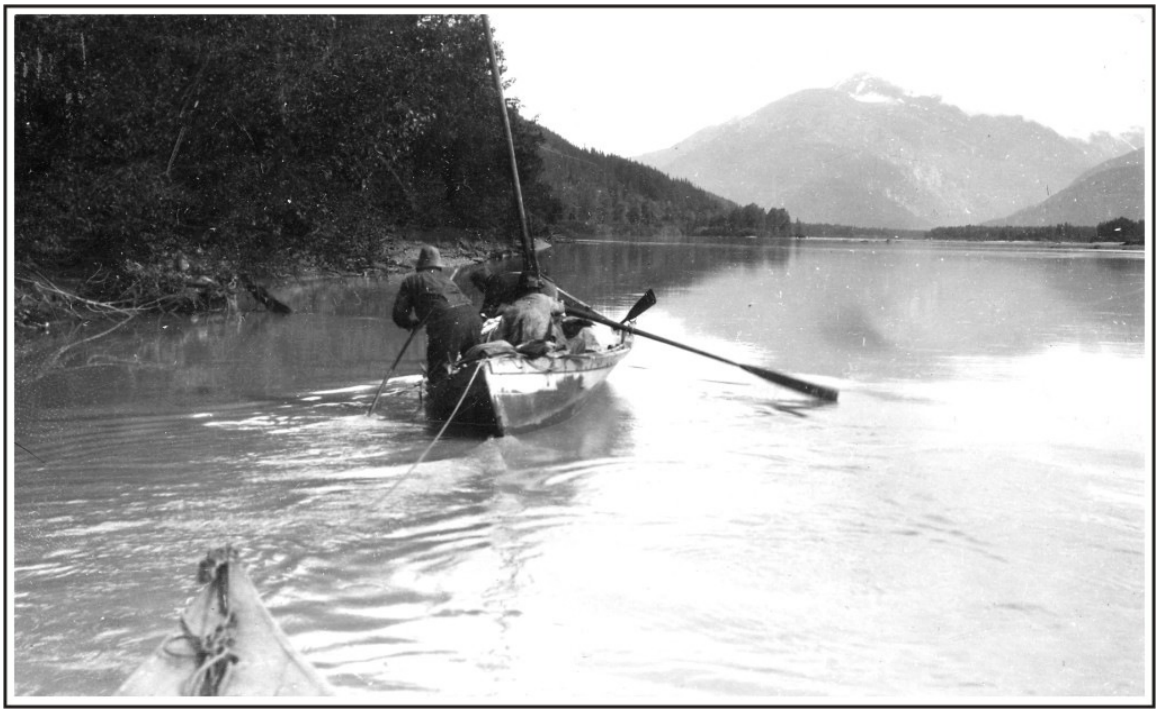

Figure 1. Men poling up a river. Photo courtesy of the ADOT&PF Bridge Section, Juneau.

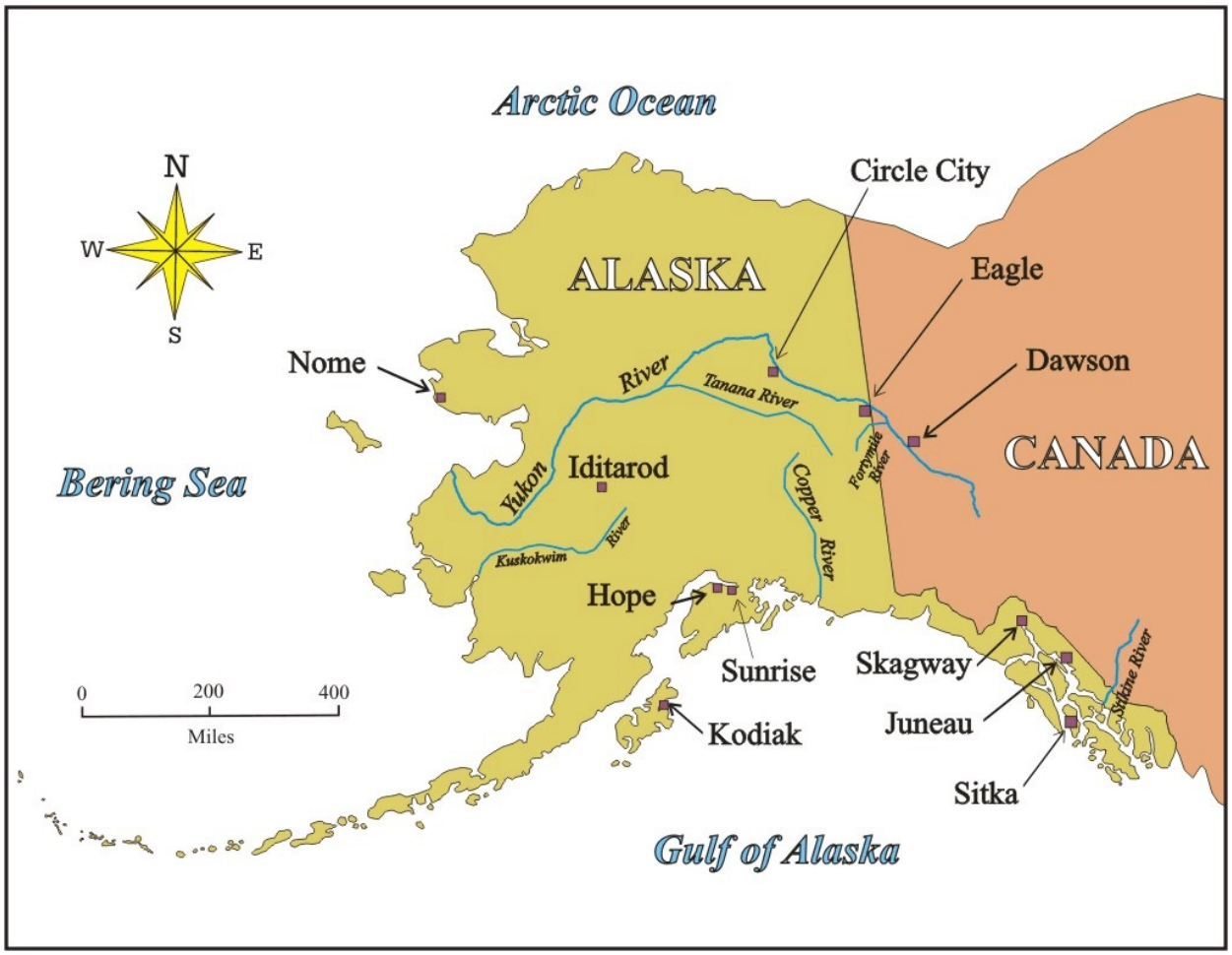

Figure 2. Map showing major rivers in Alaska and also principal mining camps and towns in the late 1890s and early 1900s.

American explorers, traders and prospectors used a variety of craft from Native canoes, Russian baidaras, poling boats, rowboats and sailboats to penetrate tidal areas and rivers into the interior. American traders introduced steamboats on the Stikine River in 1862 and the Yukon River in 1869 that could haul tons of passengers and goods into the interior (Figure 2). In early 1897, roughly a dozen steamboats operated on the Yukon. Shortly after news spread about the rich gold discoveries in the Klondike near Dawson City, thirty steamboats companies were operating 60 new steamboats and barges (Figure 3) on the Yukon (Antonson and Hanable 1985:335-338).

Early Trails and Wagon Roads

It was not until the gold rush era, beginning in the 1880s, that American prospectors, miners, explorers, and settlers began to build trails and wagon roads. Alaska presented formidable obstacles

Figure 3. The *General Jacobs*, one of a number of stern-wheelers operating on the Yukon River in 1929. U.S. Alaska Road Commission Collection, PCA 61-13-139, Alaska State Library.

to the construction of trails and roads. Much of southeast and southcentral Alaska was ringed by rugged coastal mountain ranges with nearly impenetrable glaciers covering many of the mountain passes. The interior featured fast moving rivers, high mountains, soft tundra that made footing difficult and ever-present permafrost conditions. Alaska's remote interior remained virtually inaccessible and unmapped until the 1890s. A few traders, explorers and prospectors penetrated the interior in the 1860s, 1870s and 1880s, using crude trails. They moved their equipment and supplies by water in the summer and by sled in the winter over frozen rivers and ground. Travel across country in summer was only possible on foot or by pack horse. It was not until the late 1890s, during the gold rush, that the U.S. Army and the U.S. Geological Survey began sending expeditions to systematically map and inventory interior Alaska resources. Government expeditions followed in the foot steps of waves of gold rushers who stampeded into the interior in search of gold, silver and copper. These gold seekers followed Native paths or created new trails that were crude and unimproved. Prospectors often hired Natives as guides and packers to help them over trails. Two of these Native routes, the Chilkoot and Chilkat trails near present day Skagway and Haines, started at Lynn Canal, penetrated the rugged mountains into the interior.

American settlers built the first improved trails and roads in the coastal communities of southeast Alaska at Sitka in the 1870s and in the Juneau area in the 1880s. The Perseverance Trail,

which miners had built from Juneau to the mines behind Juneau, was converted to a wagon road as far as Last Chance Basin in 1886-1887, and to Silver Bow Basin in 1888. This was the first wagon road built in Alaska (Alaska Road Commission [hereafter referred to as ARC] 1913:6; Stone and Stone1980:38). Prospectors took the Chilkoot and Chilkat trails into the interior, where they discovered gold in the Fortymile and Circle mining districts in the 1880s. These discoveries increased foot traffic from the coast to the headwaters of the Yukon River, where river and steam boats carried gold rushers to their remote mining camps. Miners built pack trails from the Yukon and Fortymile rivers to their mining camps. The discovery of gold on Turnagain Arm in the early 1890s and the 1896 rush to Cook Inlet prompted prospectors, miners and packers to blaze trails in the Resurrection and Sixmile Creek drainages. They used the trails to carry supplies and equipment from the supply centers at Hope and Sunrise to their mining camps (Figure 4). When the Klondike Gold Rush began in 1897, Jack Dalton improved the trail over the Chilkat Mountains into the Yukon River and began charging tolls. Captain William Moore blazed a trail from his homestead at Skagway over White Pass. In the fall of 1897, the Skaguay and Lake Bennett Tramway Company began building a wagon road up the Skagway River valley. George Brackett took over the project and extended his toll road eight miles into the interior (Buzzell 2004:6-8).

Figure 4. A.D. Allensworth (front left) leading a pack train on the trail to Sunrise City, about 1900. Dorothy Frost Collection, courtesy of Rolfe G. Buzzell.

The early trails built by prospectors and miners were suitable only for foot traffic and pack horses. Limited by the short summer season during which Alaska miners could use water to sluice gravels, most miners lacked the time and finances to make trail improvements. So miners in many districts banded together to cooperatively improve trails. Merchants and packers also provided support, turning some pack trails into crude wagon roads. In the far northwest, entrepreneur A.E. Boyd of Nome improved the trails between Nome, Fort Davis and Cape Nome to wagon roads and charged tolls for passage (Board of Alaska Road Commissioners [hereafter referred to as ARC] 1906:29-30). In spite of these improvements, private efforts to build roads amounted to less than a dozen miles of wagon road in all of Alaska, and were largely confined to a few routes in Juneau, Nome and Fairbanks by 1904 (ARC 1920:56). Most travel continued to be confined to the open waterways in summer and over their frozen courses in winter. Heavy equipment was hauled from the coast or river landings over the snow on sleds to mining camps during the winter (Figure 5). Travel across country in summer was possible only on foot or with pack horses, always difficult and frequently dangerous (ARC 1913:6-7). These crude routes were far from adequate to meet the needs of mining, commerce and communication, prompting the private sector to construct railroads to improve overland transportation.

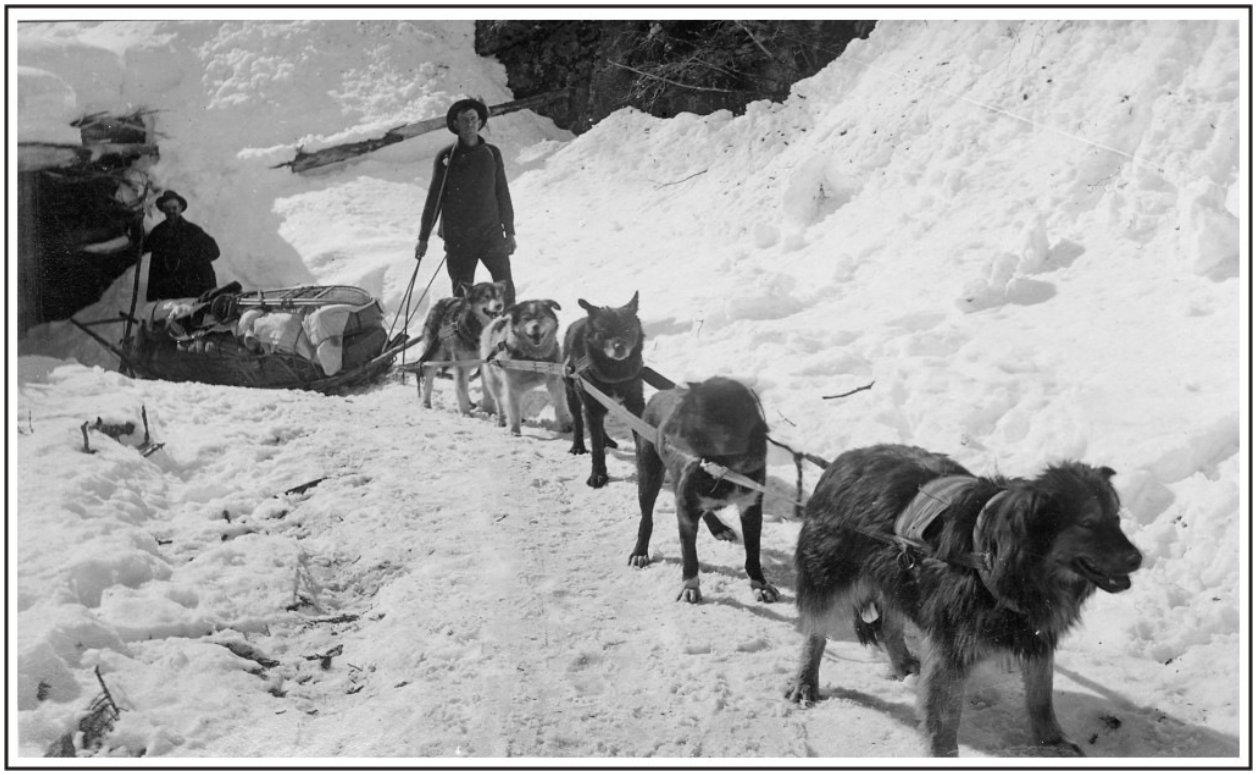

Figure 5. Two men and a dog sled team hauling freight to their mining camp, 1900s. Photograph courtesy of the ADOT&PF Bridge Section, Juneau.

Early Railroad Development

Railroads played an important role in opening the western frontier in the nineteenth century and many entrepreneurs believed that railroads would help open Alaska to resource extraction and settlement. Congress passed legislation in 1897 permitting the construction of railroads in Alaska. Over 50 corporations organized to build railroads in Alaska, but most existed only on paper. Some of these corporations did preliminary work such as surveying, a few started construction, but only 25 railroads actually operated in Alaska and most for only a few years during the gold rush era (Figure 6). Many of the railroads were started to access gold mining camps. Most of them went bankrupt when revenue failed to meet expenses. On of the earliest railroads in Alaska was the White Pass and Yukon Railway (WP&YR, 1898-1982) which extended from Skagway north to the Yukon River to provide access to the Klondike gold fields near Dawson. Other early railroads to mining camps included: the Apollo Consolidated Mining Company line (1897-1917) on the Aleutian Peninsula; the Wild Goose Railroad from Nome to Anvil Creek (1900-1905); the Wild Goose Railroad from Council City to Ophir Creek (1902-1906); the Seward Peninsula Railroad Company

Figure 6. Map showing early railroads in Alaska.

Figure 7. A Copper River and Northwestern (CR&NW) Railway train leaving Chokosna with a load of copper concentrates. Photo courtesy of the Museum of History and Industry, Seattle.

(1906-1913), which extended the Wild Goose line at Nome to the Kougarok area; the Council City and Solomon River Railroad (1903-1907); the Tanana Valley Mines Railroad (1905-1917) built to access gold mines north of Fairbanks; and the Iditarod-Flat Tram Road (1912-1918), which featured a home-made locomotive that ran on wooden rails to supply the Guggenheim Dredge at Flat.

Two early railroads built to access coal deposits were the Katalla Coal Company Railroad (1900-1908) at Katalla and the Cook Inlet Coal Field Company Railroad at Homer (1900-1907). The Copper River and Northwestern (CR&NW, 1906-1938) (Figure 7) was the only successful of three rail ventures which sought access to the rich copper deposits in the upper Chitina River drainage. The CR&NW started at Cordova, while the short-lived Alaska Home Railroad (1907) started from Valdez and the Alaska Pacific Railroad and Terminal Company (1907) started from Katalla. Six early railroads built in southeast Alaska supported hard rock mine processing plants. They include the Rush and Brown Copper Mine Railroad (1900-1908), the Alaska Marble Company Tramway (early 1900s), the Treadwell Mines Railroad (early 1900s-1917) at Douglas, the Salmon Creek Railroad (1913) at Juneau, the Alaska-Juneau Gold Mine Railroad (1911-1944) at Juneau, and the Gastineau Mining Company (Sheep Creek) Railroad (1914-1921) at Thane. Railroads built in southeast Alaska to support fish processing and timber mills included the Yakutat and Southern Railway (1903-1949), the Ketchikan Pulp Company rail line (1954-1990s) at Ketchikan, and the Alaska Lumber and Pulp Company (1959-1990s) at Sitka. While most Alaskan railroad were built to access specific mining camps, logging camps, canneries or settlements, only a few were intended to access a larger area or region. The WP&YR opened up overland access from southeast Alaska

to the upper Yukon River in Canada. Within Alaska, the Alaska Central Railroad (1904-1909) and Alaska Northern Railroad (1909-1914) started at tidewater in Seward with the intention of extending to interior mining camps on the Tanana River, but these two lines went bankrupt. The federal government created the Alaska Railroad (1915-present), took over the Alaska Central and Alaska Northern routes and completed a rail link to Fairbanks in 1923.

In less than two decades from the onset of the gold rush, entrepreneurs and the federal government built 700 miles of railroad in Alaska and some form of steamboat service was found on nearly all Alaskan rivers (Brooks 1953:399). Most railroads had little impact on overland transportation because they covered small areas or restricted operations to a specific business. The WP&YR, the CR&NW, and the Alaska Railroad covered larger areas but had difficulty attracting sufficient passengers and freight to cover expenses. Railroads served only a small part of the sprawling territory and river travel was fraught with hazards on shallow rivers, time consuming, and confined to a few months when rivers were not frozen. Overland access roads and trails were needed to cross the landscape to supply remote mining camps and tie disparate settlements together.

Trail and Road Building Agencies in Alaska

The U.S. Army sent three expeditions to Alaska in 1898 to look for overland routes from ice-free ports to the Yukon River. Captain William R. Abercrombie led an expedition up the Copper River drainage, while Captain Edwin F. Glenn and Lieutenant Joseph Herron led expeditions to mapped potential trails in the Susitna and Matanuska valleys. Abercrombie recommended that the Army build a military trail from Valdez, on Prince William Sound, north to Eagle on the Yukon River. During the following year, the Army began constructing a five-foot wide pack trail from Valdez to Fort Egbert at Eagle. The Army called this route the Trans-Alaskan Military Road, but it was little more than a pack horse trail. In 1901, Congress appropriated $100,000 to the War Department to build roads and trails in Alaska. Practically all of the funding was spent constructing the crude pack trail from Valdez to Eagle. The Army made improvements to the route between 1900 and 1903 while constructing the Washington-Alaska Military Cable and Telegraph System (WAMCATS) line between Valdez and Eagle. At the request of Congress, the U.S. Army conducted a survey in 1904 to determine if the Valdez-Eagle Trail could be upgraded to a wagon road.

In 1904, Congress authorized 70 percent of funds collected from licenses issued outside of Alaskan towns to be used to build roads and trails. Each able-bodied male living outside incorporated towns was to give two days labor or eight dollars cash toward building roads each year. Congress also created a Board of Road Commissioners, consisting of three army officers appointed by the Secretary of War, to oversee construction and maintenance of trails and roads in Alaska. The board, which came to be known as the Alaska Road Commission (ARC), established its headquarters in Skagway and began flagging trails and building new trails and roads in 1905. By 1911, the ARC had flagged 450 miles of winter trails, built 1,107 miles of pack trails, 534 miles of winter sled roads, and 800 miles of wagon roads (Figure 8). More than half of the wagon road mileage was on the 435-mile Valdez to Fairbanks road, which was made passable for dog teams in 1907 and for light wagons in 1910 (ARC 1910b:5; ARC 1914:9). The ARC became the primary trail and road building agency in Alaska and moved its headquarters to Juneau in 1917. Its guiding principal during its first 35 years

Figure 8. A horse-drawn freight wagon climbing a hill on a rough trail, 1910s. U.S. Alaska Road Commission Collection, PCA 61-6-61, Alaska Historical Library.

was that water transport and railroads were primary and the ARC's purpose was to build feeder roads linking ocean and river ports and rail lines to mining camps and settlements. The ARC Board believed it was "unwarranted to parallel waterways and railroads with wagon roads." It built feeder roads that "linked together existing lines of traffic" to obtain the "greatest return with the minimum of cost" (ARC 1920:62; ARC 1923b:18; ARC 1924:29). The ARC conceded in 1929 that construction of wagon roads was warranted where "operations are of considerable magnitude and around larger communities" on "account of increased travel," but refused to build a road between Matanuska-Anchorage because the route would parallel the Alaska Railroad (ARC 1929:36, 46).

Several other agencies also contributed to construction and maintenance of trails and roads. After Alaska became a territory in 1912, the Territorial legislature repealed the 1904 road tax law and replaced it with a flat four dollar annual tax on all taxpayers to support trails and roads. In 1915, the legislature created road districts corresponding to judicial districts with elected commissioner to oversee improvements in each district. Two years later, the legislature eliminated the road districts and created a Territorial Board of Road Commissioners (TBRC), comprised of the Governor, the Secretary and the Treasurer of the Territory. The TBRC administered the territorial portion of a cooperative funding agreement with the ARC. This gave the territory some influence over how funding was spent on trails and roads in an arena where the ARC received the lion's share of funding for trails and roads (Theile 1923:9, 11). While the ARC built and maintained most of the trails and roads in Alaska through the 1910s, the TBRC funded trail and road projects that the ARC could not

get to because of limited funding. The TBRC funded construction of trails to remote mining camps, shelter cabins and, later, airfields. Shelter cabins were shelters built with territorial funds for travelers using trails in remote areas. The TBRC had no construction crews, so their projects were often built by ARC crews. Some projects were jointly funded by the ARC and TBRC. In places where there were no ARC crews, the TBRC granted funds directly to miners to make the trail improvements. In those cases, miners contributed labor and equipment (Metcalf 1949:8).

The Bureau of Public Roads (BPR) also contributed to road construction in Alaska. The U.S. Department of Agriculture created the BPR during the nineteenth century to build roads in national forests. The BPR established an office in Juneau in 1919 and assumed responsibility for roads on Tongass and Chugach National Forest lands on May 20, 1920 (ARC 1921:5). For two years, the ARC and BPR worked closely on some projects, but over time they developed differences (ARC 1928b:20) because the ARC did projects with a minimum of engineering while the BPR took great pains to engineer its road and bridge projects. In March 1927, the BPR in Alaska, which had been part of District One headquartered in Portland, was elevated to a separate district (BPR 1927:70).

Development of Alaska's Road System

In the early 1910s, the ARC kicked its trail and road building program into high gear. By 1913, the ARC had created 2,167 miles of trail, 617 miles of winter sled trail and 862 miles of wagon road. By 1910, the population of Fairbanks and the Tanana Valley had grown to 13,064 and ranked second in population to the 15,216 people living in all of southeast Alaska (Naske 1983:49). The ARC considered the 419-mile trail from Valdez to Fairbanks to be the primary overland route to the interior until the Alaska Railroad, which was under construction in the mid- and late 1910s, could shoulder the primary responsibility for access. In 1913, the first truck completed a round trip from Valdez to Fairbanks in three weeks, covering twice the miles in a day that could be traveled by a horse-drawn wagon (ARC 1913:10-12). After the United States entered World War I in April 1917, federal appropriations for road building in Alaska decreased. Advances in road building equipment (Figure 9) and in auto-mobiles, however, helped make up for the cut in trail and road funding. By 1919, automobiles and trucks made up about 90 percent of the traffic on

Figure 9. An ARC employee using a mechanical grader to widen a road. Photo courtesy of ADOT&PF Bridge Section, Juneau.

Alaskan wagon roads, which greatly increased the cost pf road maintenance (ARC 1919:2099). Most of the Valdez-Fairbanks Road was upgraded to an auto-mobile road in 1920 and was renamed the Richardson Road in honor of Colonel Wilds P. Richardson, the first president of the ARC. The route was renamed the Richardson Highway in 1922 (ARC 1920:60; ARC 1922:31).

While the Richardson Highway was the most important road in the territory, the ARC and BPR built numerous roads and improved existing trails throughout the territory. The greatest obstacle to road building in Alaska, outside of the heavy cost of labor and horse teams, was permanently frozen soils, which were found in bottom and lower slopes of valleys and sometimes in higher slopes in the interior (ARC 1913:10). The ARC built feeder roads (Figure 10) and numerous trails to remote mining districts in central, northern and western Alaska. These feeder routes were principally spurs off rivers, railroads and roads, such as the 162-mile Steese Highway and the 152-mile Elliott Highway that were completed in 1937, and the Anchorage-Palmer Highway, that was completed in 1937. As automobile and truck traffic increased, so did demand for improved roads suitable for automobiles. Traffic counts on the Richardson Highway and other feeder routes remained low by comparison with the 48 states. Traffic in Alaska was dispersed over hundreds of trails and wagon roads that extended to remote mining camps. Funding for road building and maintenance always fell short of local demands for improved trails and roads. Low traffic volumes influenced the decisions of engineers on the width of roads, construction materials and types of water crossings. The ARC had a small engineering staff in the 1930s and early 1940s and did "very little engineering" on roads, which the ARC characterized as of a "low type of construction" (ARC 1933:12; ARC 1942:10). The Bureau of Public Roads in Alaska designated all of its roads on forest lands as the

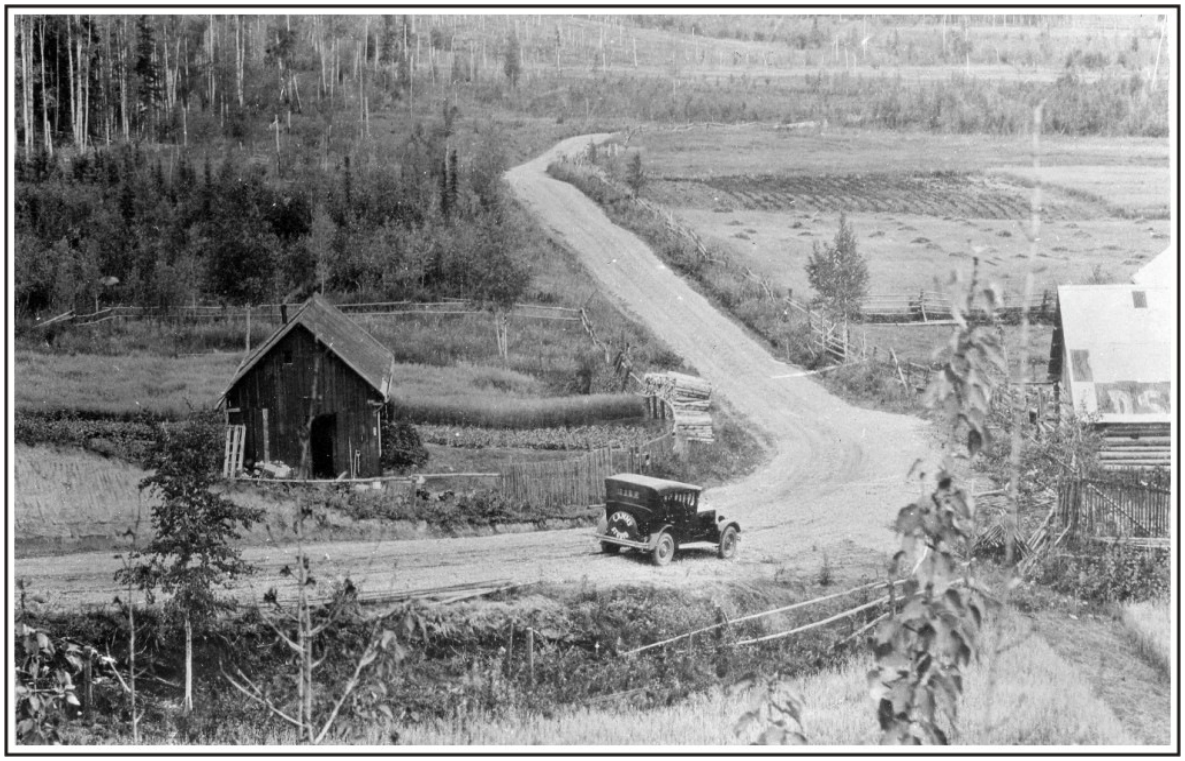

Figure 10. An automobile traveling on a rural Alaskan road in the 1920s. Photo courtesy of the ADOT&PF Bridge Section, Juneau.

Forest Highway system on July 7, 1924. The system included 338.7 miles of roads, most of which were unimproved. The BPR began improving the system in the 1920s and roads were built for development. In the 1930s, reconstruction to higher standards was done to roads adjacent to main towns, but limited traffic did not warrant improvements to routes capable of more than all-year normal use (BPR 1953:1).

Most of the railroads that had operated in the 1900s and 1910s went bankrupt within a few years. Many of Alaska's mining camps were remote and their gold deposits were not rich enough to support the high operating costs of a railroad. Early railroads, such as the Seward Peninsula Railroad, helped open areas to mining, such as the Kougarok District. When bankrupt railroads shut down, miners in remote areas were left without supply lines. Under pressure from vocal miners, the ARC purchased several abandoned railroads and maintained them as tram roads. Other railroads, such as the Alaska Railroad and the CR&NW, prospered. The ARC built a few roads that paralleled rail lines, as in the case of the road from Seward to Kenai Lake (Figure 11). But in general, the ARC stuck with its primary mission of building roads that emanated from tidal and river ports and railroads.

The ARC was transferred from the War Department to the U.S. Department of the Interior in 1932. The Board of Officers was abolished and the ARC was administered by the Chief Engineer, who reported to the Secretary of the Interior through the Governor of Alaska (ARC 1952:2). At the time, the ARC was responsible for 7,626 miles of overland routes, including 1,527 miles of roads, 74 miles of tram roads, 833.5 miles of sled roads, 4,862 miles of permanent trails, 329 miles of flagged trails, 26 airfields and 32 shelter cabins. Road and trail building had cost over $18 million, of which nearly $12 million had come from the War Department (ARC 1932:3, 59-66)). After the Alaska Railroad line was completed to Fairbanks in 1923, buses and trucks using the Richardson Highway competed with and under cut rates charged by the railroad. The Department of Interior received authority to charge fees and tolls and began imposing them on tour buses and trucks using the Rich-

Figure 11. Parallel railroad and wagon bridges at the Resurrection River six miles north of Seward. Skinner Collection, AEC-G805, Anchorage Museum of History and Art.

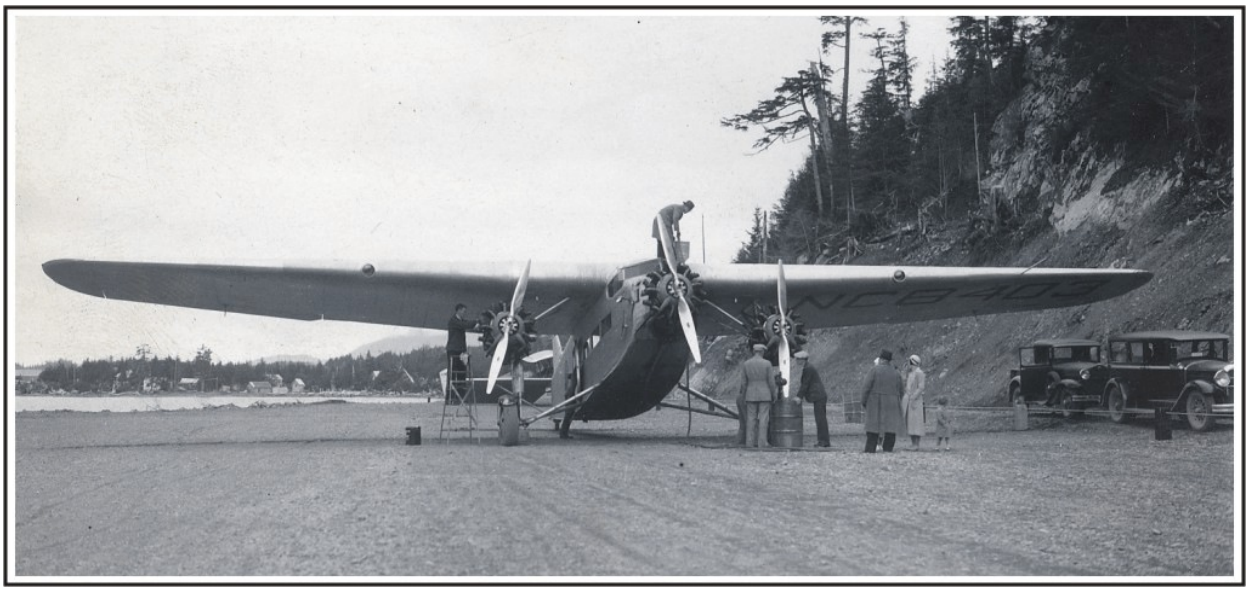

Figure 12. A tri-engine plane at the Cordova airport, 1930s. U.S. Alaska Road Commission Collection, PCA 61-25-21, Alaska State Library, Juneau.

ardson Highway in 1936. Truckers rebelled against the tolls, creating hard feelings toward the ARC and the Alaska Railroad, which was suspected of being behind the toll fees.

Funding for road construction and maintenance, which had increased in the 1920s, declined with the onset of the Great Depression in the 1930s. Trail use began to decline in the 1930s, in part because of a slow down in mining during the depression and in part because the introduction of airplanes (Figure 12) began to change how supplies and goods were transported to remote mining camps. The first airplanes began flying to remote mining camps in the mid-1920s. Air travel quickly caught on in rural Alaska. By the 1930s, airplanes had taken over most of the mail delivery and a fair share of passenger and freight service to some mining districts, particularly in the winter. Caught in a funding crunch, the ARC suspended maintenance on trails in some remote mining districts after 1935, and suspended maintenance of shelter cabins in most areas by 1940.

Road Building During World War II

Military construction just prior to and during World War II expanded Alaska's road system and began the process of connecting major roads to each other. As part of the pre-war buildup, the ARC began building a road in 1941 to link Anchorage and Palmer with the Richardson Highway near today's Glennallen. When opened in 1943, the 190-mile Glenn Highway provided an overland highway between two of Alaska's largest military bases, Fort Richardson in Anchorage and Ladd Field in Fairbanks. With the passage of the Defense Highway Act of November 19, 1941 (55 Stat. 765) and the Japanese bombing of Pearl Harbor on December 7, 1941, all ARC road and trail construction and maintenance activities not required in the conduct of the war were stopped. In early

1942, Public Law L-208 curtailed mining in the United States and Alaska not related to the production of strategic materials. At the behest of the War Department, the efforts of the ARC and the BPR in Alaska were directed to constructing access roads to war industries and military areas. The ARC suspended maintenance on thousands of miles of remote wagon roads and trails, placing additional hardships on miners who were already faced with shortages of labor, supplies, fuel and spare parts.

Three months after the Japanese bombing of Pearl Harbor, the U.S. Army Corps of Engineers with the assistance of the U.S. Public Roads Administration began construction of an overland wartime military supply road linking the 48 states with Alaska. With the consent of Canada, seven U.S. Army engineer regiments and 47 civilian contracting companies built the 1,619-mile Alaska-Canada or Alcan Highway in a little over nine months. The original Alcan Highway, which was dedicated and opened to military traffic on November 20, 1942, was a "pioneer road" carved out of the wilderness from Dawson Creek in British Columbia to the Richardson Highway at Delta Junction in Alaska. During 1943, much of the grade on the pioneer road was improved to regulation standards, low spots were filled, gravel surfacing was done and steel through truss bridges replaced the temporary timber trestle bridges on major water crossings (Figure 13). The portion of the Alcan in Alaska extended 200 miles. Construction of the Alaska Highway, as it has become known, was an astounding engineering feat (Naske 1976:12). At the peak of construction in September 1943, there were 10,400 Americans working for 63 contractors and 3,700 Canadians employed by 14 con-

Figure 13. The Johnson River steel through truss bridge under construction on the Alaska Highway, 1943. Glass lantern slide, U.S. Alaska Road Commission Collection, PCA 61-107-B-59, Alaska State Library.

tractors. Turnover in workers was estimated at 100 percent due in large part to the rigorous climate and difficult terrain (Woodward 1997:202). Wartime improvements and relocation of the route shortened the highway from 1,619 miles to 1,422 miles by the end of 1945. The road was built at a total cost of $138,312,166, not including the cost of housing and pay for Army personnel and the cost of the Army's equipment (U.S. House Committee on Roads 1946; Twitchell 1992:253). The ARC took over cost of maintenance on the 215 miles of the highway in Alaska on a reimbursable basis in 1944 (ARC 1944:8).

In addition to constructing the Glenn and Alcan highways, wartime activities also resulted in construction of the 152-mile Haines Highway. The ARC had built the first 42 miles of the Haines-Chilkoot Road in the late 1920s from the town of Haines to the Canadian boundary. During the war, U.S. Army engineers improved the existing road and extended it from the border to Haines Junction on the Alaska Highway. At the behest of the U.S. Army, the ARC also made improvements during the war years to Richardson Highway to bring it up to military standards for automobiles and trucks.

Road Construction In the Early Postwar Years

In 1948, three years after World War II ended, the ARC began an accelerated, multi-year road construction program to link major military installations with paved highways and access roads. This program carried forward the work begun during the war to link military installations and population centers by roads and highways. This postwar expansion of the territorial road system reflected the greatly enhanced importance of automobiles and truck transport. Expansion of the territorial road system also was mandated by U.S. Army, which sought to standardize roads as part of its preparations for the Cold War with the Soviet Union. Construction of new highways initiated in the immediate aftermath of World War II included: the 128-mile Turnagain Arm-Seward Road, started in 1947 and completed in 1951, which connected Anchorage with Seward; the 143-mile Sterling Highway, started in 1948 and completed in 1951, which extended from Cooper Landing down the Kenai Peninsula to Kenai, Kasiloff, Ninilchik and Homer; the 160-mile Taylor Highway, started in 1946 and was completed in 1953, which began at Tok Junction on the Alaska Highway and extended to Eagle; the 174-mile Top-of the World Highway, begun in 1946 and completed in 1953, which branched off of the Taylor Highway, extended 11 miles to the Canadian border, and continued 149 miles to Dawson City; and the Copper River Highway, started in 1945 from Cordova that the ARC planned to extend 133 miles to Chitina. Other major projects undertaken by the ARC in the late 1940s included paving the Alaska portion of the Haines Highway and reconstructing the Livengood Road northwest of Fairbanks.

The needs of the military and the territory's rapid postwar population growth changed the dynamics of road construction and maintenance in Alaska in the late 1940s. In 1947, the Secretary of Defense suggested that national defense required upgrading the Alaska, Richardson and Glenn highways to all-weather standards, and that the Anchorage-Seward Highway, which was still under construction, be completed. In 1948, Congress appropriated $17,904,000 to fund a greatly expanded road construction and maintenance program in Alaska, nearly four times the funding for the previous year. Over the following six years (1949-1955), Congress appropriated $135,395,031 for road, trail

and bridge construction and maintenance in Alaska, more than three times as much as in the previous 43 years put together (Associated General Contractors of Alaska 1998:62).

The vast infusion of funds to build new roads and upgrade existing roads in Alaska outstripped the capacity of the ARC and BPR to meet the new goals, prompting both agencies to undergo significant reorganizations. In 1949, the ARC underwent a reorganization which included revising its priorities to bring its practices since the war into line with the agency's new goals. At the behest of the U.S. Army, the ARC officially changed its mission to improving and linking up the Territory's 1,845-mile system of main roads. The ARC redirected its priorities from the pre-World War II mission of connecting communities and mining camps with rail stops and river ports to the new goal of improving main and feeder roads to connect military installations and population centers on the road system. The ARC's budget shifted to construction of new highways and improving existing paved and unpaved highways by bringing them up to two-lane and paved standards (Figure 14). The funding that was left went to improving and building new feeder roads that linked local farms and industries to markets in populated areas. With the shift in its mission to linking population

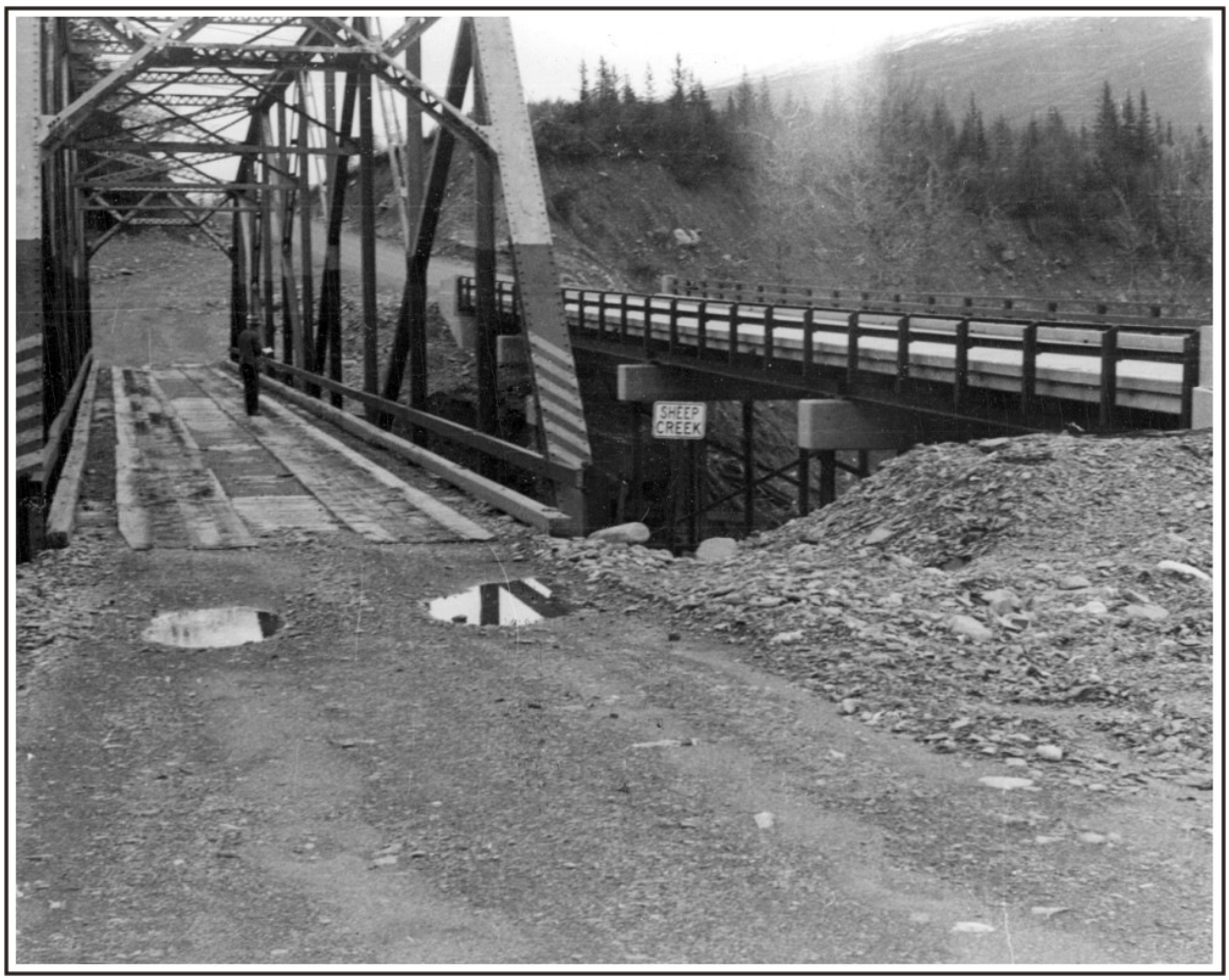

Figure 14. The one-lane steel thru truss bridge (left) was replaced in 1954 by a two-lane steel stringer bridge (right) at Sheep Creek at Mile 19.0 of the Richardson Highway. Photographer unknown. Photo from ADOT&PF Bridge Section, Juneau.

centers, the ARC suspended maintenance of most of the 1,000 miles of sled roads and trails that extended from railheads and rivers to remote mining camps on the grounds that the construction standards of these roads were low, very few of them were kept open in the winter, and traffic capacity, even in summer, was far below the standards common in the 48 states (ARC 1949:1; ARC, 1951:3, 23, 27-28, and Table 14). The ARC revised its designation of route numbers in 1949, reclassifying routes as Through Roads (nine main highways), Feeder Roads, Feeder Roads not connected with Through Roads, Local Roads, and Local Roads not connected with Through Roads (Naske 1986:314-315).

In the years before 1948, BPR headquarters in Juneau was a district office that had reported to division headquarters in Portland Oregon. On August 19, 1948, Alaska became a separate BPR division, and the office in Juneau became the division headquarters. BPR's responsibilities were expanded outside of road construction on Alaska national forest lands to include responsibility for construction of the Anchorage-Seward Highway project (BPR 1953:1; ARC 1951:5).

In addition to changing their goals and objectives, the ARC and BPR reorganized internally, adding specialized engineering, contracting and accounting staff. Prior to 1949, the ARC and BPR employees constructed most roads and bridges. Each agency had a small engineering staff and lots of seasonal employees. Most projects were built with a minimum of engineering. Special projects, such as bridges, were built in the field using standard plans drawn up by an ARC engineer or BPR engineers in Portland. With the sudden infusion of millions of dollars of funding and ambitious project schedules, both the ARC and BPR recruited additional engineering staff to design roads and bridges. Starting in 1950, the vast majority of construction work done by both agencies was put out to bid and agency personnel monitored the construction that was done by private contractors. The ARC's six-year road building program, adopted in 1949, attracted new contractors from the states to do business in the territory. For the first time in Alaska, road and bridge construction became big business (Associated General Contractors of Alaska 1998:62).

During the early and mid-1950s, the ARC and BPR took on new road construction projects as well as continuing ones started in the late 1940s. One of the new projects was a 150-mile gravel road from Paxson on the Richardson Highway that extended west to Cantwell, then north to Mount McKinley National Park. The project, which became known as the Denali Highway, began in 1950 and was completed in 1957. Other projects included widening and paving the Tok-Cutoff and Glenn highways in 1950-1952 (Figure 15) and the Richardson Highway, which was hard surfaced by 1957. The BPR completed the Anchorage-Seward Highway in 1951 and the Taylor Highway was opened in 1953. The ARC continued construction of a pioneer road up the Copper River along the route of the abandoned CR&NW throughout the 1950s. The ARC also began construction in 1956 on the Parks Highway that would link the Susitna Valley with Fairbanks and the Tanana Valley.

Alaska was more dependent upon federal funds for highway development than any of the 48 states. Throughout the 1940s and early 1950s, many Alaskans sought to have the territory included in the Federal-Aid Act, believing that would bring more road construction funds. But inclusion in the Federal-Aid Act required substantial matching funds, which the territory would not appropriate. Even if the territory increased the matching funds to the levels paid by the states, federal funds available on a matching basis would have been less than Congress annually appropriated to the ARC in the late 1940s and early 1950s. From 1920 to 1940, the territory contributed 11.7 percent of the total funds the ARC expended for road work. Because of the unusually high appropriations made by Congress

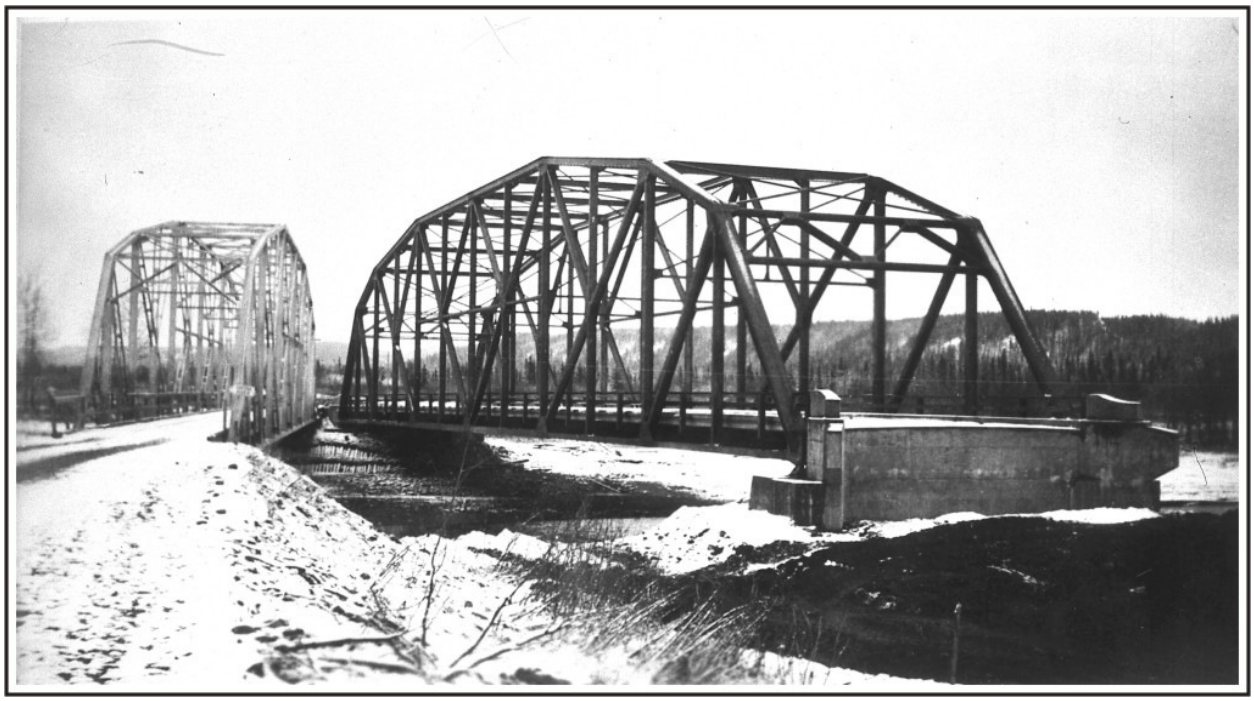

Figure 15. The two-lane steel through truss bridge (right), shown here on October 11, 1950, replaced an earlier one-lane steel camelback truss bridge (left) at the Gakona River on the Tok Cut-off Highway. Alaska Road Commission Collection, PCA 61-23-117, Alaska State Library.

for road work under the umbrella of national defense, the territory's contribution to federal funding between 1950 and 1952 was only 1.2 percent of the total. Territorial officials and other people disagreed during the early 1950s whether the territory would benefit from inclusion in the Federal-Aid program unless the territory was willing to contribute substantially more to match federal funds (Naske 1983:500-502).

By August 1953, the BPR's Forest Highway system in Alaska covered 19 routes in southeast and southcentral Alaska. The system included 365.9 miles of roads, of which 299.9 had been constructed or rebuilt by the BPR. The Forest Highway system included 172.1 miles in the Tongass National Forest and 193.8 miles in the Chugach National Forest. In the Tongass, routes radiated from towns, with improvements tied to local economies. Within the Chugach National Forest, 153.4 miles of road were concentrated on the Kenai Peninsula. These roads connected to the Anchorage-Seward Highway which augmented the Alaska Railroad. The remaining 40.4 miles of road in the Chugach National Forest were located in Prince William Sound. The first paving done by the BPR in Alaska was in 1949 on 9 miles of the Glacier Highway. The BPR constructed 47.4 of the 59.4 miles of the Turnagain Arm Road project in the late 1940s and early 1950s which helped connect Anchorage and Seward (BPR 1953:1-2, 22).

Several other agencies built roads during the 1940s and 1950s. The U.S. Bureau of Mines built a road to the Red Mountain Chromium Mine, located on south side of Kachemak Bay on the Kenai Peninsula. The agency built several short bridges along the route, which began in Seldovia (Note in Album # 62, U.S. Alaska Road Commission Collection, PCA 61-62, Alaska State Library).

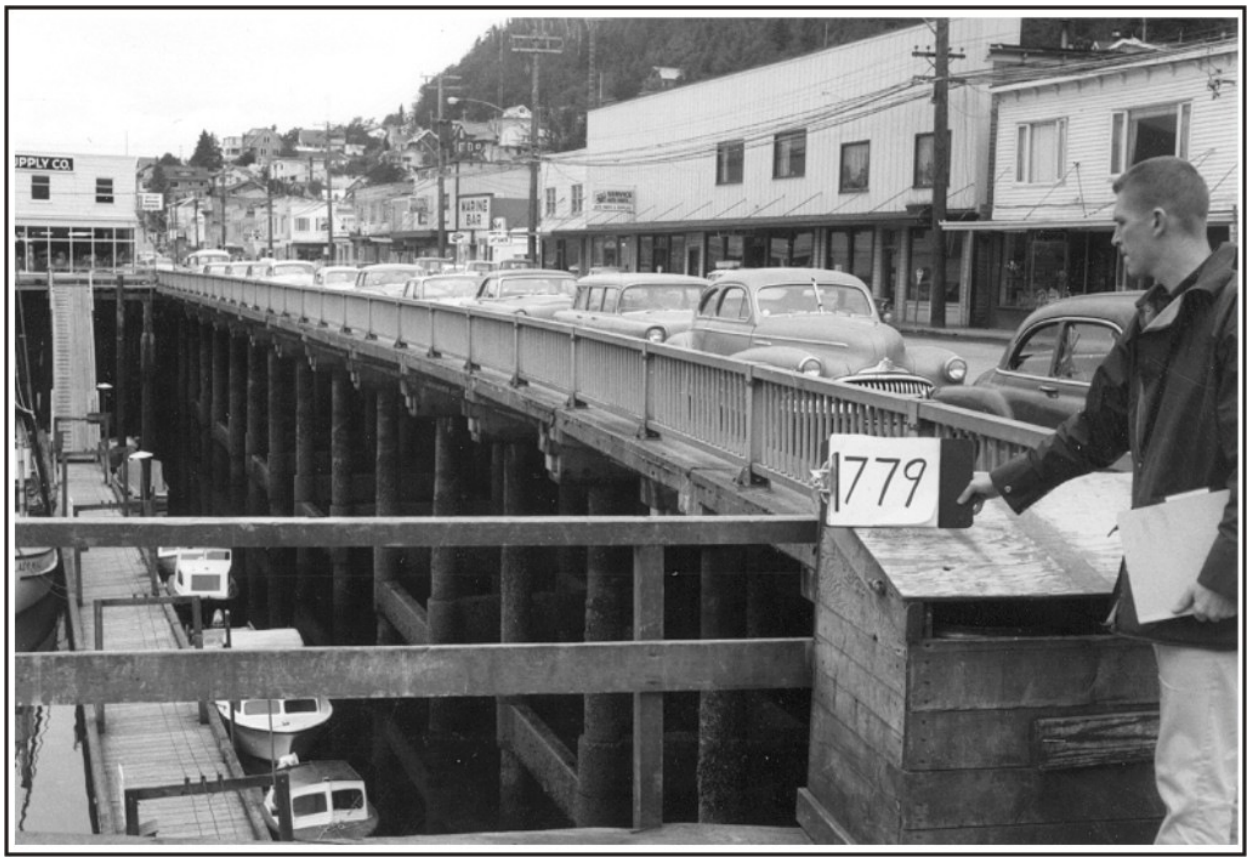

Figure 16. The Water Street Viaduct, shown here shortly after construction in the mid-1950s, was part of Tongass Avenue, the main arterial linking the northern and southern parts of Ketchikan. Photographer unknown. Photo from ADOT&PF Bridge Section, Juneau.

The U.S. Navy built a new bridge over the Indian River in Sitka after a storm took out the old one in September 1942 (U.S. Alaska Road Commission Collection, PCA 61-76, Album #76, Alaska State Library). The Navy also built a navigational aide at Yakutat in the early 1960s and a road and timber trestle bridge so that crews could do periodic maintenance on the navigational aide (File for Bridge No. 1112, Ankau Sough on Ocean Cape Road, ADOT&PF/Bridge Section). Cities also built feeder roads and streets as the population of urban communities grew and automobile traffic increased, clogging narrow urban streets and roads. The City of Ketchikan, for example, re-built and widened Tongass Avenue, the town's main arterial, in the mid 1950s (Figure 16).

During the years between 1940 and 1948, the number of vessels operating in the Alaska shipping industry dropped from 42 to seven. Federal subsidies, put in place in 1946 and 1947, ceased in 1948, prompting all the steamship lines to cease Alaskan operations except for the Alaska Steamship Company (Antonson and Hanable 1985:328). The first step in creating a marine ferry system in southeast Alaska occurred in 1948 when three men purchased and refitted a 121 foot long surplus LCT (land craft-tank) vessel called the *Chilkoot* and started passenger service. The vessel

carried 14 cars and 20 passengers, but the venture lost money due in part to Coast Guard limitations. The Territory of Alaska bought the *Chilkoot* in 1951 and operated it between southeast Alaska communities until it was retired in 1957. The territory replaced it with the *M/V Chilkat*, a 99-foot ferry that carried fifteen cars and forty passengers (Simpson 1995:89). In the meantime, Alaska Steamship Company lost $1.5 million between 1949 and 1953 due to increased operating costs, and competition from airlines, barges and containerized cargo vessels. In 1954, the company decided to end ocean passenger service to Alaska. After adopting containerized cargo, Alaska Steam resumed service to southeast and southcentral communities, but passenger services continued to loose money (Antonson and Hanable 1985:328-331).

In 1956, Congress passed and President Eisenhower signed the Federal-Aid Highway Act into law. The new law provided federal highway dollars to Alaska for the first time and authorized funding for three years, 1957 through 1959. It also allowed the intermingling of federal dollars for highway construction and maintenance, with only a ten percent match by the state. Another provision of the law transferred the ARC to the BPR in the Department of Commerce, combining Alaska's two federal road building agencies. The ARC was significantly large than the BPR, and the two organizations had a sometimes contentious history (Associated General Contractors of Alaska 1998:62-76). All ARC personnel, equipment, property and unexpended appropriations were transferred to the BPR. The ARC organization was combined with the existing BPR Alaska organization to form BPR Region 10. The regional office was established in Juneau, with district offices at Anchorage, Valdez, Fairbanks, Nome and Juneau (American Society of Civil Engineers, Alaska Section 1976:49). The Federal Aid Highway Act of 1956 created a single, unified road building agency--the BPR--and assured a steady source of funding for the future. The BPR maintained 1,000 miles of all-weather routes connecting the ice-free ports of Valdez, Seward and Haines with the principal military installations and the lower 48 states. The BPR also maintained a secondary road system that linked smaller communities with the main highways, and continued to build new feeder roads in cities such as Anchorage and Fairbanks and other communities. The BPR continued construction on a new highway extending north from Wasilla towards Willow and Talkeetna, and eventually Mt. McKinley Park and Fairbanks.

Road and Highway Construction Since 1959

After President Eisenhower signed a proclamation admitting Alaska as the 49th State into the Union on January 3, 1959, the new state of Alaska became responsible for Alaska's road system. The new state legislature created a Division of Highways within the Department of Public Works in July 1960, which assumed responsibility for the Federal Aid Highway program in Alaska. The role of the federal BPR office in Juneau changed from road building to oversight of the federal funds that went to the state. To staff the new state agency, the Division of Highways recruited BPR employees, former ARC employees and skilled people from other road building agencies in the lower 48 states. The Division of Highways took over responsibility for over 1,800 miles of connecting roads and 1,300 miles of local and isolated roads (Antonson and Hanable 1985:356-357). The Division continued to expand Alaska's highway system, designing and putting out to bid road and bridge projects. During the first year, some of those projects were designed by the BPR or its contractors,

within a year the new state agency had hired engineers to design their own projects. Construction continued on the 323-mile Parks Highway, which was gradually extended through the Susitna and Nenana river valleys and was completed in 1972.

The Good Friday Earthquake, which occurred in March 1964, had a profound impact on road building in Alaska. Registering 9.2 on the Richter scale, it was the largest recorded earthquake on the North American continent. It damaged roads and bridges (Figure 17) all over southcentral Alaska and the tsunami that followed destroyed the communities of Valdez and Chenaga and heavily damaged the town of Kodiak. The earthquake and tidal wave destroyed or severely damaged 27 percent of the state's bridges and did an estimated $75 million dollars in damage (Alaska Department of Highways 1964:11). The Alaska Department of Highways suspended on-going construction projects throughout much of Alaska in order to focus on reconstructing southcentral Alaska's road system. In the aftermath of the earthquake, state engineers revised plans and building techniques to make roads, highways and bridges safer in the future. After rebuilding roads and bridges damaged by the earthquake, the State Department of Highways resumed construction on major projects such as the Parks Highway and the Edgerton Cut-off in the late 1960s. The State also constructed a new 33-mile Edgerton Highway linking the Richardson Highway at Mile 83 with Chitina. That project was completed in the early 1970s. After the discovery of oil on the North Slope, the state undertook

Figure 17. The Sterling Highway bridge at the Kenai River, Cooper Landing, April 1964. Bridge File 210, ADOT&PF Bridge Section, Juneau.

construction of a road from Fairbanks to the Arctic Ocean. The 414-mile gravel-surfaced Dalton Highway was completed in 1974 and parallels the Trans-Alaska Oil Pipeline.

The federal government transferred the M/V Chilkat to Alaska in 1959. A year later, voters approved an $18 million bond to help finance construction of new vessels, and terminals. In 1963, the State of Alaska began operating three ferries in southeast Alaska, the *Malaspina*, the *Matanuska* and the *Taku*. Each vessel was 352 feet long, and capable of carrying 109 automobiles and 500 passengers. The vessels exceeded initial projections in terms of passengers and vehicles, but the system was never self supporting (Simpson 1995:90-95). Over the years, increased resources were put into the ferry system and new vessels were brought on line. The system provided reliable ferry service for southeast communities and later to communities in Prince William Sound and Kodiak that were not connected by roads and that had previously relied on steamships for passenger service. Development of the Alaska Marine Highway system in the 1960s and later years had the effect of limiting expansion of the road system in southeast Alaska and Prince William Sound. Most new roads in southeast Alaska were built within existing communities or to support commercial logging.

In September 1962, the Department of Public Works was reorganized and a separate Department of Highways was created. By 1969, the Department of Highways was responsible for 4,456 miles of roads. The state road system included 1,647 miles of primary roads (1,319 mile paved), 1,800 miles of secondary roads (252 miles paved), and 1,010 miles of local roads (34 miles paved) (Alaska Department of Highways 1969:24). The agency was reorganized again in 1977, when the Department of Highways was merged with the Department Public of Works to become the Alaska Department of Transportation and Public Facilities (DOT&PF). By 2006, the DOT&PF was a multi-faceted department of state government that maintained more than 5,000 miles of highways, managed 268 airports and 73 harbors, operated a ferry system of ten vessels visiting 33 ports, and managed more than 700 buildings. The largest component of the ADOT&PF continued to be its overland transportation divisions that design, build and maintain roads and bridges throughout Alaska.

PART II :

THE CHRONOLOGY OF ALASKA TRAIL AND ROAD BRIDGES

III. EARLY BRIDGE BUILDING IN ALASKA

The first bridges built in the United States and Alaska were constructed for trails and wagon roads. The manner in which Alaska trails and roads developed directly affected the early design and construction of bridges. Low traffic volumes, environmental obstacles, and high construction costs affected the types of bridges built, materials used for construction and the places where settlers, prospectors and miners, packers and freight carriers, toll road builders and public agencies built bridges for trails and roads.

Wooden Bridges Built by Early Settlers and Miners

One of the primary obstacles to historic overland travel in Alaska has been river and creek crossings. In the nineteenth century, Natives and Euro-Americans forded water crossings--walked through creeks and rivers - - where the rivers were not too deep. They established ferries at water bodies that were too deep to cross on foot, horseback or in wagons. Alaska's earliest bridges were crude makeshift foot bridges built of logs placed over stream crossings (Figure 18). As traffic increased, miners and settlers created simple bridges of hewn logs set across upturned, forked tree trunks. These first bridges were built using native (local) timber. Most early bridges were simple log structures, but some were more elaborate log and timber trestle bridges. These primitive bridges were vulnerable to floods, fire and rot, and they had to be frequently replaced.

Figure 18. An example of a simple log foot bridge built in the interior in the early 1900s. Rita Cottnair Album, 1974-130-101, University of Alaska Fairbanks.

Figure 19. The elaborate log foot bridge at Indian River, Sitka, 1887, demonstrated considerable engineering skill. William H. Partridge Collection, PCA 88-102, Alaska State Library.

The earliest record of any bridge constructed in Alaska dates to Juneau during the 1880s. On July 22, 1886, a mine superintendent on Basin Road proposed building a new bridge across Gold Creek on the cemetery road to replace an existing bridge. The date that the original bridge was constructed is unknown. The mine superintendent offered to provide the labor to build the bridge if the citizens of Juneau provided the materials (*Alaska Mining Record*, July 22, 1886:10). The town of Sitka had a wooden suspension bridge that spanned the Indian River in 1894. The bridge (Figure 19) was wide enough for pedestrians and pack horses (*Alaska Search Light*, January 7, 1895:1). The gold rush era began in the mid-1890s, as hundreds and later thousands of gold seekers stampeded to new mining camps in various parts of Alaska. The miners created trails from water bodies to the diggings, and they built bridges to cross wetlands, streams, creeks and rivers to get their equipment and supplies to their camps. In 1895, miners in the Sixmile Creek drainage on Turnagain Arm built a log bridge over Canyon Creek that was 100 feet long and fifty feet above the water (*Alaska Search Light*, December 28, 1895:6).

After gold was discovered in the Klondike, the number of travelers crossing the coastal range from southeast Alaska to the interior grew from a trickle to a flood. Stampeders on the Chilkoot Trail built makeshift log bridges to haul their equipment and supplies from the coast to the mountain pass (Figure 20). Entrepreneurs built trails and toll roads, such as the Dalton and the White Pass trails, to make packing supplies into the interior easier and cheaper. The Skagway-White Pass trail had four log bridges in September 1897, where the trail crossed and re-crossed the Skagway River. The first bridge on the route, at the outskirts of Skagway, was 6 feet wide. Wagons had to ford the river at this location because the bridge was wide enough only for pedestrians and pack horses. The trail extended up the west side of the river and three additional wooden bridges were located above the confluence of the Skagway River and the White Fork (Figure 21). An alternative trail in the

Figure 20. A simple log bridge on the Chilkoot Trail near Dyea, 1897. Winter and Pond Collection, PCA 87-0665, Alaska State Library.

Figure 21. A log pack horse bridge, Porcupine Creek, White Pass Trail, seven miles north of Skagway, 1897. Frank LaRoche photo, Klondike Gold Rush National Park, Skagway.

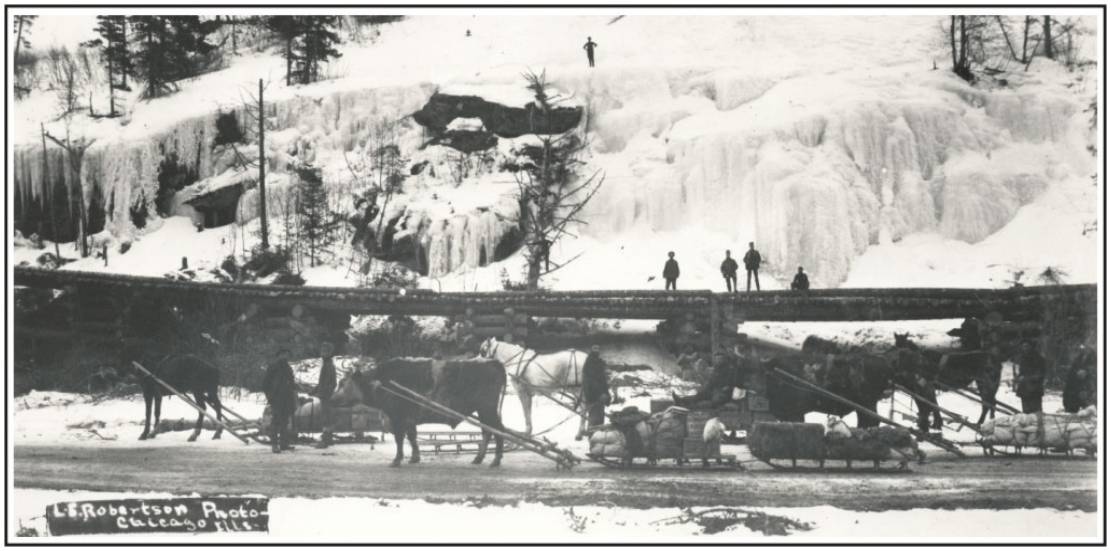

Figure 22. A log bridge on the Brackett Wagon Road. The packers in the foreground are sledding freight up the frozen Skagway River to avoid paying tolls on the Brackett Road. L.E. Robertson photo, Yukon Archives photo #1992, Whitehorse.

lower valley extended up the east side of the Skagway River and another timber bridge crossed the Skagway River about half a mile below its confluence with the White Fork (Talbot 1897). After George Brackett took over the trail in 1897, he widened it into a toll road and replaced the bridges with structures wide enough for wagons and sleds (Figure 22). While most of these early bridges were simple log structures, one was an elaborate through truss wooden structure (Figure 23) that

Figure 23. Timber through truss bridge over the Skagway River on the Bracket Wagon Road, 1898. E.A. Hegg photo, BW 19-1-155, Klondike Gold Rush National Park, Skagway.

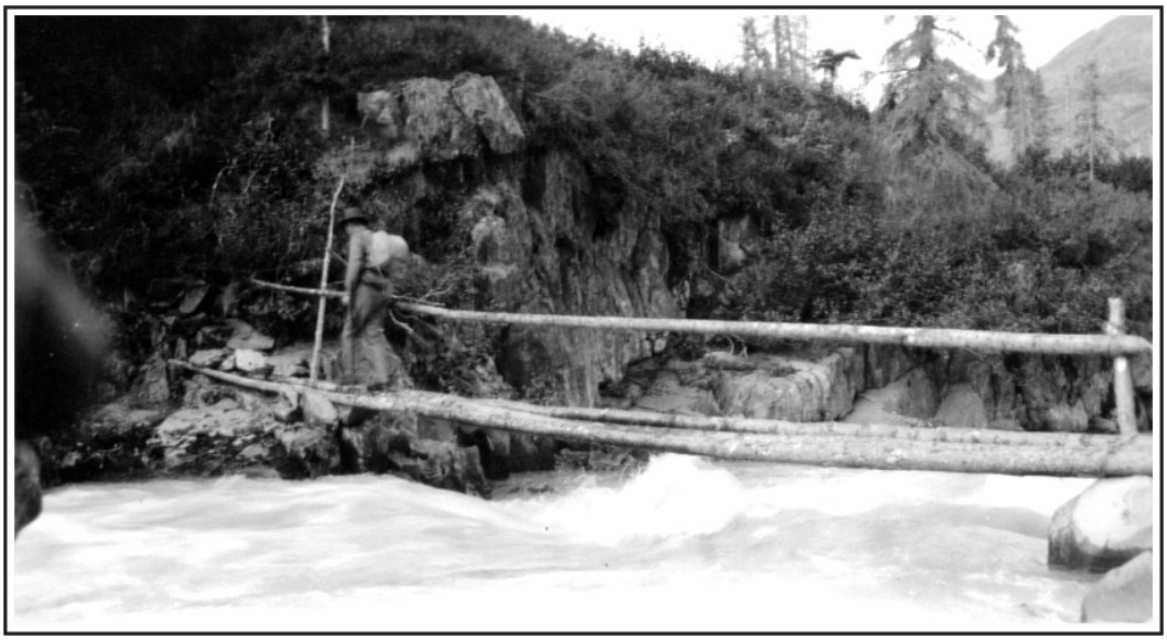

Figure 24. Count Scheney, the Hungarian Ambassador, crossing Benjamin Creek on a crude foot bridge, Kenai Peninsula, 1908. George P. Nelson Papers, HMC-0187, series 4-3-C38, University of Alaska Anchorage.

rested on a timber piling substructure. In May 1903, the City of Skagway took over the 16th Street bridge on the Skagway River, which had fallen into disrepair. A city crew made repairs to the bridge during August of the same year (*Daily Alaskan* 1903a:1 and 1903b:1).

As gold was discovered in various parts of Alaska and the Yukon, gold seekers stampeded from camp to camp, seeking their fortune. Wherever prospectors and miners went, packers and merchants followed. They worked together to cut trails through the wilderness and to build bridges to cross creeks and rivers. Most of the bridges built by miners, packers and merchants were simple structures made of logs (Figures 24 and 25). As traffic increased, the need for bridges capable of carrying pack horses and sleds and wagons with heavy loads became obvious. The high cost of building roads and bridges called for new capital, and some entrepreneurs believed that railroads would be instrumental in opening Alaska.

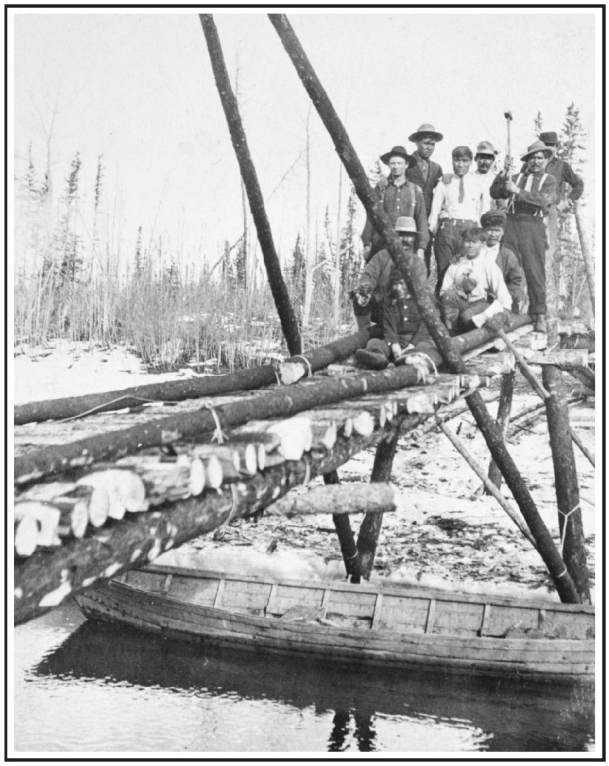

Figure 25. Men building a log suspension bridge over the slough at Tanana Crossing. Walter and Lillian Phillips Photo Collection, 1985-27-125, University of Alaska Fairbanks.

Early Railroad Bridges

The first railroad was built in the United States in 1829 and initially railroad engineers built bridges based on those developed for wagons. Locomotives and railcars weighed significantly more than wagons, so railroad bridges had to be sturdier than wagon bridges and able to carry heavier loads. Railroad locomotives could only climb low grades. This placed limits on the kind of terrain where construction engineers could lay track and sometimes required longer bridge spans than on wagon routes. These constraints prompted railroad engineers to create numerous innovations in bridge design and construction in the late nineteenth century. They developed new bridge designs, pioneered the use of new materials, and led to the adoption of higher construction standards for bridges. Engineers who built trail, road and highway bridges in the states borrowed heavily from railroad bridge innovations (Potter and Puschendof 1999:16). Alaskans who built bridges for trails and roads also transferred railroad bridge technology to road construction applications. Most early Alaskan railroad bridges were short, simple log or timber spans similar to early trail and wagon bridges. The rugged terrain and limitations that grade changes placed on rail routes prompted railroad engineers to built the first complex bridges in Alaska during the late 1890s and early 1900s.

The White Pass and Yukon Railroad (WP&YR) constructed the first railroad bridges in Alaska. Construction of the WP&YR began in May 1898 at the port in Skagway and extended up the White Pass and over the coastal mountains to White Horse on the Yukon River. Initially all WP&YR bridges were timber trestle structures (Figure 26). The steep terrain in the Skagway River

Figure 26. A damaged WP&YR timber trestle bridge at Mile 4 after the 1901 Skagway River flood. H.D. Barley Collection, Photo #5226, Yukon Archives, Whitehorse.

valley presented challenges for the builders of the line, and some of the trestle bridges appeared to cling perilously to the side of mountain walls (Figure 27). The original line extended up the east side of the Skagway River, up the south side of the White River to a switchback, along the north side of White River canyon before continuing up the Skagway River canyon to the pass. To shorten the route, WP&YR engineers built a steel arch cantilever bridge (Figure 28) across Deadhorse Gulch in July 1900. The structure was completed in December (*Daily Alaskan* July 17, 1900a:1, September 27, 1900b:4, and December 20, 1900c:1), eliminating the two sections of track up White River canyon. The 850-foot long Deadhorse Gulch Bridge was the first steel arch bridge built in Alaska and, at 215 feet above the bottom of the gorge, the highest steel cantilever bridge in

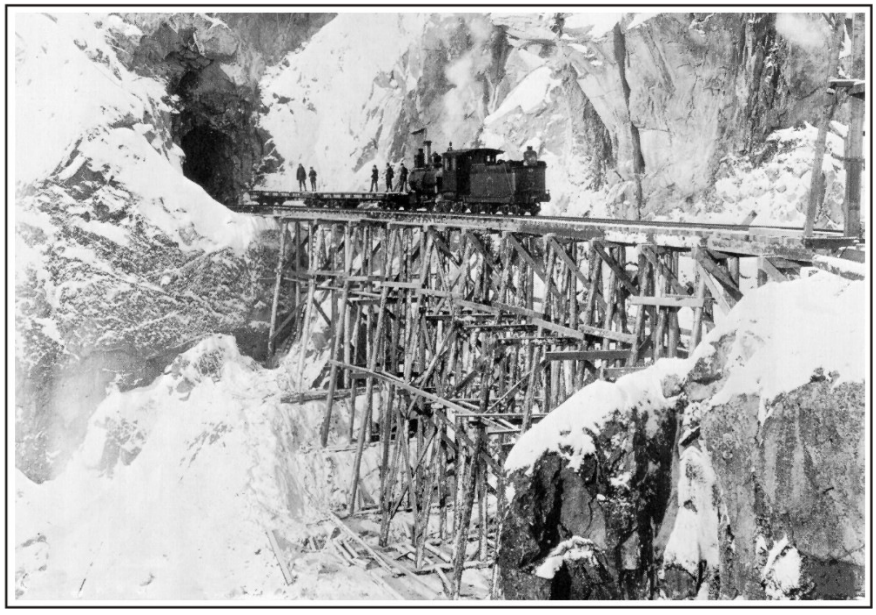

Figure 27. A timber trestle bridge on the WP&YR, 1899. E.A. Hegg photo, reprinted from Morgan 1967:104.

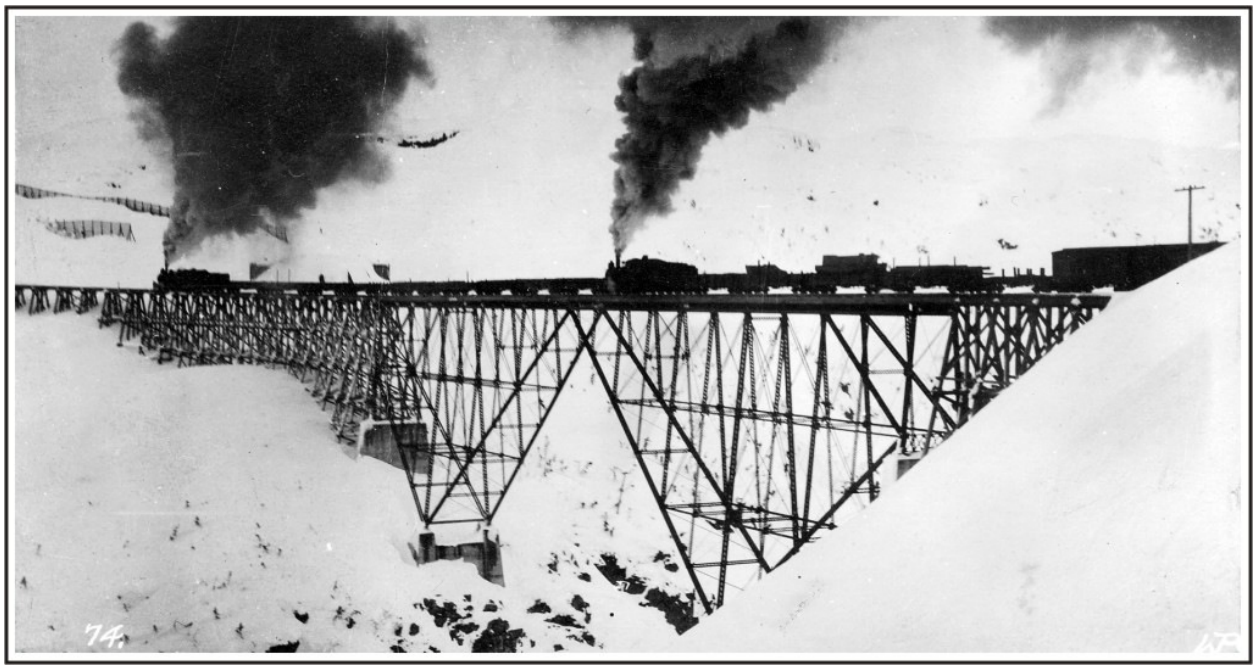

Figure 28. Two trains on the WP&YR bridge at Deadhorse Gulch. Photo courtesy of ADOT&PF Bridge Section, Juneau.

the world when built (*The Daily Alaskan* 1900c:1; Cohen 1980:48-49). In August 1901, the WP&YR began replacing some of its wood bridges with steel structures (*Daily Alaskan* 1901:4, and 1903c:4).

As the gold rush spread north and west to the Seward Peninsula, construction of the 6.5-mile long Wild Goose Railroad started in Nome in 1898. Four years later, construction began on the 5-mile Wild Goose Railroad from Council to Ophir Creek. Crews started building the Council City and Solomon River Railroad (CC&SR) in 1903. The company went bankrupt in 1907 after laying 35 miles of track, seven miles short of Council. The longest CC&SR bridge was a 927-foot long timber trestle that spanned the Solomon River (Buzzell and Gibson 1986:29). In 1906, the Seward Peninsula Railroad was organized and took over the Wild Goose Railroad at Nome. The new company laid track to the Kougarok River, 85 miles inland from Nome. The line had 128 bridges, including a thousand-foot long trestle over the Kuzitrin River (Clifford 1981:174-175).

In southcentral Alaska, the Alaska Central Railroad was organized in 1902 to build a rail line from Resurrection Bay to the Tanana River. Construction began in Seward in 1903. Crews laid 50 miles of track and built dozens of trestle bridges in the rugged Kenai Mountains before the line went bankrupt in 1907. The railroad operated in receivership until 1910, when it was reorganized as the Alaska Northern Railroad. Construction crews extended the line to Mile 71, but the Alaska Northern went bankrupt in 1912. The line was taken over in 1915 by the Alaska Engineering Commission (AEC), a federal agency which succeeded in laying rails all the way to Fairbanks in the following eight years. The line, which was renamed the Alaska Railroad, built mostly simple timber and timber trestle bridges. AEC engineers built complex steel arch and steel through truss bridges to span long crossings, notably at Hurricane Gulch (Figure 29) and the Tanana River. Construction of the Tanana Valley Railroad began in 1905. The narrow gauge line extended 44.7 miles from the town of Chena (near Fairbanks) to Chatanika. Construction crews built several 600-foot long trestle bridges to overcome geographic obstacles. The railroad's organizers planned to extend the line to Circle City, but revenue from operations did not support such ambitious plans. The AEC purchased the line in 1917 and operated it until 1930 (Clifford 1981:117-124).

Figure 29. The steel arch Hurricane Gulch railroad bridge during construction by the AEC, August 1921. Photo courtesy of the ADOT&PF Bridge Section, Juneau.

Three outfits attempted to build railroads from tidewater ports in Prince William Sound to the rich copper deposits in the Chitina River

drainage. In 1907, the Alaska Home railroad laid a few miles of track leading north out of Valdez before it became mired in controversy and shut down. Another outfit called the Alaska Pacific Railway and Terminal Company started construction in Katalla in 1907 and extended 6 miles toward the Copper River. A giant storm destroyed the port facilities, dealing the knockout punch to the line. The third outfit, the CR&NW, started construction from Cordova in 1906 and completed the 196-mile rail line to the Kennecott Mill in 1911. The rail line had 154 bridges, including 129 bridges in the first 130 miles between Cordova and Chitina. Most of the bridges on this first portion of the line were timber stringer and timber trestle bridges, which were considered temporary structures, were usually reliable, and quick and inexpensive to build and replace. Four bridges between Cordova and Chitina were permanent steel thru truss structures (Buzzell *et. al.* 1993:15). The most important of the four steel truss bridges was the Million Dollar Bridge (ADOT&PF Bridge No. 206, COR-005), a 1,500-foot long, four span structure that crossed the Copper River between the Childs and Miles Glacier. Construction crews erected the steel during the winter of 1909-1910 on falsework on top of the frozen river. Completed in June 1910, the Million Dollar Bridge (Figure 30) was a significant engineering accomplishment, overcoming topographic, geologic and hydrologic barriers.

The 60-mile Chitina Branch of the CR&NW extended from Chitina to Kennecott and included 24 timber stringer and timber trestle bridges (Buzzell 2005:52), including a 2,190-foot long timber

Figure 30. The Million Dollar Bridge, looking north across the Copper River, ca 1910. Photo courtesy of the U.S. Bureau of Land Management, Anchorage.

trestle bridge across the Copper River and a 90-foot high, 890-foot long timber trestle bridge at the Gilahina River. The Chitina Branch also included the Kuskulana Bridge (ADOT&PF Bridge No. 397, VAL-207), built in the dead of winter during 1911 (Figure 31). This steel deck truss cantilever bridge was 775 feet long and the deck was 235 feet above the Kuskulana River (Figure 32). It was the second steel cantilever bridge built in Alaska.

Early Alaskan railroads built mostly simple timber stringer and elaborate timber trestle bridges, but also constructed the first steel through and deck truss and steel arch structures in Alaska. Railroad bridge designs were later adapted to automobile uses in Alaska. The CR&NW closed in November 1938 after the high grade copper at Kennecott was exhausted. The ARC converted the Million Dollar Bridge to highway use in 1958 and the Alaska Department of Highways converted the Kuskulana Bridge to automobile use in 1973. These two steel truss structures are the oldest bridges still in use for automobile traffic in Alaska.

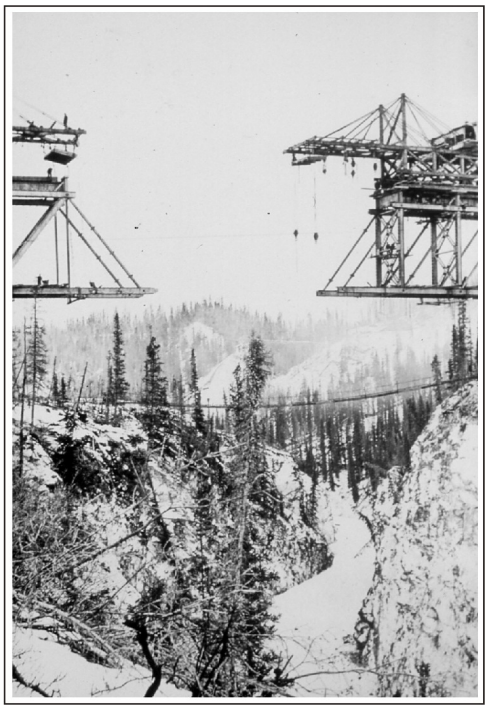

Figure 31. Crews constructing the Kuskulana River Bridge, 1911. Photo courtesy of the ADOT&PF Bridge Section, Juneau.

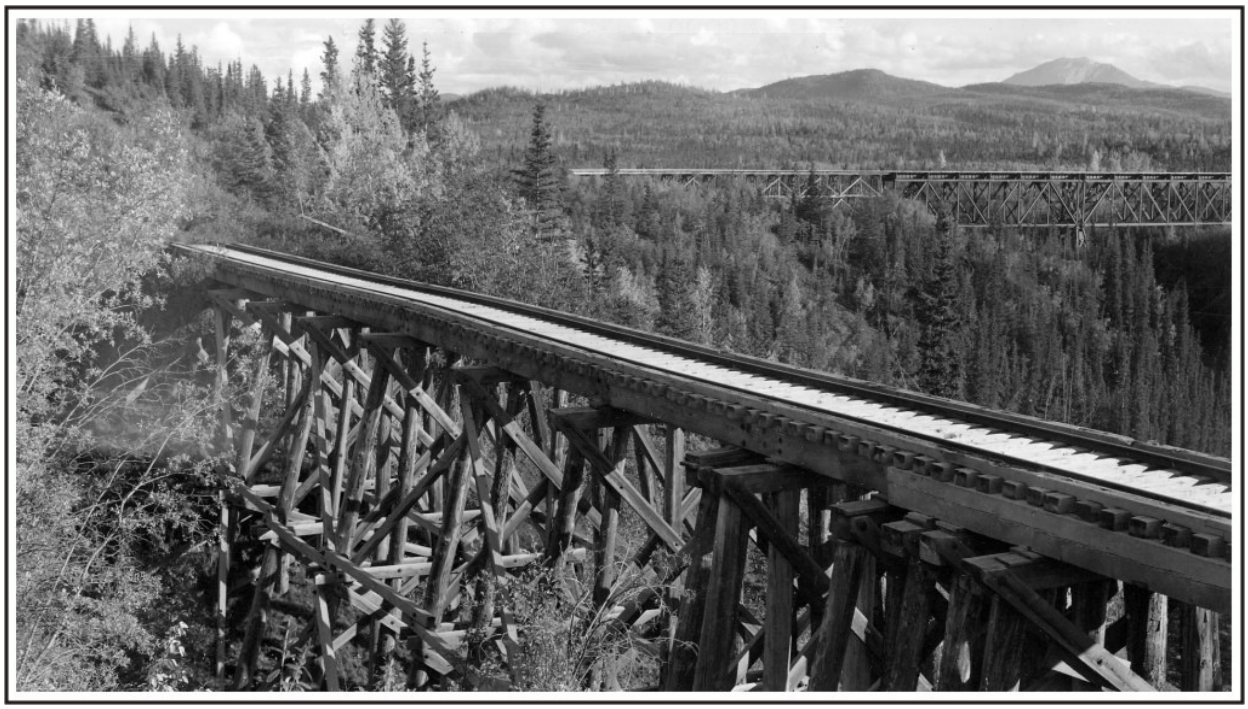

Figure 32. CR&NW trestle bridge 147B at Mile 147, 1957. The Kuskulana Bridge (VAL-207) is in the background. Photo courtesy of the ADOT&PF Bridge Section, Juneau.

Despite all the money and effort put to building railroads, Alaska was too expansive in area and there were too few railroads to access most towns, villages and mining camps. People living in and traveling to most Alaskan communities and mining camps still had to travel overland from rail lines and river ports. They relied on trails and roads for access. Towards the end of the gold rush, a number of government agencies became involved with trail and road building, and, by necessity, bridge building. The U.S. Army was the first government agency to build bridges in Alaska.

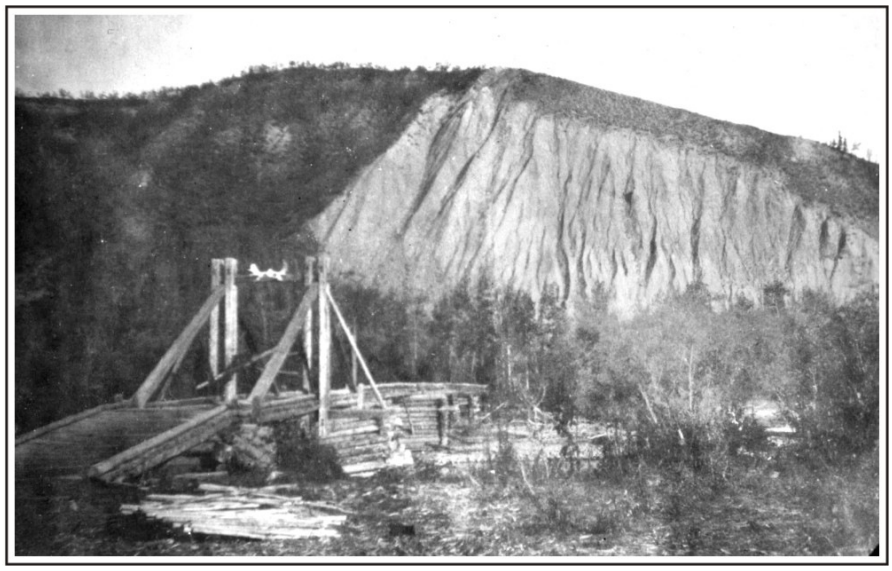

Figure 33. A log king post bridge built by the U.S. Army in 1900 over the Tonsina River, September 1908. Francis E. Pope Collection, 66-15-400, University of Alaska Fairbanks.

The first trail built by the U.S. Army was the Valdez-Eagle Trail. Construction on the five-foot wide trail began in 1899 and was completed to the Yukon River in 1900 (Figure 33). In the following three years, soldiers improved the trail, officially known as the Trans-Alaskan Military Road, to support the construction of a telegraph line by the U.S. Signal Corps. Bridges built along the trail were log structures made of native timber. Most were simple, single span structures that crossed small streams and creeks. Log bridges with more than one span (Figure 34) or of king post design (Figure 35) were used to cross small rivers. Wide, deep and fast running rivers were forded or

Figure 34. The U.S. Signal Corps Bridge at Mile 85.5 of the Valdez-Eagle Trail. Rita Cottnair Collection, 1974-130-93, University of Alaska Fairbanks.

crossed using rafts or ferries. In 1905, the ARC took over maintenance of the Valdez Eagle Trail and built a spur trail to the mining camp at Fairbanks on the Tanana River. In the following years, most traffic on the trail starting at Valdez went to Fairbanks. Soldiers assigned to the U.S. Signal Corps continued to maintain the trail and bridges on the original northern section of trail that extended from Gakona to Eagle until the WAMCATS line was abandoned in the 1920s.

Figure 35. A king post log bridge with log cribbed piers at Mile 89 on the WAMCATS Line, 1913. Rita Cottnair Collection, 1974-130-100, University of Alaska Fairbanks.

With the discovery of gold in the Tanana Valley in 1904, the need to build new roads and bridges grew rapidly. Civilians and mining companies banded together and built local roads and bridges, including a bridge across the Tanana River in the new town of Fairbanks (Figure 36). William Geiger of Nome built toll bridges in Nome and at Fort Davis, including an elaborate suspension bridge over the Nome River (Laura Samuelson, personal communication, January 11, 2007). As the population of Alaska grew and the need for overland transportation expanded, Congress decided to create a separate agency to build roads and bridges in Alaska.

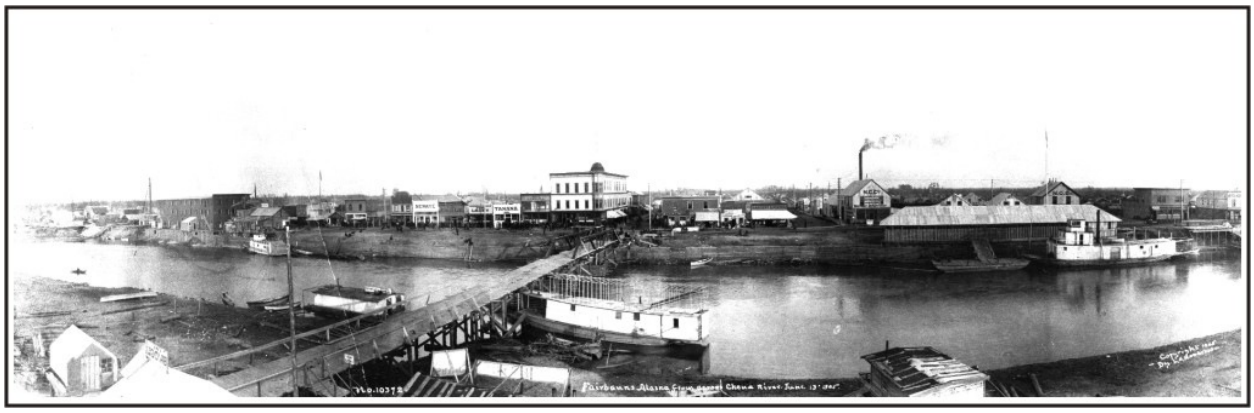

Figure 36. The Chena River Bridge at Fairbanks, June 13, 1905. Charles E. Bunnel Collection, 1958-1026-2163, University of Alaska Fairbanks.

The City of Cordova, or a contractor working on behalf of the city, built the Front Street Trestle (Bridge No. 1499) sometime between 1909 and 1911 (Ermold 2007). The timber trestle extended nearly two city blocks, from Council Avenue to Adams Avenue (Buzzell 2002:20, 31, 32), and provided public access to buildings between First and Front streets in downtown Cordova (Figure 37). Most of the trestle, which was called Front Street but served as an alleyway behind the buildings on First Street, was removed during the 1950s. A small section of the trestle is still in use behind the Osborn/Steen Building and the Orca Books and Sound Building (Arvidson 1984:12, 24, 25, 54, 58, 68).

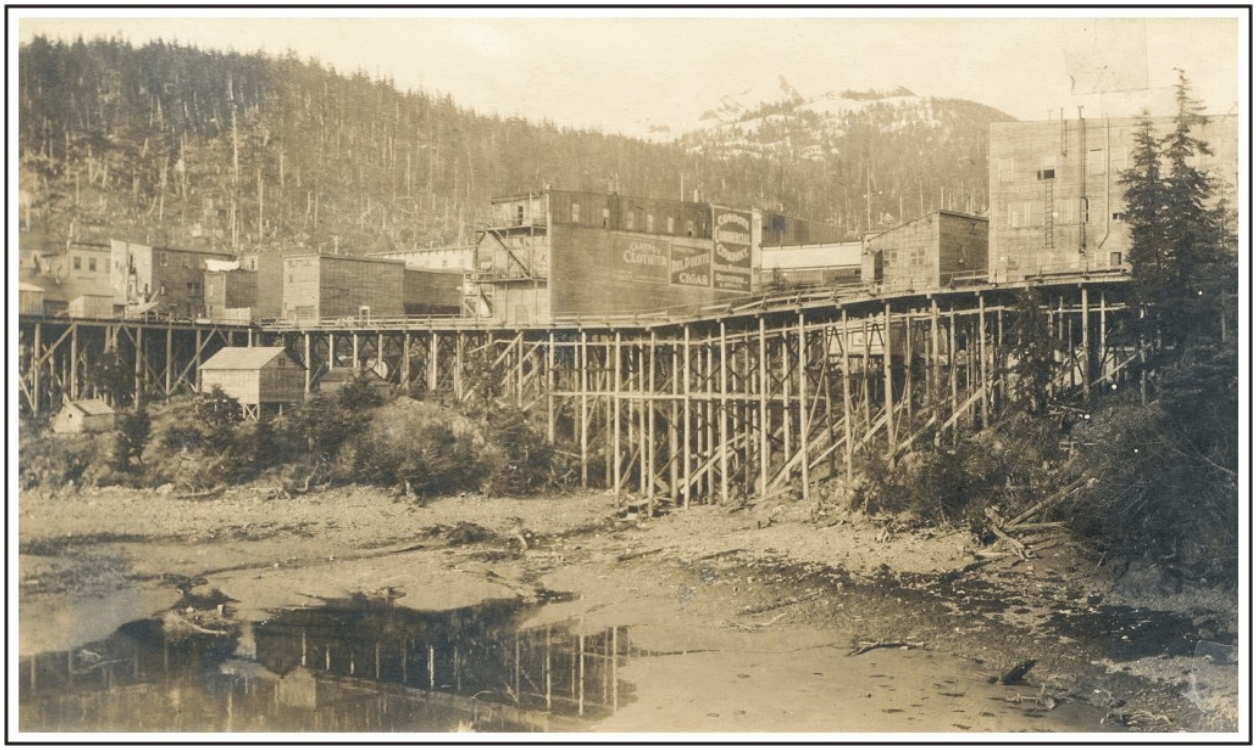

Figure 37. The Front Street Trestle, downtown Cordova, 1940s. Photo 95-72-186, Cordova Historical Society.

IV. ALASKA ROAD COMMISSION BRIDGES, 1905-1916

Early Bridge Types

With the establishment of the ARC in 1905, the U.S. Army continued to play a significant role in trail, wagon road and bridge building. The ARC became a distinct entity and developed an identity separate from the Army. Members of the ARC governing board and the engineers who oversaw the construction and maintenance were military personnel. The agency hired civilians to do the construction and most were seasonal employees. The ARC regarded the construction of bridges and the establishment of ferries across dangerous steams "as one of the most important duties of the Board" (ARC 1906:17). The first necessity in road building, according to the ARC, was "to provide for the safe crossing of various water courses, which are numerous in Alaska." During 1907, the agency's third construction season, ARC crews built several dozen bridges and spent $10,595 on bridges and ferries (ARC 1907:107, 142). Captain George B. Pillsbury, the ARC's chief engineer from 1908 to 1911, oversaw bridge construction from ARC headquarters in Juneau.

Most bridges built in the early ARC years were simple log or timber stringer structures. These bridges incorporated light construction methods, used native lumber and required little engineering. ARC supervisors and employees in the field developed an understanding the basics of log and timber bridge construction. ARC crews built hundreds of short bridges in the early years without the benefit of any plan drawings. Some of these bridges were single span structures, but most were log (Figure 38) or timber stringer (Figure 39) bridges with two or more spans. The spans on simple log bridges

Figure 38. A log stringer bridge on the Valdez-Fairbanks Road, 1910. Note the cribbed log piers. U.S. Alaska Road Commission Collection, PCA 228-225, Alaska State Library.

Figure 39. A timber stringer bridge on Peluk Creek near Nome, late 1910s. U.S. Alaska Road Commission Collection, PCA 61-141-21, Alaska State Library.

were supported by cribbed log piers (Figures 38 and 40). Other log and timber stringer bridges were supported by rows of pilings, known as pile bents (Figure 41) or by pile trestle in which the pile bents

Figure 40. A log bridge with log cribbed piers at Sheep Creek on the Valdez-Fairbanks Trail. White's Roadhouse is in the background. Crary-Henderson Collection, B62-1-a-426, Anchorage Museum of History and Art.

Figure 41. A log bridge supported by pile bents at Jarvis Creek on the Valdez-Fairbanks Trail, 1910. Rita Cottnair Collection, 1974-130-42, University of Alaska Fairbanks.

were reinforced with diagonal timbers attached to the pilings in each bent (Figure 42). In locations where bridges spanned deep canyons, diagonal and horizontal bracing timbers were attached to the outside pilings, tying the bents together to create a stronger substructure. This type of bridge was called a timber trestle (for an example see Figure 23, page 32).

Where traffic and local conditions warranted, the ARC built longer timber trestles and timber truss bridges. Timber truss bridges

Figure 42. A pile trestle bridge at Ship Creek, Anchorage, June 30, 1917. U. S. Marshals are destroying confiscated whiskey. Alaska Engineering Commission Photo Collection, AEC-G549, Anchorage Museum of History and Art.

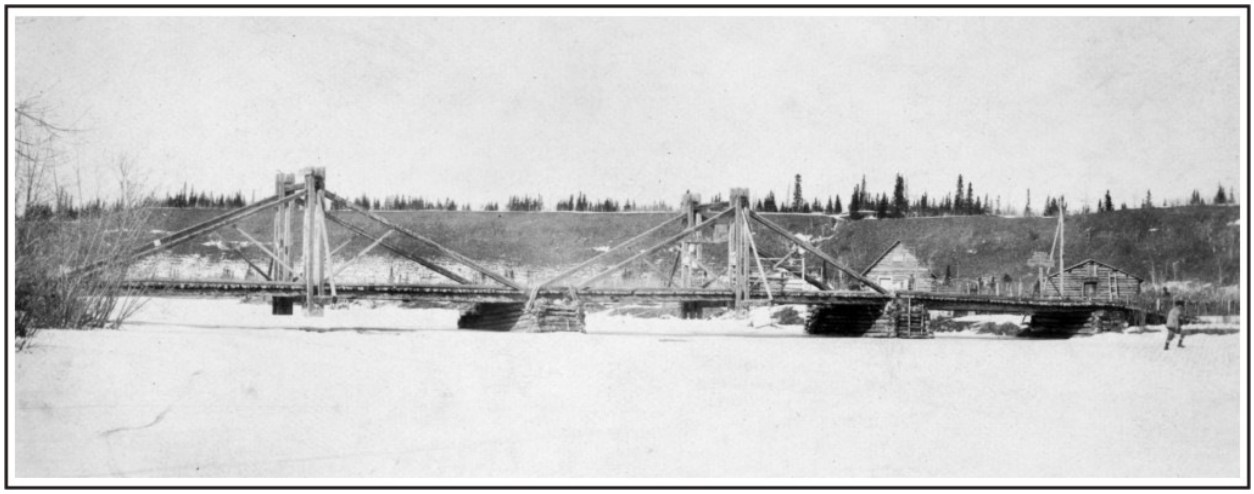

Figure 43. The Klutina River Bridge, featuring two king post and a log stringer span, March 26, 1910. Francis E. Pope Collection, 19966-15-915, University of Alaska Fairbanks.

were structures that consisted of a web-like assembly of smaller members linked together into rigid triangles. Bridges made of these triangles were capable of much longer spans and could carry much heavier loads than simple log or wood beam structures. The most common truss designs during the early years of the ARC were the king post (Figure 43), the queen post (Figure 44), the Howe

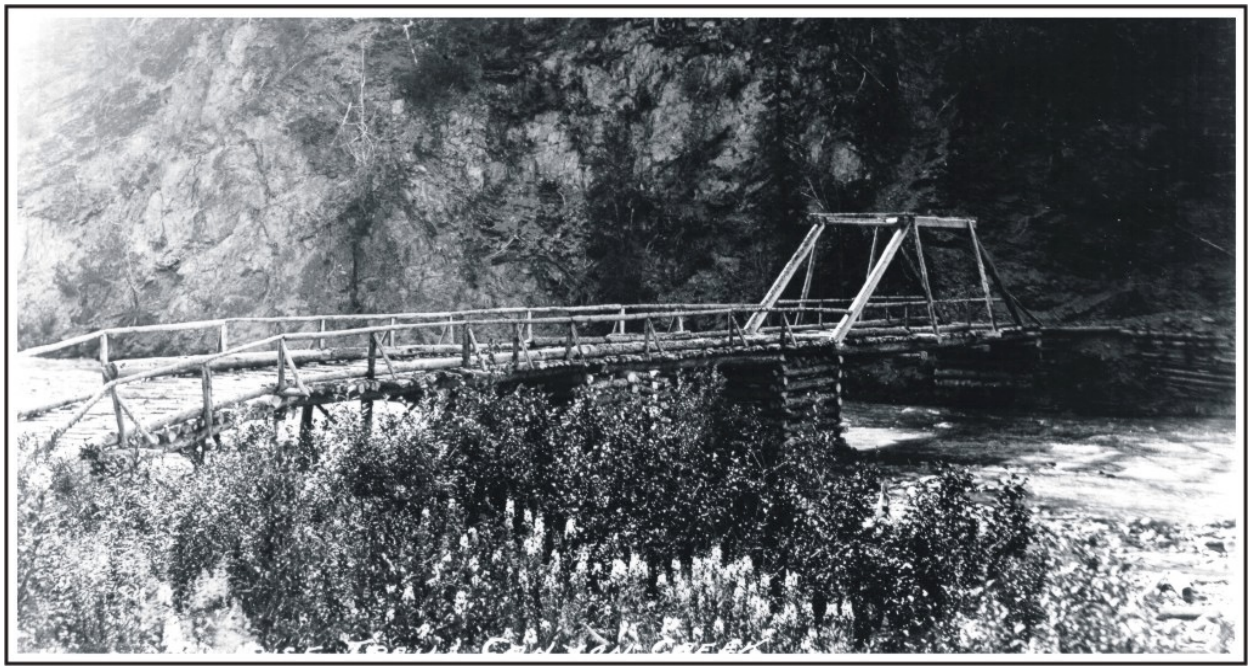

Figure 44. An example of a queen post truss bridge, one of the first bridges over Canyon Creek on the trail to Sunrise near Turnagain Arm, 1911. Photo by L.H. Peterson, Lot 8749, Library of Congress, Washington, D.C.

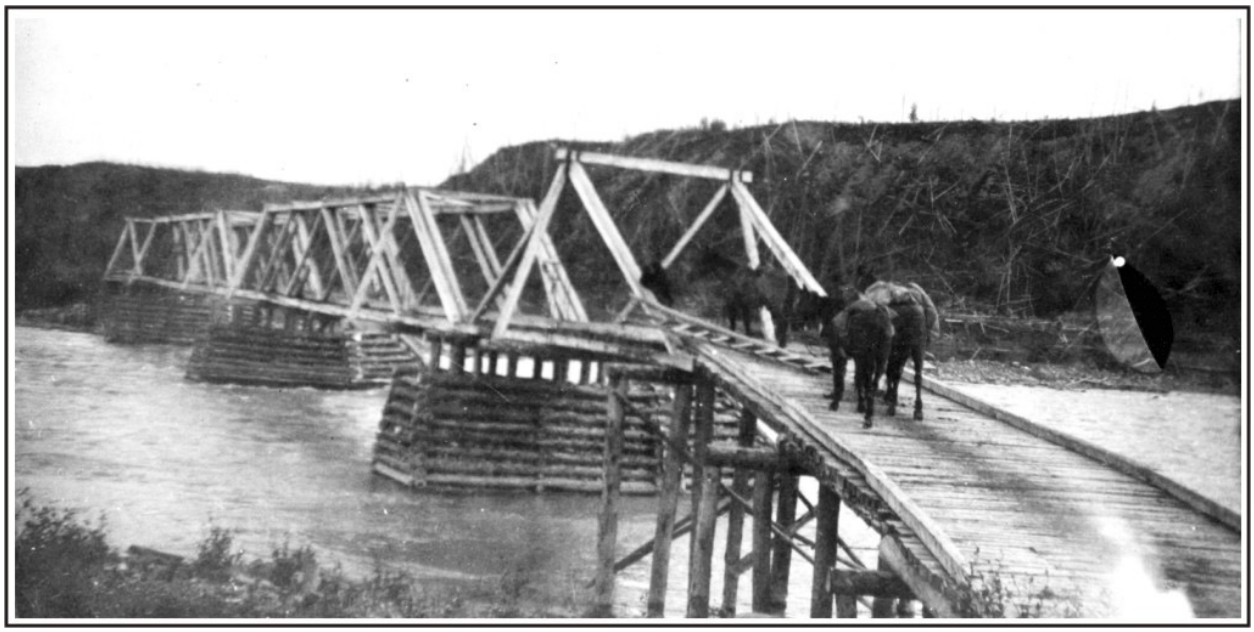

Figure 45. The Tanana River Bridge, consisting of two Howe truss spans, a king post span and pile trestle approach, 1908. Francis E. Pope Collection, 1966-15-480, University of Alaska Fairbanks.

through truss (Figure 45) and the Pratt through truss (Figure 46). Early ARC bridges at longer water crossings incorporated various timber truss designs and were built of native lumber.

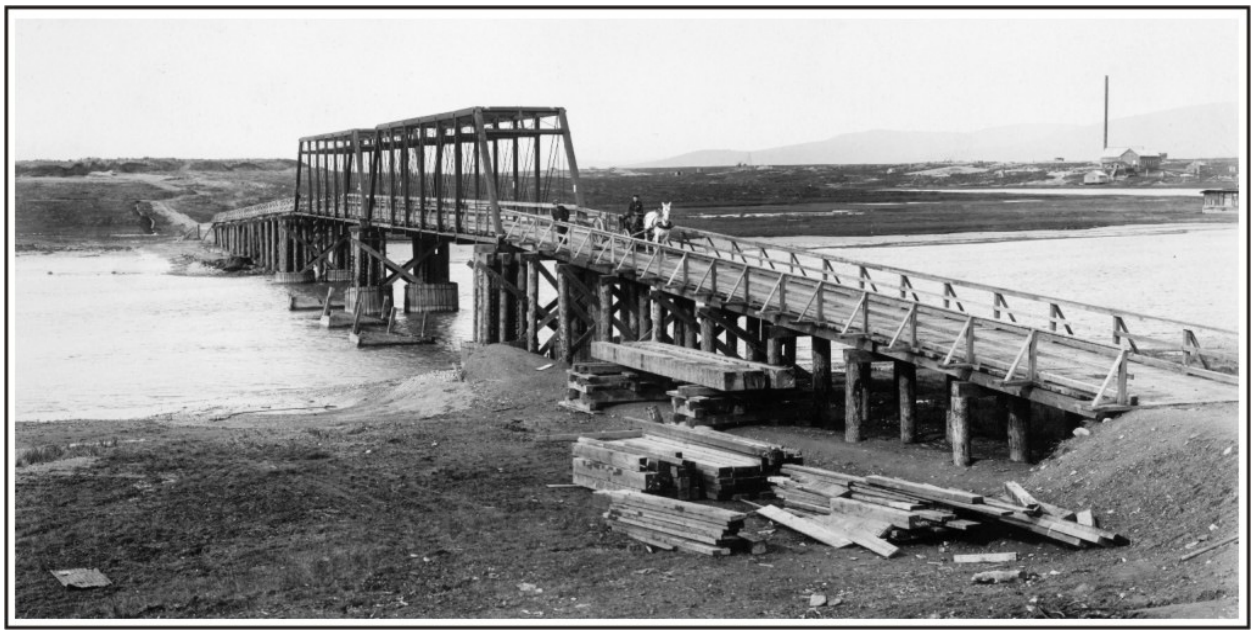

Figure 46. The Snake River Bridge, a two span Pratt through truss structure near Nome, early 1900s. John Zug Collection, 1980-68-333, University of Alaska Fairbanks.

The first major ARC project was to upgrade the Valdez-Fairbanks Trail to a wagon road. Water crossings were a significant obstacle along the route, which provided the only overland access to the interior north of the Alaska Range until 1923. During the ARC's first construction season, its crews built 25 small log bridges on the trail and a timber trestle bridge over the Robe River near Valdez (ARC Valdez (ARC 1905:299). In 1906, ARC crews replaced a ferry at the Tazlina River with a 450-foot bridge, consisting of two Howe truss spans, two king post truss spans and timber trestle approaches (ARC 1906:22). One of the longest structures built on the trail during 1907 was a bridge across the Kotsina River consisting of an 89-foot Howe Truss span and a log pile trestle span (ARC 1907:140). Flooding partially washed away the Tazlina River Bridge in 1909. During the following year, the ARC replaced the washed out bridge with a 70-foot Howe through truss and 70 feet of timber trestle approaches (ARC 1908:8; ARC 1910a:12). In 1910, ARC crews replaced the ferry at Shaw Creek with a two span king post truss bridge (Figure 47). By 1911, all but five important rivers, the Gulkana, Delta, Tanana, and Salcha Rivers and Piledriver Slough, on the Valdez-Fairbanks Road were spanned by bridges. The ARC subsidized ferries at the five water crossings where there were no bridges (ARC 1910a:12; ARC 1912a:6). A two-span king post timber truss was built over Piledriver Slough in late 1910 (ARC 1912a:13). In 1913, the ARC built a Howe timber truss bridge with two 150-foot spans over the Gulkana River and a 60-foot Howe timber truss bridge across the Delta River, replacing ferries at both crossings (ARC 1913:17, 19-21).

While the ARC was improving the Valdez-Fairbanks Trail, its crews frequently replaced bridges that washed out, become unsafe or were not strong or wide enough to support increased

Figure 47. The two span king post truss bridge at Shaw Creek on the Valdez-Fairbanks Road, winter 1912. Rita Cottnair Collection, 1974-130-41, University of Alaska Fairbanks.

traffic. Replacement bridges were usually more complex structures created to overcome flooding or channel changes. For example, the ARC replaced the 1900 Tonsina River Bridge in 1911 with four timber Howe truss spans (ARC 1912a:11). A year later, ARC crews constructed two 60-foot timber through truss spans over Stewart Creek and two 60-foot truss bridges in Keystone Canyon (ARC 1912b:9, 10). Light bridges on the Richardson-Salchaket segment of the Valdez-Fairbanks Road were repaired and upgraded in 1912 due to increased traffic and heavier loads (ARC 1912b:17). In 1913, the ARC replaced a 30-foot stringer bridge at Mile 7 with a 40-foot king post truss. Crews also replaced bridge the 1901 Klutina River, built a 60-foot Howe truss bridge across the Tiekel River, a 270-foot pile bent bridge over Gun Creek, and a 743-foot pile trestle bridge over Jarvis Creek (Figure 41, page 43) (ARC 1913:18, 21). ARC crews replaced a 40-foot truss over Willow Creek and 100 feet of pile trestle washed out by the Valdez Glacier in 1914. Crews constructed a new 60-foot queen post truss span three-quarters of a mile north of Millers Roadhouse and added 675 feet of pile trestle approaches to the Tonsina Bridge (ARC 1914:12, 110; ARC 1915:9-10).

The ARC also built and repaired bridges on numerous trails and wagon roads that served as feeders to railroads and ports. In southeast Alaska, for example, ARC crews built a bridge consisting of two 100-foot Howe truss spans across the Chilkat River at Welles in 1909 (ARC 1910a:12). The ARC replaced three old cottonwood stringer bridges above Welles on the Haines-Pleasant Camp Road in 1913 (ARC 1913:16). Two years later, crews built 300 linear feet of stringer bridges on the Douglas-Gastineau Road (ARC 1915:7). In 1916, the ARC constructed a 50-foot king post truss span over the Mendenhall River (Figure 48) and a 60-foot king post span to replace temporarily a portion of the Chilkat Bridge that had washed out (ARC 1916:8).

In southcentral Alaska, ARC crews built a 594-foot timber trestle across Resurrection Creek near Seward in 1912 (ARC 1912b:14) and a 462-foot combination Howe truss and king post bridge

Figure 48. The king post truss bridge over the Mendenhall River, about 1916. Winter and Pond Collection, PCA 87-1887, Alaska State Library.

over Snow River on the Seward- Kenai Lake Road in 1913 (ARC 1913:23). ARC crews built a 216-foot stringer span over Bear Creek on the same road in 1914 and a 150-foot, five span stringer bridge across an arm of Crouse Lake in 1915 (ARC 1914:15; ARC 1915:10).

In the Yukon District, ARC crews built bridges on roads in the Fairbanks and Rampart areas in 1908 (ARC 1908:112-113) and an 84-foot Howe truss bridge across Baker Creek on Hot Springs-Eureka Road in 1912 (ARC 1912b:19). Flooding in 1914 took out a number of small bridges on the Fairbanks-Gilmore Road and a bridge over Butler Creek was carried away. They were replaced with trestle bridges (ARC 1915:13, 15). In Northwest Alaska, the ARC built a king post bridge in 1907 at Hastings Creek between Nome and Solomon (ARC 1907:140). In 1914, the ARC built 14 small light pole-stringer bridges on the Kaltag-Solomon trail. The bridges were 8 feet wide and designed to carry dog teams (ARC 1914:20-21). ARC crews built new bridges in 1915 over Rocker, Peluk (Figure 38, page 39), Martin and Bering Creeks on the Nome-Council Road (ARC 1915:14). The ARC completed a bridge in 1916 over the Snake River consisting of two 100-foot timber Pratt through truss spans (Figure 49) and 360 feet of pile trestle approaches (ARC 1916:18; ARC 1917:33).

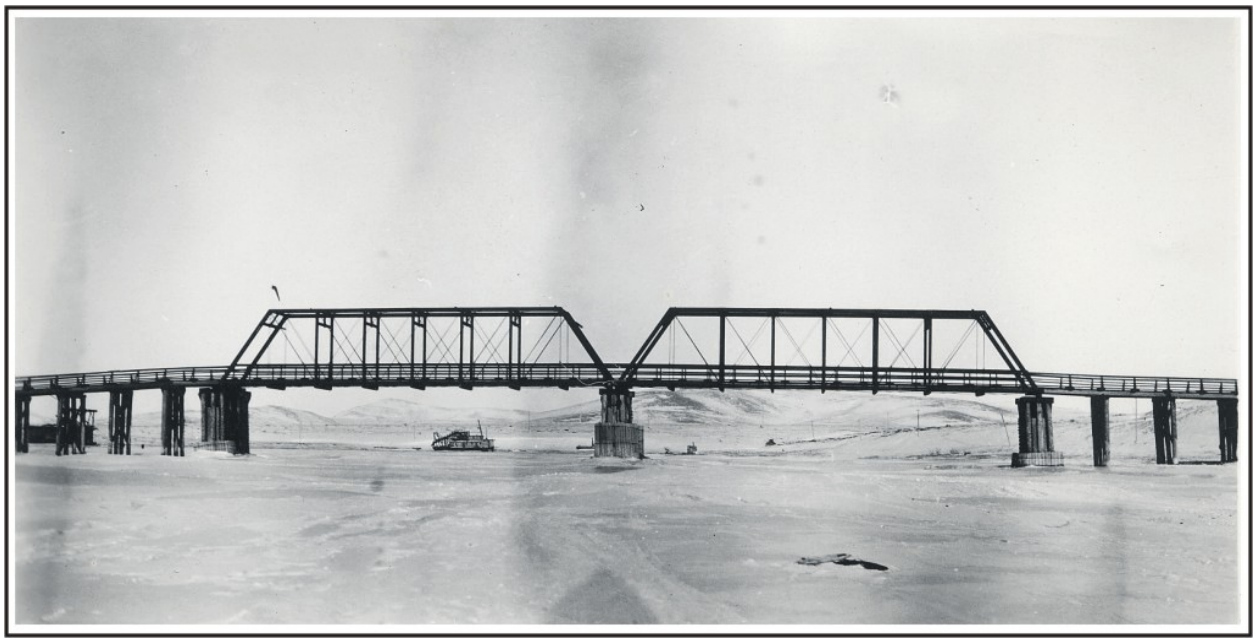

Figure 49. The Snake River Bridge, a two span Pratt timber truss, built in 1916. U.S. Alaska Road Commission Collection, PCA 61-141-7, Alaska State Library.

Challenges to Bridge Building

Bridge building in Alaska's varied terrain posed numerous challenges. Bridges over glacial streams were frequently at risk from the huge volumes of water that accumulated in glacial lakes that discharged their reservoirs and created floods that could not be predicted. Constantly changing channels made it necessary to construct longer bridges. Pile bridges were used for bridging minor

streams, but large boulders in the creek bottoms sometimes prevented deep penetration of the piles. Changing channels washed out parts or all of trestle bridges, interrupting traffic and entailing additional expense. ARC crews built dikes along glacial streams to protect bridges from glacial outfalls. These dikes often had to be rebuilt. The ARC spanned the largest and most dangerous of these streams along important roads with bridges, but many smaller streams remain un-bridged because of the cost and the fact that during the greater part of the year they were fordable (ARC 1917:15, 22). Due to the expense of building bridges, the ARC often used ferries or cable trams instead of bridges for water crossings. This occurred where traffic volumes were low. The ARC established its first ferries in 1906 at Big Delta on the Valdez-Fairbanks trail and at Bonanza Inlet (Figure 50) on the Nome-Council Trail (ARC 1906:12, 21). One of the first ARC aerial tram was built in 1908 over the Bear River in the Nome area (ARC 1908:112). The ARC increased the number of ferries in 1909, subsidizing them in place of bridges which it could not afford to build (ARC 1910a:11). In 1914, high water took out a railroad bridge on the Seward Peninsula Railroad, which the ARC operated as a tram. An ARC crew installed a ferry instead of rebuilding the bridge (ARC 1914:20).

Figure 50. The Bonanza River Ferry at Solomon, about 1908, which was subsidized by the ARC. Francis Pope Collection, 66-150-743, University of Alaska Fairbanks.

The quality of bridge construction was uneven in Alaska, and safety, particularly in view of extreme climatic conditions, was often an issue. The difficult conditions in Alaska resulted in periodic bridge failures. A bridge on the Valdez-Fairbanks route collapsed in 1911 after a glacial creek flooded (ARC 1912a:9-10). The bridge over Sheep Creek was carried away two years later when a glacier reservoir burst upstream. The ARC replaced it with a bridge that included a 75-foot

Douglas fir Howe truss span (ARC 1914:9-10). A bridge erected over Snow River north of Seward in 1911 was carried away in 1912. An ARC crew replaced it, but extreme high water destroyed it again a short time later. The bridge was erected again, the third bridge in two years (ARC 1912b:14). In June 1911, a bridge over the Kahiltna River was damaged by high water, which undermined the two center piers and wrecked the center truss. It was repaired at high cost due to the remote location and scarcity of timber (ARC 1912b:17). Two stringer bridges were destroyed by forest fires on the Eagle-Fortymile Road in 1912 and had to be replaced, and small bridges along the Chatanika-Birch Creek Sled Road had to be replaced after they were damaged by flooding (ARC 1912b:19). In 1913, waves from a huge storm broke over the Nome River suspension bridge, which had been built prior to 1905 as part of a toll-road. High water destroyed the approaches and damaged one of the cable towers. The ARC repaired the bridge, but later in the year W.J. Rowe tried to move a dredge across the bridge. He exceeded the posted limit of 5 tons and 4 horses, and the decking collapsed. The ARC constructed a new bridge in May 1913 (ARC 1913:28) High water from a 1914 storm wrecked the three span Howe truss Nizina River Bridge, which the ARC had built the year before. ARC crews rebuilt the bridge using two 150-foot Howe truss spans, four 75-foot Howe truss spans and 200 feet of pile trestle (ARC 1914:8-9, 13, 15).

Until 1916, all wagon bridges constructed by the ARC, with the exception of two suspension bridges, were made of wood. Suitable native lumber was usually available near most building sites. The cost of transporting stronger timber from the states was excessive. Most early through truss bridges constructed by the ARC were Howe type with iron or steel verticals and were built in spans up to 150 feet long. These wooden bridges were often supported by piles that were surrounded by rock cribs (ARC 1917:15). The ARC constructed most large truss bridges during the winter (Figure 51). Streams were subject to sudden rises during the summer that could bring driftwood down the channel that could endanger the falsework during construction. The additional expense caused by working in temperatures as low as 50 degrees below zero was partly compensated for by the greater ease with which falsework and piers could be erected on the ice (ARC 1917:15).

Figure 51. An ARC crew erecting a Pratt truss bridge on falsework during the winter. Photo courtesy of ADOT&PF Bridge Section, Juneau.

The scarcity of suitable local timber in some areas, such as the Alaska Range and areas north of Fairbanks, sometimes made construction of wooden bridges unusually expensive (ARC 1910b:8, 12; ARC 1914:12). For example, the ARC built a 748-foot timber trestle bridge with a 30-foot king post truss span in the center near Miller's Roadhouse in 1912. The sparseness and poor quality of local timber made the project very expensive (ARC 1912b:12). Local timber, usually native

pruce, was prone to failure under heavy loads (Figure 52). In 1913, the ARC began importing Douglas fir from the states for structural members on long truss bridges, but con-tinued to rely on local timber for most piling and trestle bridges. A 43-foot timber truss on the Saina River and a 60-foot timber truss at Ptarmigan Drop on the Valdez-Fairbanks Road failed under heavy snow loads in 1913. ARC crews replaced the Ptarmigan Drop Bridge with a 60-foot Howe truss, the Klutina River Bridge with four 75-foot Howe truss spans and a 60-foot truss bridge over a slough near McCrary's Roadhouse, all with imported Douglas fir (ARC 1913: 18-19).

Figure 52. A collapsed bridge at Mile 88 of the WAMCATS Line, August 1913. Rita Cottnair Collection, 1974-130-130, University of Alaska Fairbanks.

Starting in 1913, the ARC built temporary bridges for winter river crossings before or after the ice became solid. The first was a temporary bridge over the Gulkana River, which featured an experimental ice breaker on the piers. After the experiment proved successful, the ARC incorporated the feature later the same year into a permanent bridge over the river that had two 150-foot timber Howe truss spans. During the same year, the ARC contracted to have temporary winter bridges built on the Donnolly-Washburn Winter Sled Road, a shortcut on the Valdez-Fairbanks Trail (ARC 1913:17, 19-20). In 1914, an ARC crew constructed 66 feet of temporary stringer bridges for winter use in overflows of the Tonsina River on the Tonsina-Chitina Road (ARC 1914:13).

The ARC built a number of suspension bridges, but most were used for foot or pack horse traffic (Figure 53). The first was a foot bridge built over the Indian River at Sitka in 1908. The bridge rested on cement piers and the superstructure was supported by 1.5 inch-thick steel cables. The bridge collapsed in 1911 after a cable fastener failed, re-

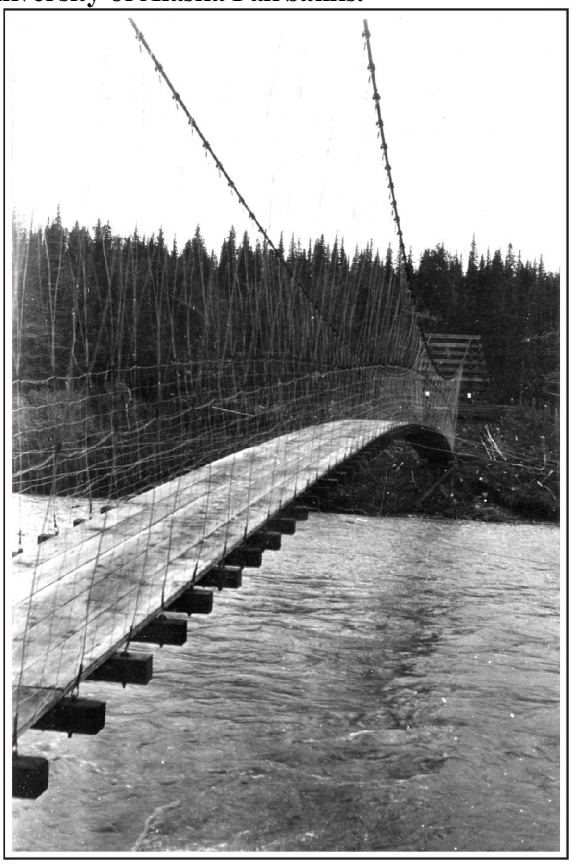

Figure 53. Standard ARC suspension bridge for pack horse traffic. Photo courtesy of the ADOT&PF Bridge Section, Juneau.

Figure 54. The Nome River suspension bridge, Mile 3 of the Nome-Council Road, 1913. U.S. Alaska Road Commission Collection, PCA 61-141-3, Alaska State Library.

quiring re-erection of the bridge (ARC 1912a:9). The abutments of the Nome River steel cable suspension bridge, which had been built by entrepreneurs, were damaged by ice in 1911. The ARC repaired the bridge (Figure 54) and built a suspension foot bridge across the Snake River in 1911 (ARC 1912a:23). ARC crews constructed a 95-foot cable-suspension foot bridge over the Burnt River on the Dahl-Candle Trail in 1912 and a 160-foot suspension bridge over Taylor Creek on the Dahl-Candle Trail in 1914 (ARC 1912b:25; ARC 1914:21-22). The ARC constructed a 200-foot suspension foot bridge over the Snake River at the mouth of Boulder Creek in 1915 (ARC 1915:16). Ice destroyed the Snake River and Taylor Creek foot bridges in the spring of 1916 and the ARC replaced both of them with new suspension spans (ARC 1916:17-18; ARC 1917:33).

On occasion, the ARC partnered with local parties to construct bridges. In 1913, the ARC built 72 linear feet of stringer bridges on the Juneau-Sheep Creek Road. The Alaska-Gastineau Mining Company assisted the project by building 2,500 feet of pile trestle along the route at its own expense (ARC 1913:16). In 1914, the ARC built two stringer bridges in the Seward area. Local residents donated the decking (ARC 1914:15).

During its first eleven years of operations, ARC crews constructed most of the bridges, but occasionally the ARC hired a contractor to build a bridge. In 1911, the ARC hired a contractor to build a 100-foot two-span Howe Truss bridge over the Tanana River Slough and to build a ferry across the Tanana River (ARC 1912a:12-13). The agency hired a different contractor in 1912 to build a bridge consisting of two 84-foot Howe Truss spans over Piledriver Slough (ARC 1912b:17). The ARC contracted with J.E. Sullivan during 1913-1914 to build permanent and temporary bridges totaling 486 feet in length and to build temporary bridges on the Little Delta and Big Delta rivers on

the Donnolly-Washburn Sled Road (ARC 1913:17; ARC 1914:9). Sullivan received additional contracts to construct temporary winter bridges over the Big Delta and Little Delta rivers in 1915 and 1917 (ARC 1915:8; ARC 1917:19). In 1913, the ARC contracted with S.R. Hudson to construct a 112-foot bridge containing a 46-foot king post truss over Moses Creek on the Fort Gibbon-Kaltag Trail (ARC 1913:27).

The ARC made its first attempt at standardizing bridge design in 1913. Captain Glenn E. Edgerton, the ARC's chief engineer in Juneau, drew up plans for standard truss bridges such as king post, queen post, and Howe truss structures. One of the first of these standard design bridges was a 60-foot queen post truss built over Ernestine Creek (ARC 1914:110). The following year, the ARC built a bridge at Sheep Creek with a 75-foot "standard Douglas fir" Howe truss span (ARC 1914:10). The ARC planned to replace its bridges at major river crossings by erecting "standard bridges," but a shortage of funds in the mid-1910s forced the agency cut corners and for the most part build the cheapest bridges that could support the traffic (ARC 1914:17).

The vastness of the territory and increasing requests for improved roads and bridges placed demands on the ARC that it was not able to meet due to limits on its funding (ARC 1916:6). The cost of work on roads and bridges in Alaska, the ARC noted, "is not less than twice the cost of similar work done under similar construction ... in other parts of the United States" (ARC 1917:17). President Woodrow Wilson signed the first Federal Aid Act in July 11, 1916, ushering in a new federal commitment to road building in the United Sates. The program committed the federal government to developing an interconnected network of well-built and well-maintained roads throughout the country. Congress designated the U.S. Bureau of Public Roads, the forerunner to today's Federal Highway Administration (FHWA), to set national standards for road and bridge construction and provided funds to states with road building programs (Potter and Rushendorf 1999:36). The act only applied to states, however, and Alaska was exempt from the provisions of the act. If the ARC was going to meet demands for improved roads and bridges, it would have to find new ways to overcome the challenges present by Alaska's vast and formidable terrain.

V. BRIDGE CONSTRUCTION FROM 1917 TO 1929

Building Bridges During World War I, 1917-1919

World War I had a direct impacted on the ARC. The years 1917 to 1919 were characterized by small appropriations, shortages of skilled labor and equipment, and high prices for labor and materials. Many of the roads, trails and bridges built during the ARC's first eleven years fell into disrepair during the war years. Despite these circumstances, the ARC made some important progress during this period in terms of building bridges.

An important accomplishment during the war years was the adoption of standardized plans for new bridge construction. With the improvement of roads and increased traffic, the ARC decided in 1917 "to make all new bridges stronger than those constructed in the past" by adopting "a new standard design loading." Major Joseph C. Mahaffey, the chief engineering officer from July-October 1917, and Captain William H. Waugh, the chief engineering officer from October-December 1917, began drawing up standard plans for specific design loads for spans varying from 30 feet to 150 feet. Spans 100 feet and longer were to be Pratt combination trusses. Engineers prepared standard drawings for Howe truss spans 60 feet to 100 feet long and for pony trusses on spans ranging from 40 to 60 feet long. The pony truss (Figure 55), which had not been used previously in Alaska for wagon and automobile bridges, became a replacement for king and queen post truss designs on

Figure 55. A "Type B" ARC standard bridge, 1920s. This pony truss bridge was located at the Little Susitna River at Mile 12.2 of the Wasilla-Fishhook Road. U.S. Alaska Road Commission Collection, PCA 61-9-54, Alaska State Library.

heavily used routes. Engineers prepared alternative designs using steel for the lower chords in localities where suitable timber for structural members had been logged or burned off, or could be secured only at great expense (ARC 1917:15). Spans over 60 feet called for truss timbers built with Douglas fir, but native timber continued to be used in some Howe truss spans.

During 1917, the ARC built 48 new bridges, replaced or lengthened 17 others and repaired at least 8 bridges. The 1918 ARC *Annual Report* provides a rare summary of bridges built during one of the agency's early years. Most of the bridges built in 1917 were timber piling or trestle structures. Of the new bridges erected and the ones that were replaced or lengthened, at least six were pony trusses, two were Howe trusses, two were Pratt trusses, one was a steel Petit through truss and one was a suspension bridge. One of the reconstructed bridges crossed the Tazlina River. Crews replaced the north 75-foot span with two 100-foot spans "of the new standard type (Pratt combination trusses)." The old 75-foot span was re-erected north of the 100-foot spans, and a new 60-foot pony truss span and 170 feet of pile trestle were added at the north end (ARC 1917:20). Other bridges built in 1917 included "standard 60-foot pony truss" spans at Miller Creek and at a creek near McCarty, and a "standard 60-foot pony truss" over the Little Susitna River. If a truss bridge failed, the ARC did not always replace it in kind. At Noyes Slough, for example, a 70-foot Howe truss that collapsed was replaced with a pile bridge (ARC 1917:18, 21, 24-25, 26).

An important accomplishment in 1917 was erection of the first all-steel automobile bridge (Figure 56) in the territory. The ARC began design work in 1915 on a five span, 300-foot steel bridge with Petit trusses over the Chena Slough at Fairbanks. The length of the span on a river with extremely heavy winter ice runs and the location on a navigable river dictated the choice of steel. The ARC hired Oliver A. Hall as the design engineer for the project and he started work in June 1915. The Penn Bridge Company of Beaver Falls, Pennsylvania fabricated the bridge under contract to the ARC in 1916 (ARC 1916:15) and construction at the site proceeded through the summer, fall and

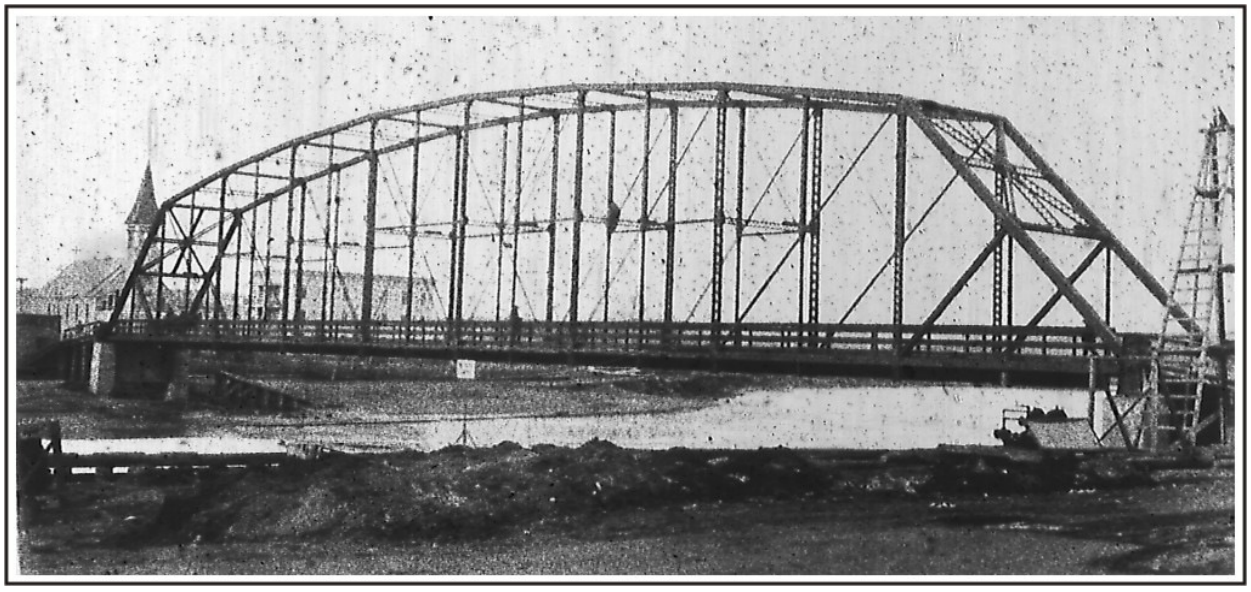

Figure 56. The Cushman Street Bridge, a 300-foot Petit steel truss span crossing the Chena River in Fairbanks, completed in 1917. U.S. Alaska Road Commission Collection, PCA 61-12-271, Alaska State Library.

winter on the substructure. ARC crews erected the steel trusses on the frozen Chena Slough during March of 1917. The steel Petit trusses were designed to support two 8-ton motor trucks or a line load of 50 pounds per quare foot. The abutments were made of concrete and the north approach was a framed trestle 180 feet long. The south approach, built by the City of Fairbanks, was a combination of earth fill and trestle. Completion of the Chena River Bridge was hailed as a milestone, but ARC officials concluded that the adoption of steel as the primary material for bridges was "out of the question under present circumstances" due to cost (ARC 1917:15, 29).

The Alaska Engineering Commission (AEC), which was building the Alaska Railroad, also built wagon roads and bridges. During the war years, AEC crews built roads in the upper Susitna Valley, an area that had few trails or roads, to support its rail construction activities. The AEC built mainly log stringer bridges for its wagons, as the bridges were intended to be temporary during construction of the rail line to Fairbanks. A typical example of a wagon bridge built by AEC crews was the log stringer and cribbed piling bridge at Indian River, 40 miles north of Talkeetna (Figure 57).

Natural disasters in 1918 and 1919 wrecked roads and bridges. In southeast Alaska, where ARC road projects were jointly funded during the war years by the BPR and the Territory, flooding during 1918 damaged or destroyed bridges over Salmon Creek, Lemon Creek and the Mendenhall River on the Glacier Highway; bridges along Basin Road in Juneau; the Chilkat River Bridge at Welles; and the Skagway River Bridge. Most of these bridges were repaired or replaced in 1919. The Skagway Bridge was repaired only because the City of Skagway paid for half of the costs (ARC

Figure 57. Wagon bridge built by the Alaska Engineering Commission at Indian River, 40 miles north of Talkeetna, 1919. Alaska Engineering Commission Photo Collection, AEC-G1425, Anchorage Museum of History and Art.

1919b:3874-3875). Flooding in the in Valdez District in 1919 damaged and destroyed bridges and forced the ARC to move the Valdez-Fairbanks Road up onto the hillside above Keystone Canyon. ARC crews built 11 new bridges and repaired 28 others along the first 62 miles of the Valdez-Fairbanks Road. Army personnel from nearby Fort Liscum were called upon to help with the pile driver repairing bridges near Valdez. The bridge at Bear Creek was washed out and both approaches destroyed (ARC 1919b:3875-3877). Flood waters breached the dike protecting the Tonsina River Bridge on the Tonsina-Chitina Road. ARC crews built 300 feet of new dike and 114 feet of trestle bents to re-establish the river crossing (ARC 1919b:3878-3879). Flooding also damaged the main pier of the Matanuska Bridge over Palmer Canyon, which ARC crews repaired (ARC 1919b:3882). Later in 1919, forest fires destroyed ten bridges in the Ernestine-Willow section of the Valdez-Fairbanks Road, which ARC crews rebuilt (ARC 1919b:3897).

In 1919, the ARC reported that it had done "little work on new construction" in the territory during the year, due to funding limits caused by the war (ARC 1919b:3871). Some important bridges, such as the Gulkana River Bridge and the Chilkat River Bridge at Welles, were deemed unsafe (ARC 1919a:2098) and could not be replaced for lack of funds. The territory's economy stagnated during the war, but the use of autos and trucks increased significantly. Autos and trucks operated for one-third of the cost of horse-drawn traffic per ton per mile and Alaskans in ever increasing numbers embraced the automobile, especially for hauling freight. By 1919, "ninety percent of traffic on Alaska roads and trails was by automobiles and motor trucks," and this "class of traffic" was growing much faster than ARC funds could fill the demand (ARC 1919b:3871). Autos and trucks were significantly heavier than wagons and placed increased strain on bridges.

ARC Bridge Building in the 1920s

ARC funding increased significantly during the1920s after the lean war years. Increased funds allowed the ARC to beef up construction on new and replacement bridges (ARC 1924:35) and to replace bridges that had become unsafe, such as the Chilkat River Bridge in 1921 (ARC 1921:27) and the Welles Bridge in 1924 (ARC 1924:55). The ARC built new bridges throughout the 1920s, replacing bridges that had worn out, washed out, or were no longer suitable for the volume of traffic. In the States, wood fell out of favor in the 1910s and 1920s as timber bridges were replaced by steel truss and stringer bridges for long crossings and concrete bridges for shorter crossings (Potter and Puschendorf1999:43), but most bridges built in Alaska were short timber stringer, pile or pile trestle structures. During the 1920s, the ARC favored the timber pony truss for medium length spans of 40 to 60 feet. The pony truss (Figure 58) appeared on Alaska trails and roads for the first time in the early 1920s, often replacing king and queen post truss types for medium length spans. ARC crews in remote areas also built "A" truss spans, a variation of the king post, and queen post for spans of 30 to 40 feet in length. Timber Howe (Figure 59) and Pratt truss spans were preferred for longer crossings. Bridges that crossed long water bodies usually combined timber truss spans with pile or trestle approaches.

The ARC wanted to build more all-steel bridges, but the costs involved were prohibitive. In the states, all-steel through truss bridges were used on spans over a hundred feet in the 1920s. The steel pony truss was the bridge of choice for spans of 80 to 100 feet. Steel truss bridges offered long-

Figure 58. The Indian River Bridge, a timber pony truss, at Sitka, July 14, 1929. Estelle and Phillip Georges Collection, HMC-0381 series 2-7-2, University of Alaska Anchorage.

Figure 59. The Birch Creek Howe timber truss bridge on the Fairbanks-Circle Road, 1920s. Skinner Foundation, PCA 44–02-220, Alaska State Library.

Figure 60. The Salcha River Bridge, an all-steel 180-foot Camelback truss span with 345 feet of trestle approach, at Mile 331 of the Richardson Highway, 1925. U.S. Alaska Road Commission Collection, PCA 61-12-273, Alaska State Library.

er life and heavier load carrying capacities. For shorter bridges, 25 to 32-foot I-beam stringers spans were often used. Wood fell out of favor with bridge builders in the states as wood bridges were replaced by steel and concrete bridges (Potter and Puschendorf 1999:32, 41, 43). Alaska, unlike the states in the 1920s, did not have established bridge companies that specialized in the manufacturing, fabrication and erection of steel bridges. While steel bridges were available in standard specifications from manufacturers in the states, the cost of purchasing and transporting the materials, together with limited budgets and low traffic counts, led the ARC to stick with building timber truss spans during the 1920s with one exception. In 1925, the ARC erected a steel camelback truss bridge across the Salcha River on the Richardson Highway (Figure 60). The 180-foot steel span was fabricated in Pittsburgh, Pennsylvania and became the territory's second all-steel through truss bridge (ARC 1925b:80). The ARC also planned to erect a steel bridge at the Nizina River to replace the timber structure that washed out in the early 1920s. Design and pier work began in 1922 and plans called for five spans made of light steel consisting of 180 feet each (ARC 1922:35; ARC 1923b:44). The high costs of steel fabrication and transportation, prompted the ARC to change it's plans. The 2,050-foot Nizina River Bridge completed in 1925 was built with four 178-foot Howe timber truss spans with the remainder composed of timber trestle approach (Thiele 1925:42; ARC 1925b:76).

The Richardson Road, the only overland access to the interior before the Alaska Railroad was completed, had 14,312 linear feet of bridges by 1924. The route, which the ARC considered the most important road in Alaska, had a wide variety of bridge types. They included: 5,976 linear feet of pile trestles; 3,412 linear feet of pile and framed trestle approaches to truss spans; 882 feet of log stringer culverts; a number of two-panel A-Frame timber truss spans extending 893 feet; a number of three-panel Pratt timber truss spans extending 606 linear feet; 325 linear feet of suspension spans (Figure

Figure 61. The suspension bridge at Sheep Creek on the Richardson Highway, 1920s. Photo courtesy of ADOT&PF Bridge Design Section, Juneau.

61); a dozen Howe truss timber spans (Figure 62) extending 1,478 linear feet; 200 linear feet of combination steel and fir lumber Pratt truss spans; 240 linear feet of pony truss timber spans; and the Chena River all-steel Petit through truss bridge in Fairbanks built in 1917 (ARC 1924: 48, 50).

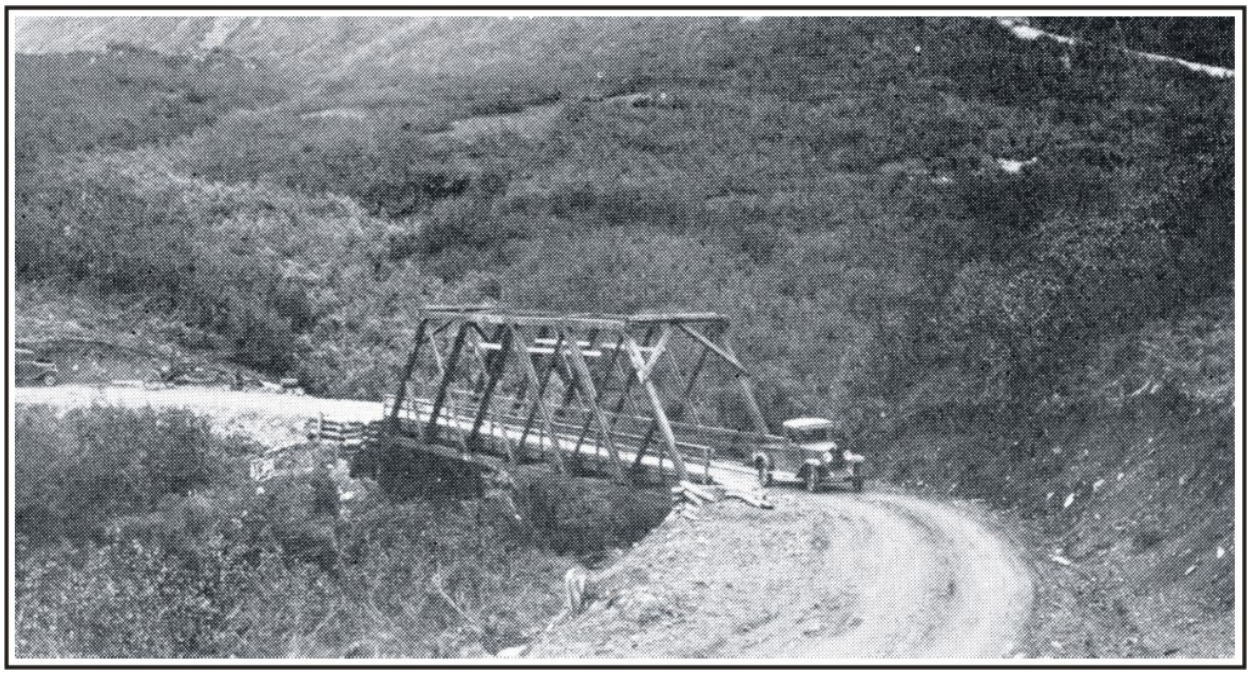

Figure 62. An 80-foot Howe timber truss bridge at Mile 32 on the Richardson Highway, late 1920s. U.S. Alaska Road Commission Collection, PCA 61-5-262, Alaska State Library.

The ARC constructed bridges on other main roads, dozens of local roads and hundreds of trails to remote mining districts throughout the Southeast, Southwest, Yukon and Nome districts. The ARC also created new districts in the 1920s as it expanded its road and bridge building activities to areas it had not previously served. The ARC built and repaired bridges in the Kuskokwim area including at Otter Creek in the Iditarod area, along the Ruby-Long Creek and the Ophir-Takotna roads, and along the Ophir-Diskaket, Flat-Holy Cross, Ophir-Iditarod, and Ophir-Cripple trails, and along the Medfra Nixon Mine Road near the Kuskokwim River. Significant bridges erected in the Kuskokwim area included Howe truss spans built of native timber in 1923 at Gaines Creek and the Solatna River on the Long-Poorman Road, and an 80-foot timber Howe truss span at Otter Creek (Figure 63) on the Iditarod-Flat Road (ARC 1924:128). ARC crews also built bridges in the late 1920s over the Bethel Slough, at the Tuluksak River on the Upper Landing-Bear Creek Trail, and on the Togiak-Nushagak Trail. The ARC expanded into the Nenana area in the 1920s, building and repairing bridges on the Hot Springs-Eureka Road, Hot Springs-Tofty Road, the Diamond-Telida Trail, and the Tanana-Kaltag Trail. In the Kodiak area, ARC crews constructed bridges on the Kodiak-Abberts Road, the Larson Bay-Karluk Road, the Homer Spit, and the Illiamna Bay-Illiamna Lake Road. In the Chitina River area, the ARC built roads and bridges that connected remote mining camps on the Kotsina and Kuskulana rivers with the CR&NW.

As AEC construction crews laid tracks going north from Cook Inlet toward Fairbanks, the ARC built bridges on roads opened up by the railroad. After the railroad reached Talkeetna in 1917, miners in the Dutch and Peters Hills cut a trail from Talkeetna west to their mining camps. The ARC

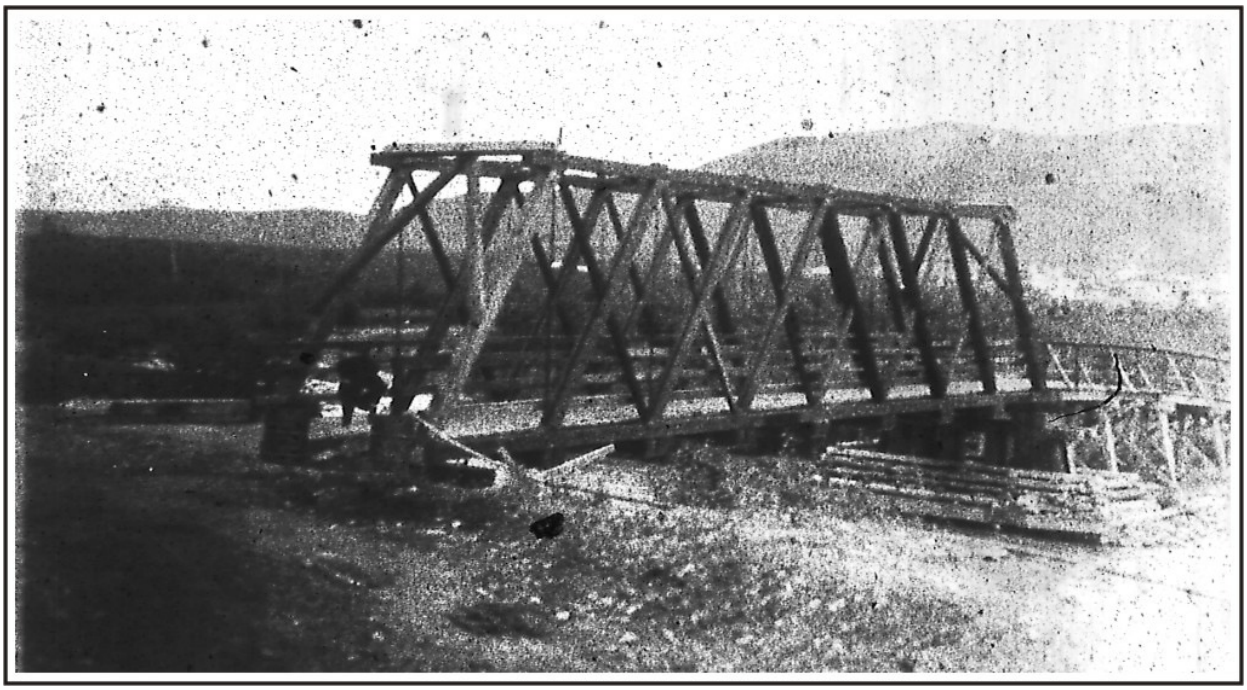

Figure 63. The Otter Creek Bridge, a 100-foot Howe timber truss span, located eight miles southeast of Iditarod. U.S. Alaska Road Commission Collection, PCA 61-1-285, Alaska State Library.

began making improvements and building bridges on the Talkeetna-Cache Creek Trail (now known as the Petersville Road) in 1918, and continued to build and repair bridges made of local timber on the route throughout the 1920s (Figure 64). After rails were laid to Mount McKinley National Park in the early 1920s, the ARC built bridges along the McKinley Park Road under contract to the U.S. Department of the Interior. Bridges erected included trestle and frame bent bridges of native timber and Douglas and two 60-foot pony truss spans of Douglas fir over the Savage and Sanctuary rivers on the McKinley Park Road (ARC 1924:115-116; ARC 1926:76; ARC 1928b:66; ARC 1929:105).

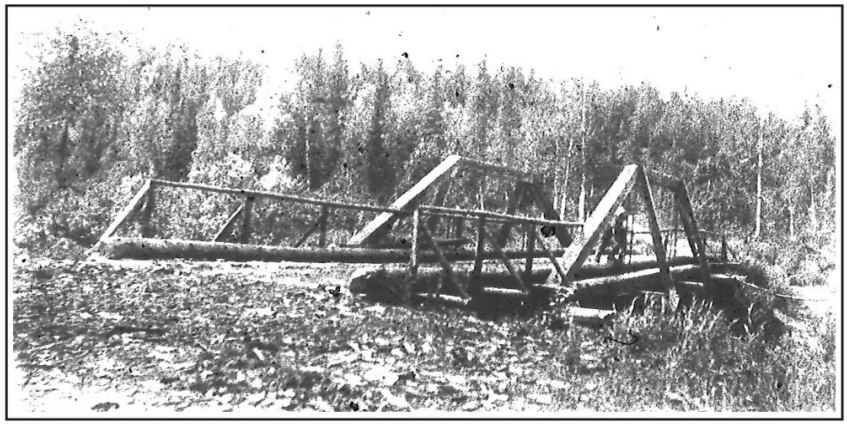

Figure 64. A queen post bridge at Moose Creek at Mile 12 of the Talkeetna-Cache Creek Road, 1920s. U.S. Alaska Road Commission Collection, PCA 61-10-11, Alaska State Library.

The ARC built bridges of native timber or imported fir, depending on the length of the bridge and the volume of traffic. ARC crews used local timber to build short-span bridges over streams and creeks. On remote trails, log stringer bridges of peeled native timber were sometimes built without abutments, in which the ends of the stringers rested on the ground (mudsills) (ARC 1924:117). The ARC used expensive imported Douglas fir to build long truss spans, but continued to use local timber for medium length truss spans through the mid-1920s. Bridges built with local timber experienced a number of structural failures, however, as the weight of vehicles and the volume of traffic on bridges increased in the mid and late-1920s (Figure 65). "Available native timber has heretofore been of insufficient strength and not very durable," the ARC concluded in 1928, and "hence fir has been imported for all important bridges." The ARC tried using Alaskan hemlock for structural members on longer spans (ARC 1928b:24), but hemlock did not have the structural strength needed. The ARC began using Douglas fir on shorter spans. In 1928, ARC crews in the Fairbanks District used Douglas fir to build a single span timber stringer

Figure 65. Collapsed pony timber truss bridge, 1920s. Location unknown. Photo courtesy of Candy Waugaman, Fairbanks.

bridge over a mining ditch on the Gilmore-Summit Wagon Road and to build several short and medium length pile driven trestle bridges along the road between Chatanika and Circle. After that the ARC used local timber only on short bridges with light traffic in the Fairbanks and Southwest (Anchorage) districts (ARC 1928b:49-50, 65, 68).

The ARC purchased imported Douglas fir and iron for truss bridge fasteners through the Seattle District Office of the U.S. Engineering Department (ARC 1929:45). In 1924, the ARC replaced the north approach to the Chena River Bridge in Fairbanks using Douglas fir decking on creosote Douglas fir pilings. This was the first recorded use in the territory of creosote pilings and Douglas fir for decking in bridge construction (ARC 1924:93). Good timber was scarce and expensive, so ARC crews began re-using bridge materials in the 1920s. After a shift in the Matanuska River channel warped and damaged trusses on the Palmer-Matanuska River bridge in 1923, the ARC replaced the structure with a suspension bridge and shipped the old trusses and re-erected them at the Chatanika River (Figure 66) on the Chatanika Road (ARC 1923b:53). The ARC purchased and salvaged the fir timber from the old Guggenheim Dredge in Flat and used them to erect an 80-foot timber Howe truss span over Otter Creek on the Iditarod-Flat Road in 1923 (ARC 1924:128).

The ARC built foot and pack horse bridges in Alaskan communities and along remote trails during the late 1910s and 1920s. These bridges varied in design and included log and timber stringers, pile and pile trestles, and suspension bridges. They ranged in length from a 30-foot span

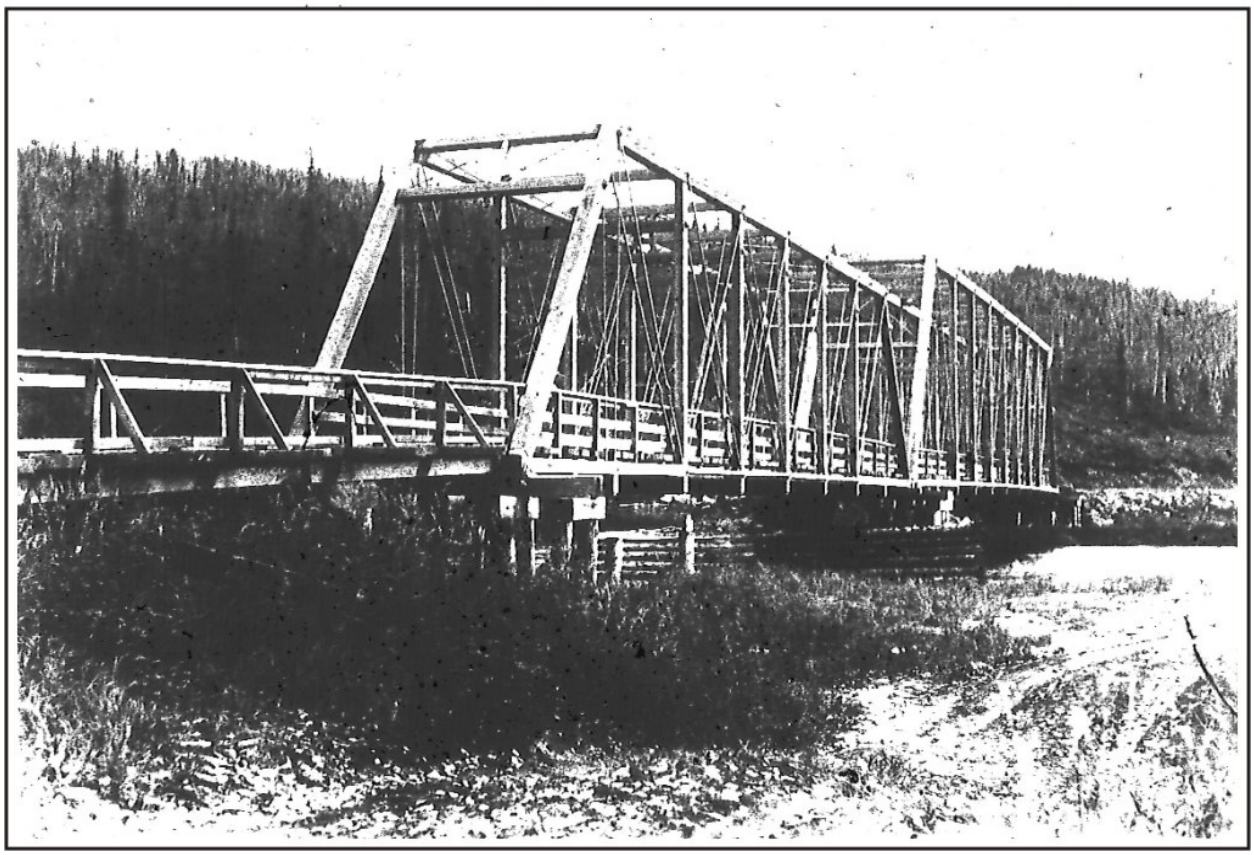

Figure 66. The two-span Howe timber truss bridge at the Chatanika River on the road to Circle, 1924. U.S. Alaska Road Commission Collection, PCA 61-12-274, Alaska State Library.

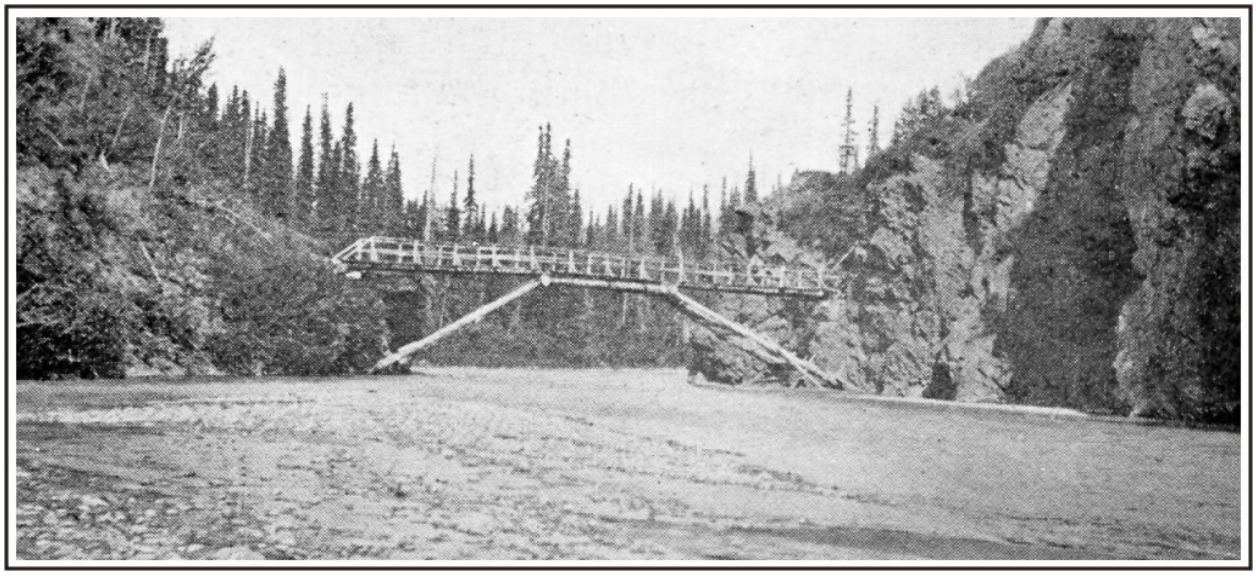

Figure 67. The Bull River Bridge, a log arch span, on the pack trail near Colorado Station. U.S. Alaska Road Commission Collection, PCA 61-11-38, Alaska State Library.

built at the Sitka National Monument in 1923 (ARC 1924:57), to a 100-foot bridge for pack animals over the Bull River near Colorado Station at Mile 197 of the Alaska Railroad (Figure 67) (ARC 1924:123; Thiele 1925:45), to 296 feet of trestle on the Candle Creek-Takotna Trail (ARC 1924: 128). The ARC replaced a bridge washed out at Washington Creek on the Oles-Livengood Sled Road with a foot bridge (ARC 1924:93-94, 96).

Most suspension bridges built in the 1920s were narrow, inexpensive to build and accommodated only foot traffic or pack horses. Suspension bridges were often used to span deep canyons where the use of piling and trestle were impractical. Other suspension spans were designed for wagons, double-ender sleds, automobiles and trucks. The ARC built two suspension bridges in southeast Alaska in the 1920s. One was the Indian River Bridge at Sitka (ARC 1921:27) and the other was a 175-foot span for pedestrians and pack horses that crossed the Skagway River (ARC 1922:11, 24). The most heavily used suspension bridges in the territory were the 150-foot span erected at Bear Creek in 1921 and the 175-foot span erected at Sheep Creek in 1922 (Figure 68) on the Richardson

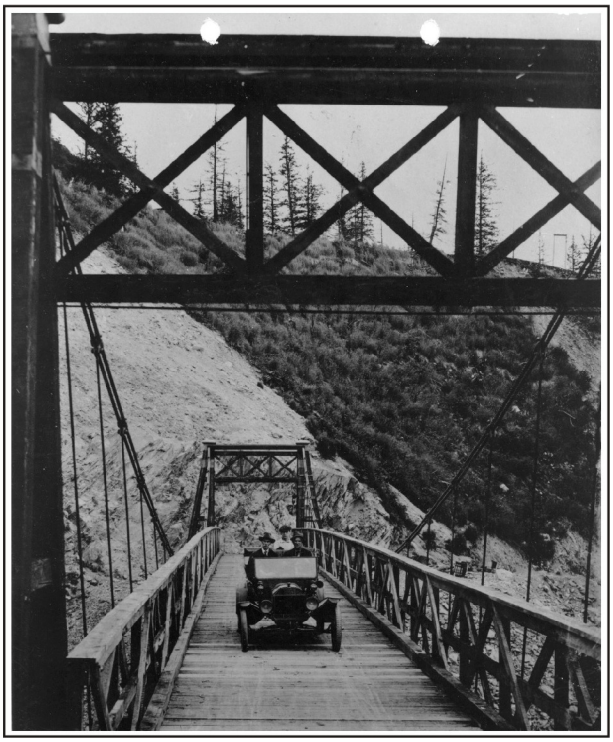

Figure 68. The suspension bridge at Sheep Creek, early 1920s. Photo courtesy of the ADOT&PF Bridge Section, Juneau.

Road near Keystone Canyon to replace bridges that had washed out (ARC 1921:29; ARC 1922:32). ARC crews built cable suspension foot bridges over the Tatalina River on the McGrath-Takotna Road in 1924 and 1928 (ARC 1928b:73), and in the Iditarod District on Belle Creek in 1924 and Bonanza Creek in 1926 (Thiele 1925:59; ARC 1926:82). The longest ARC suspension bridge was a 360-foot span over the upper Chulitna River (Figure 69) built in 1923 that linked the Alaska Railroad with a new mining district (ARC 1924b:119). ARC crews erected suspension bridges suitable for pack horses and double-ender sleds over the Kotsina River on the Strelna-Kuskulana trail in 1927 and another span over the Kotsina River further up the Kotsina Trail in 1928 (ARC 1927:47; ARC 1928b:45; Thiele 1929:38). In the Nome District, ARC crews replaced the abutments to protect the Fort Davis suspension bridge from destruction by the Nome River in 1921 (ARC 1921:41). The ARC also built and maintained cable suspension foot bridges over the Snake River, Shelton Slough, Kougarok River, Taylor Creek, Burnt River (ARC 1922:87) and the Kuzitrin River (ARC 1928b:79; Thiele 1929:28), and cable suspension bridges suitable for foot passengers and dog sleds on the Kaltag-Nome Trail (ARC 1926:86; Thiele 1927:21; ARC 1927:76).

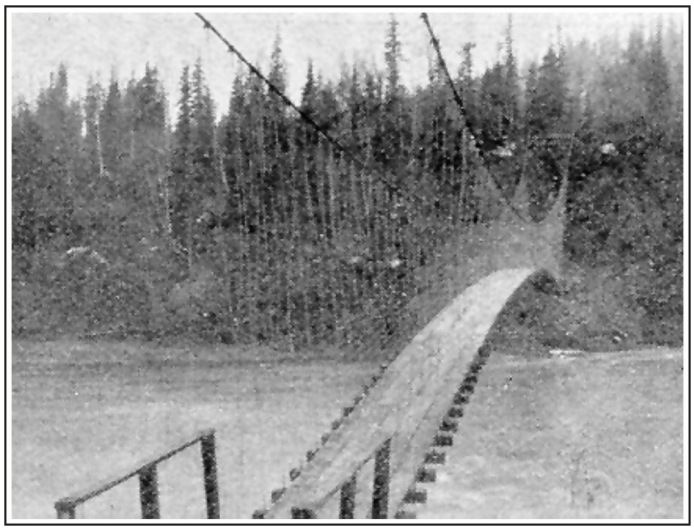

Figure 69. The Chulitna River Bridge near Honolulu Creek, a 360-foot suspension span. U.S. Alaska Road Commission Collection, PCA 61-11-49, Alaska State Library.

The ARC built at least two lift bridges to span two navigable waterways in southeast Alaska. ARC crews completed construction of an 85-foot pile bent bridge with an 18-foot lift span bridge (Figure 70) across Good Creek on the Good Creek-Salmon River Wagon Road in 1923 (ARC 1922:27). A year later, the ARC, using territorial funds, completed a lift bridge over the Salmon River on the Good Creek-Salmon River Wagon Road. The Salmon River Bridge had a 20-foot draw span and 323 feet of trestle approach (ARC 1923b: 28; Thiele 1925:16).

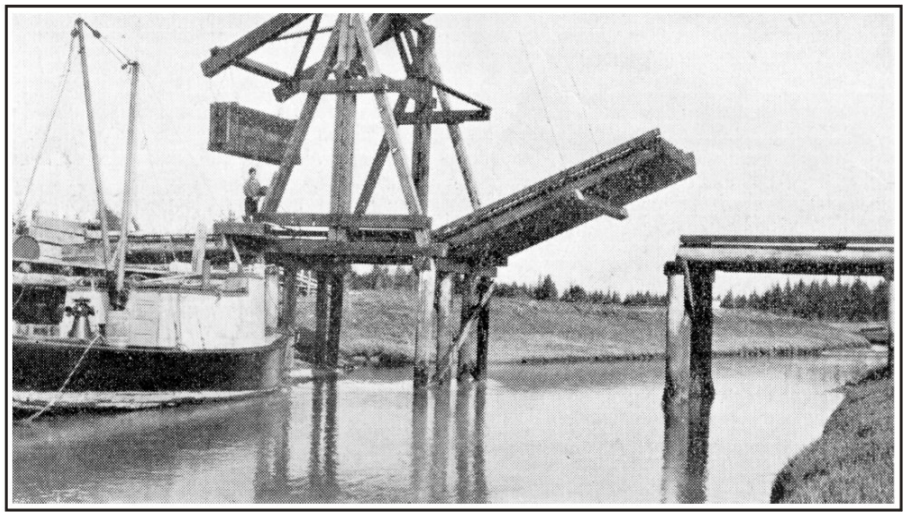

Figure 70. The lift bridge at Good Creek, Strawberry Point, in southeast Alaska. U.S. Alaska Road Commission Collection, PCA 61-1-433, Alaska State Library.

The ARC used several alternative to bridges for water crossings. The first was cable ferries in which a vessel attached to a cable used the current to propel the ferry across the river. In the 1910s, the ARC maintained and subsidized ferries at 20 locations throughout the territory, including 13 on the Seward Peninsula. Many of these were built by private individuals who charged tolls to carry passengers and freight. The quality of service was sometimes erratic, prompting the ARC to build its own ferries and hire locals to operate them (Figure 71). Ferries were less expensive to build and maintain than bridges in areas where there was little traffic on a road. As traffic increased and roads were improved in the 1920s, the ARC replaced some ferries with bridges and built fewer new ferries than before the war. The Territory reimbursed the ARC for ferry operations and maintenance. By the mid-1920s, the only ferries maintained by the ARC in the Nome area were at Safety, Bonanza and Sinrock (ARC 1919b:3883, 3885; Thiele 1925:26). While ferry traffic more than doubled at Safety and Bonanza in the 1920s on the Nome-Council Road, it remained more cost effective to operate ferries rather than build bridges in those locations. The ARC installed a ferry for foot traffic at Birch Creek on the Circle-Miller House Road in 1919, a ferry on the 40-Mile River at Steel Creek in 1926, and another ferry farther up the 40-Mile River in 1929 (ARC 1919b:3880; ARC 1926:54; ARC 1929:53).

Figure 71. ARC ferry at Rika's Roadhouse on the Richardson Highway, 1920s. Photo courtesy of ADOT&PF Bridge Section, Juneau.

A second alternative to bridges was the aerial tram, sometimes called a "passenger trolley," that consisted of a passenger cage suspended from a cable (Figure 72). During the 1920s, the ARC built and maintain aerial trams throughout

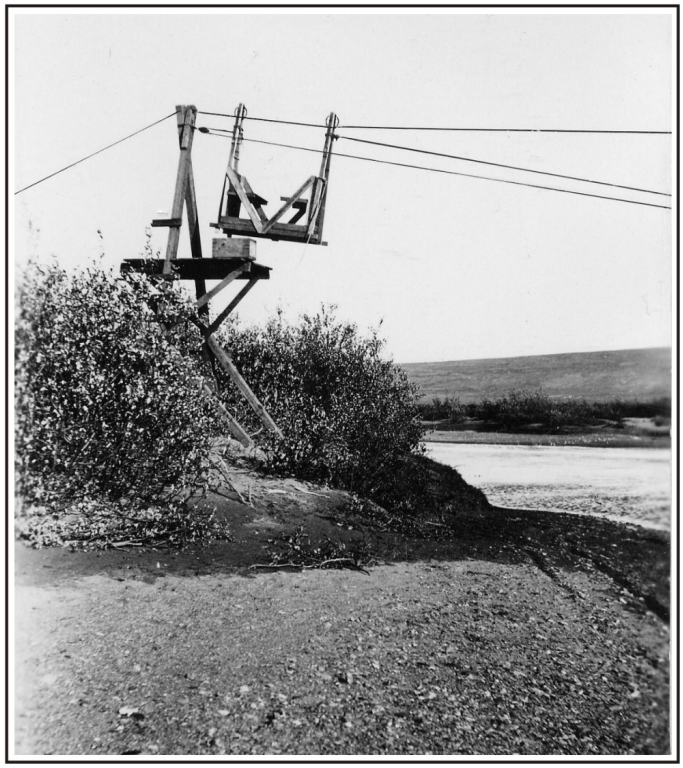

Figure 72. A standard cable tram installed by the ARC on river crossings. Photo courtesy of ADOT&PF Bridge Section, Juneau.

the territory, using territorial funds. Cable trams varied in length from 100 feet to 500 feet and were located on the Snake River, the Nome River near Monument Creek, and on the Nome-Council Road; on the Beaver-Caro Road, on the Chandalar and south Fork of the Koyukuk River for the Caro-Coldfoot Trail, on Slate Creek, Marion Creek and the Middle Fork of the Koyukuk and at Wiseman on the Coldfoot-Wiseman sled road; on the Seventymile River in the Eagle area; on the Matanuska River on the Palmer-Matanuska River Wagon Road and at Chickaloon-King River, on the Kahiltna River on the Mills Creek-Cache Creek Trail, and on Jack River along the Cantwell-Valdez Creek Trail; on Mineral Creek Mile 4.8 north of Valdez; and on the Klehini River on the Porcupine Extension. In a few cases, wagon and foot bridges that had been damaged or destroyed were temporarily or permanently replaced with aerial trams. In 1921, a foot bridge over the Snake River on the Anvil-Glacier Road was replaced by an aerial tram (ARC 1921:42-43). In 1924, a foot bridge over Mineral Creek near Valdez collapsed during flooding and a cable tram was installed until the bridge was rebuilt in 1925 (Thiele 1925:40).

A third alternative to bridges were culverts. Culverts were structures buried under the roadbed and less than 20 feet in length. The ARC built hundreds of culverts using local logs or cut timber for use at small stream crossings (Figure 73). To construct a culvert, ARC crews excavated a trench across the roadbed, laid timbers in the bottom of the trench parallel to the roadbed to form a floor. Horizontal timbers, measuring 8x18-inches, were stacked on top of each other to form the walls. Diagonal timbers were sometimes erected inside the culvert to strengthen the walls. Timbers measuring 8x8-inches running parallel to the roadbed served as the top of the culvert. Wooden culverts were less expensive to build and maintain than bridges, but tended to rot quickly. As road users switched from wagons to automobiles, heavy trucks placed great stress on culverts and bridges. The ARC replaced more than a hundred wooden culverts along the Valdez-Fairbanks Road in 1919. ARC officials noted that damage from heavy automobile trucks was "unusually heavy" between Gulkana and Mile 168, where the timber in the structures was old and had to be replaced" (ARC 1919b:3878). In 1917, the ARC experimented with box culverts, installing eight of them on the Fairbanks-Cleary Summit route. Box culverts were framed structures made from two 2x10-inch and two 2x12-inch planks. The Fairbanks ARC supervisor found box culverts "to be the most satisfactory" as that road was largely used by autos and trucks that hauled a good deal of wood and freight (Ross 1917:35). ARC crews built mostly timber culverts in the 1920s, but box culverts became more common. In 1922, for example, an ARC crew replaced the bridge over Joy's Slough at Mile 369 of the Richardson Road with a 4x4-

Figure 73. An ARC timber culvert on the Richardson Highway, 1920s. U.S. Alaska Road Commission Collection, PCA 61-12-25, Alaska State Library.

foot box culvert (ARC 1922:51). In the late 1920s, the ARC began replacing culverts made of native lumber with metal culverts (Figure 74) which did not rot (ARC 1929:37; Naske 1983:357). In some cases, metal culverts were used in place of bridges. The ARC tore down five old bridges in 1929 and replaced them with culverts on the Dunbar-Tanana Sled Road in the Nenana area (ARC 1929:89).

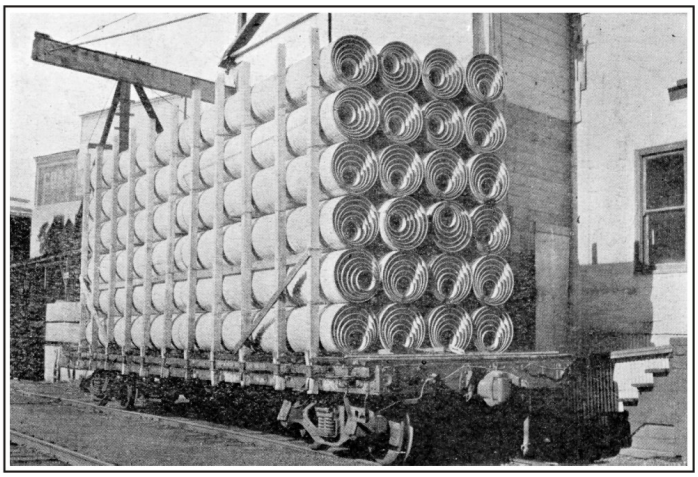

Figure 74. A flat car load of corrugated iron culverts awaiting shipment to the ARC. U.S. Alaska Road Commission Collection, PCA 61-14-40, Alaska State Library.

Disasters destroyed scores of bridges in the 1920s. The approach to the Lower Tonsina River Bridge washed out in 1922. ARC crews built a 100-foot Howe timber truss span as an extension of the bridge (ARC 1922:34). Three log stringer bridges were built to replace bridges washed out on the Chatanika-Circle Road in 1924. Frost action raised the center pier of the Snake River timber Pratt truss bridge six feet at Nome in 1924. Maintenance crews cut the piles to level the bridge (ARC 1924:90, 145). Ice took out a bridge on Hot Springs Landing-Eureka Road in the Nenana District in 1925. The ARC built a new 100-foot Howe truss span using (ARC 1926:71). Severe floods in January 1927 washed out three 100-foot spans and a 60-foot span on the Tazlina River Bridge. ARC crews salvaged one of the 100-foot spans and reconstructed two 100-foot truss spans and an 80-foot truss span (ARC 1927:46). Fire damaged bridges on Dime Creek Road in the Nome area in 1928, requiring extensive repairs (Thiele 1929:25). The two 150-foot Howe timber truss spans on the Gulkana River Bridge failed the same year. ARC crews replaced the bridge with three 100-foot Howe timber truss spans (Figure 75) on creosote pile foundations (ARC

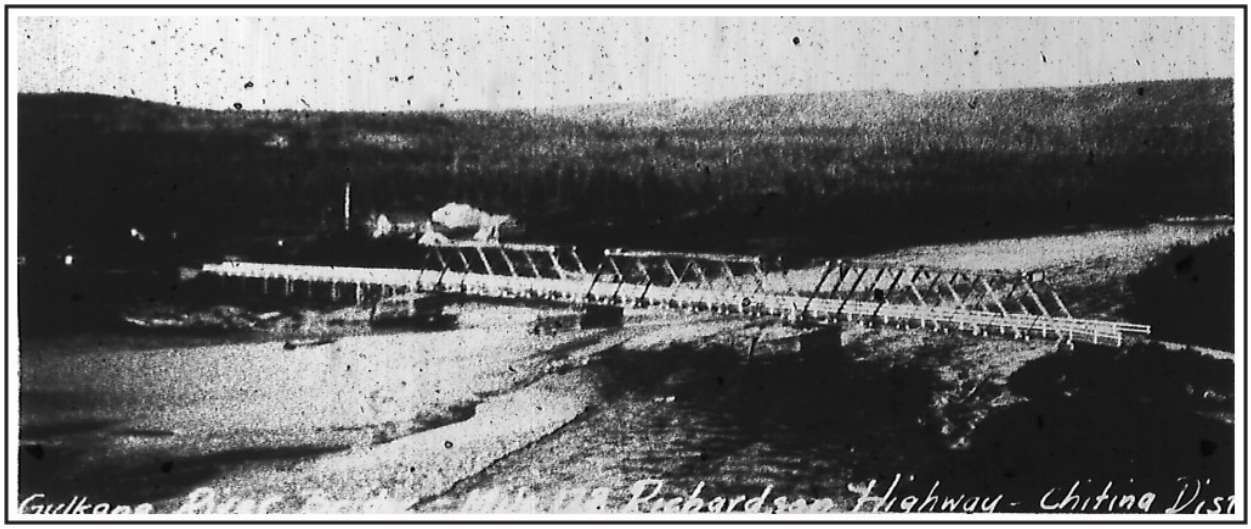

Figure 75. The rebuilt Gulkana River Bridge in 1930, a year after its two 150-foot Howe timber truss spans failed. U.S. Alaska Road Commission Collection, PCA 61-3-125, Alaska State Library.

1930:8, 54). A flood in May 1929 destroyed the Noyes Slough Bridge in Fairbanks. Crews rebuilt it later that year. The ARC rebuilt the trestles just outside of Valdez several times in the 1920s after floods from the Valdez Glacier stream damaged Richardson Highway bridges (ARC 1928b:41-42).

Another maintenance headache for the ARC was maintaining railroad bridges that were adapted for tram routes. The ARC appropriated $30,000 in 1921 to purchase and maintain the Seward Peninsula Railroad as public tramway (ARC 1921:47-48). Bridges were the first element of the tramway to deteriorate. The ARC replaced four bridges and did extensive renovations on other bridges in the mid-1920s along the route, also known as the Nome-Shelton Tramway. In 1924, ARC crews erected a 150-foot Howe truss span across the Nome River at Mile 14 (Figure 76). The bridge was built entirely of fir salvaged from the abandoned Army Post at St. Michael. Crews re-built the 600-foot trestle over Dry Creek, one-half mile from Nome, replacing 30 bents. They also planked all bridges along the line to allow horses to pull cars along the tramway (ARC 1922:89; ARC 1923b:113; ARC 1925c:2076; ARC 1924:153). The ARC replaced other bridges along the Nome-Shelton Tramway in the mid and late-1920s, including trestle bridges at Cherrette, Iron and Dry creeks (ARC 1925a:1993; ARC 1927:77; Theile 1927:34; ARC 1929:135). ARC crews erected a 125-foot cable suspension bridge for foot travel over the Kuzitrin River at the end of the route in 1928 (ARC 1928b:79). The Territory purchased the Tolovanna Tram Road in 1923 for $6,400, and the ARC maintained the line (ARC 1924:21). Also known as the Brooks Tram, the line consisted of 12 miles of wooden tram. A fire burned parts of the line, requiring reconstruction (Thiele 1925:61). ARC crews built two 60-foot pony truss spans and 60 feet of trestle over the West Fork of the Tolavanna River for the tram line in 1927 (ARC 1927:60).

Figure 76. Leonard Seppala with a dog team and pupmobile on the Nome-Shelton Tramway. The Nome River Bridge, a Howe timber truss structure built by the ARC in 1924, is in the background at right. Photo courtesy of ADOT&PF Bridge Section, Juneau.

Other Bridge Builders in the 1920s

The ARC worked cooperatively with a number of partners to build and maintain bridges. This allowed the agency to stretch its funding. In 1924, the City of Fairbanks rebuilt the south approach to the Chena River Bridge in Fairbanks. During the same year, the ARC rebuilt a bridge over Big Minook Creek on the Rampart-Eureka Road; local miners provided some of the labor (ARC 1924:93, 101). The ARC built a 64-foot trestle bridge over Bird Creek Slough near the Tuluksak River in cooperation with the New York-Alaska Gold Dredging Company in 1926 (ARC 1926:56). The ARC erected a cable foot bridge over Otter Creek at the old townsite of Discovery in the Kuskokwim District during 1927. Local residents of the community cooperated with labor (ARC 1927:72).

While most ARC bridges were built by ARC employees, the ARC occasionally let contracts for the construction or repair of bridges (ARC 1924b:50). A contractor built and repaired temporary bridges from 1918 through 1920 on the Big and Little Delta rivers in the Donnelly area of the Valdez-Fairbanks Road (ARC 1918:3849; ARC 1919:3875; ARC 1920:2095). In 1919, a contractor did revetment work for the ARC on the Snake River Bridge near Nome (ARC 1919b:3885). Four years later, a contractor replaced the Graehl Bridge, on the winter cut-off from Fox Road to Fairbanks. The new bridge consisted of nine spans with four-pile bents (ARC 1923b:77). The ARC let contracts in 1924 to construct a 50-foot span bridge at the Mosquito Fork of the 40-Mile River and to rebuild a bridge at Salmon River on the Seward-Nash Wagon Road (ARC 1924:66, 121).

The ARC continued to build and repair bridges in southeast Alaska in the 1920s, but turned over routes located on U.S. Forest Service lands to the BPR in 1921. The Alaska BPR was a branch of the U.S. Bureau of Public Roads' District One, consisting of Oregon, Washington, Idaho, Montana and Alaska. Up until March 1927, the Alaska BPR submitted plans for road and bridge construction to the BPR office in Portland for approval. On March 1, 1927, District 11 of the Bureau of Public Roads was created with headquarters in Juneau, and the District office in Juneau supervised all BPR projects in Alaska (ARC 1935:54). However, BPR engineers in Portland and San Francisco continued to design bridges for the Alaska BPR District.

The BPR in Alaska built and repaired bridges on National Forest roads in southeast Alaska, Prince William Sound and eastern Kenai Peninsula. Much of the agency's activity in the 1920s focused on repairing or replacing bridges on the Glacier Highway in the Juneau area, on the Tongass Highway north of Ketchikan, and on the Seward-Kenai Lake and Moose Pass-Sunrise roads on the Kenai Peninsula. Most BRP bridges were single span log or timber stringer structures. BPR crews also built piling, pile trestle (also called frame bent) (Figure 77), timber trestle, and through truss bridges. Examples of BPR bridges include the 50-foot Howe timber truss bridge erected in 1924 at Canyon Creek on the Moose Pass-Sunrise Road (Cheatham 1925:69, 71, 76, 78; BPR 1929:71-74), the four span Howe truss bridge at the Resurrection River at Mile 3 of the Seward-Kenai Lake Road (Figure 78), a timber Parker through truss bridge at Frenchy Creek on the Moose Pass Hope Road (Figure 79) and the three 100-foot Howe timber truss spans at lower Mendenhall River Bridge on the Glacier Highway. The BPR used a mixture of day labor forces and contractors during the late-1920s to build bridges along the Seward-Kenai Lake Road. In 1929, the BPR erected a steel stringer bridge, its first in Alaska, at Carlanna Creek on the Tongass Highway north of Ketchikan (BPR 1929:73, 77; BPR 1931:98).

Figure 77. Bridge No. 5, a pile trestle bridge built by the BPR, at Mile 7 of the Seward-Kenai Lake Road, June 10, 1927. U.S. Alaska Road Commission Collection, PCA 61-66-16, Alaska State Library.

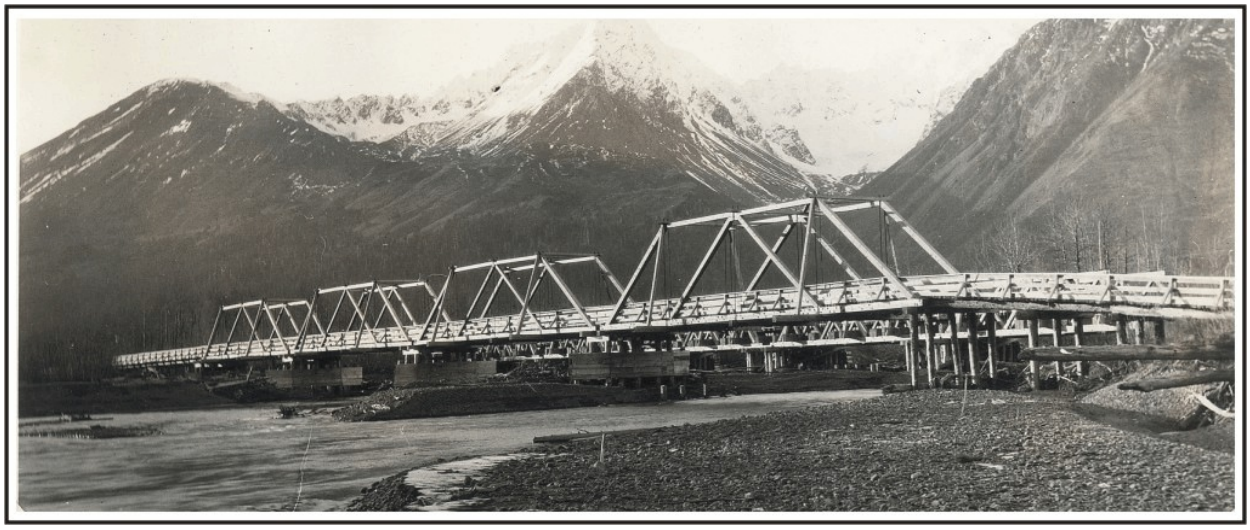

Figure 78. The four-span Howe truss Resurrection River Bridge at Mile 3 of the Seward-Kenai Lake Road, November 1926. This bridge was built by the BPR in the mid-1920s. C.F. Wyller, photographer, U.S. Alaska Road Commission Collection, PCA 61-65-127, Alaska State Library.

Seven covered bridges were built in the 1920s, all but one of them erected by the BPR. The ARC built the first covered bridge, the Nine Mile Bridge on Salmon Creek near Hyder, in 1921. It was a 102-foot Howe timber truss that had log crib abutments and 91 feet of piling approaches. The bridge had a metal gable roof, but no side walls. The structure was replaced with a steel bridge in 1937. BPR crews or their contractors built the other six covered bridges: three in the Tongass Na-

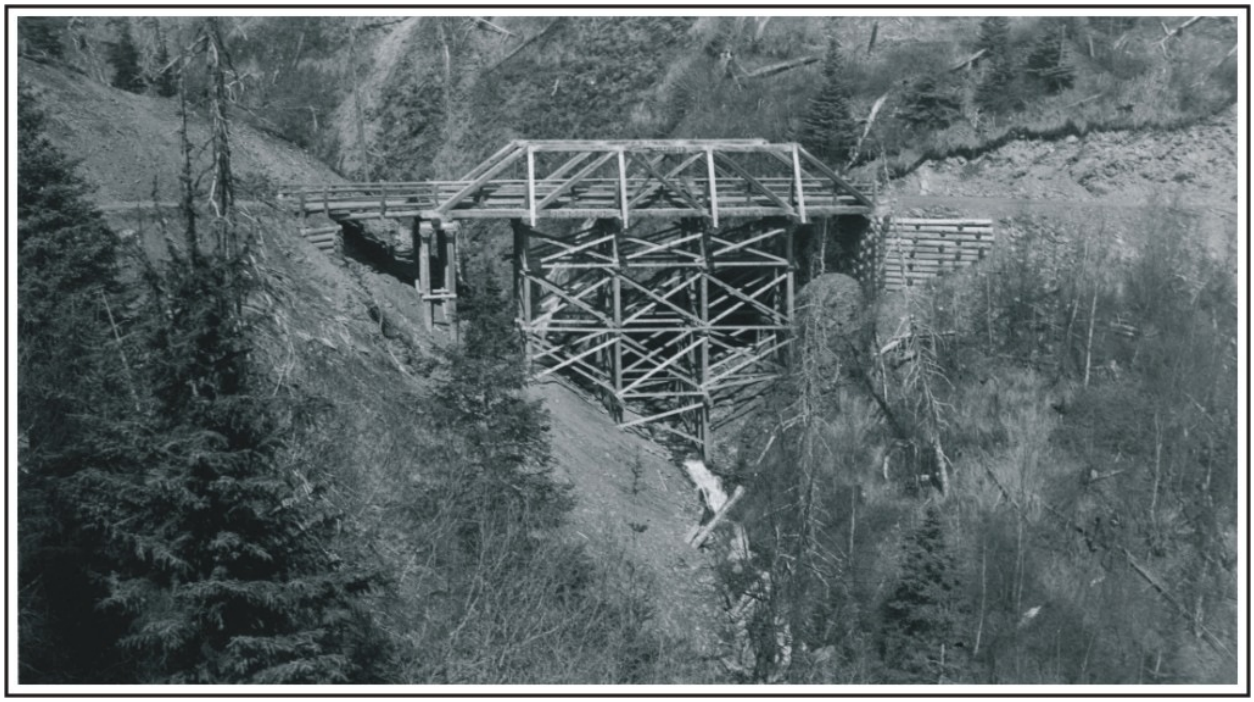

Figure 79. The timber Parker truss bridge at Frenchy Creek on the Moose Pass-Hope Road, May 1936. U.S. Alaska Road Commission Collection, PCA 61-70-102, Alaska State Library.

tional Forest and three in the Chugach National Forest. All six were Howe truss timber structures of the Oregon type built with heavy timbers made of Douglas fir and roofs and walls covered with sheet metal. The BPR built the Upper Mendenhall River Bridge, located 10 miles from Juneau, in 1926. It was a 122-foot span on concrete piers with trestle approaches (Figure 80). The bridge was

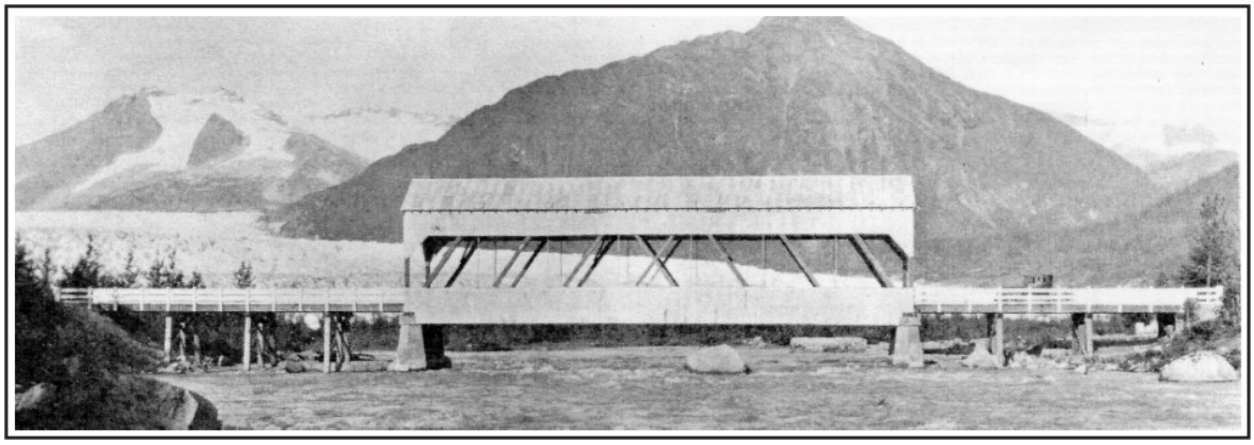

Figure 80. The upper Mendenhall River covered bridge, built in the late 1920s by the BPR. Photo by Richard S. Allen, reprinted from *Connecticut River Valley Covered Bridge Society Bulletin*, Spring 1980:6.

replaced in 1948 with a steel span. The BPR built the Afognak Island Bridge in 1929 as part of the Afognak Lake Highway. It was 122 feet long and was washed out by the tsunami caused by the 1964 Earthquake. Wright Construction Company of Aberdeen, Washington, built the Schooner Bend Bridge at the Kenai River in 1929 under contract to the BPR. The bridge was 122 feet long and was replaced in 1956 or 1957. Contractor C.H. Keil built the Seward Twin Bridges (Figure 81), located 3.5 miles north of Seward on the Seward-Kenai Lake Road, in 1928. The two covered bridges replaced earlier bridges at Mineral and Resurrection Creeks that had been built by the ARC. Both covered bridges were 102-foot spans with trestle approaches. They were replaced in 1952-1953. The BPR built the Texas Creek Bridge in 1928 as part of a 3.5 mile road project extending from the Salmon River, near Hyder. The bridge was a 122-foot span that rested on concrete abutments and had 80 feet of timber approach trestles. The structure collapsed during the winter of 1978-1979 (Connecticut River Valley Covered Bridge Society 1980:1-8; Halsted 1979:1-2).

Figure 81. The twin covered bridges at Mile 3.5 on the Seward-Kenai Lake Road that were built by contractor C.H. Keil for the BPR in the late 1920s. Photo courtesy of ADOT&PF Bridge Section Juneau.

The TBRC also built and funded construction of bridges during the 1920s. In its first years of operations, the TBRC had its own work force. Its crews built an 85-foot pile bent bridge on Strawberry Point Road in southeast Alaska in 1922, a 120-foot timber stringer bridge (Graehl Bridge) in 1922 on Fox Road near Fairbanks, three bridges on the Dumbar-Brooks Sled Road in 1921, and rebuilt four bridges on the Hot Springs-Sullivan Road in 1922 (Thiele 1923:10, 43, 46). The territorial road program after 1922 was carried out through the ARC and BPR (Thiele 1925:8). Most bridges built with territorial funds in the 1920s were on rural roads in expanding communities, such as the Matanuska and Tanana valleys, and trails and roads in remote mining districts. These were projects that the ARC was unable to fund due to budget limitations. Most bridges built with territorial funds were short timber stringer spans, multi-span pile bent, pile trestles, or king post

trusses, made with local timber. The territory supplied funds which the ARC used to repair bridges on rural roads and trails that had been damaged or needed repairs. The territory also contributed to ARC projects to jointly fund longer truss span bridges that had significant support from local interests. Examples included an 80-foot Howe truss bridge erected over Otter Creek on the Flat-Iditarod Wagon Road in 1924, the Howe truss bridge over the Nizina River (Figure 82) in the remote Wrangell Mountains (Theile 1925:42, 59), and a 100-foot Howe truss bridge with 159 feet of approach across Hot Springs Slough on Hot Springs Landing-Eureka Wagon Road (Thiele 1927:62). The territory funded construction of most cable trams and many of the foot and pack horse bridges built by the ARC in the 1920s. Occasionally, the territory hired a contractor to build or repair a bridge, such as the Salmon River Bridge near Seward, that was washed out by floods in 1923. In 1924, the Territorial Road Commission paid for repairs to the cable suspension foot bridge on the trail to Sitka National Monument. The repairs included creosote timber abutments, the first record of creosote being use on a bridge in Alaska (Thiele 1925:14, 36).

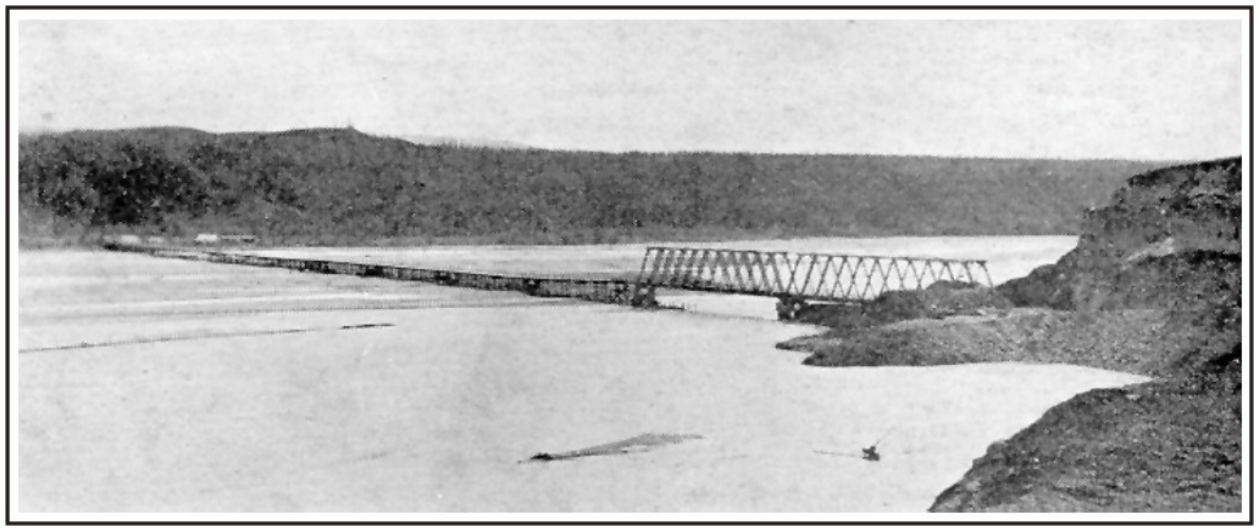

Figure 82. The Nizina River Bridge, with two 180-foot timber Howe truss spans and 1,650 feet of trestle approach, was partially built with territorial road funds. U.S. Alaska Road Commission Collection, PCA 61-4-117, Alaska State Library.

As communities such as Juneau and Ketchikan grew in the 1910s and 1920s, they built bridges within their city boundaries as part of local streets. These bridges included timber single span and pile trestle structures in low lying areas and timber trestle structures that filled gaps in streets on steep hillside terrain. Little documentation is available on early bridges built by cities. Some were erected by city workers and others were built by contractors. The oldest timber trestle bridge still in use that was built by a city is the Water Street Trestle (Bridge No. 389) in Ketchikan. The City of Ketchikan built the Water Street Trestle in 1920 and another trestle bridge over Ketchikan Creek at Thomas Basin later in the same decade. The City of Juneau built timber stringer and piling bridges over Gold Creek in three separate locations during the 1920s (Figure 83).

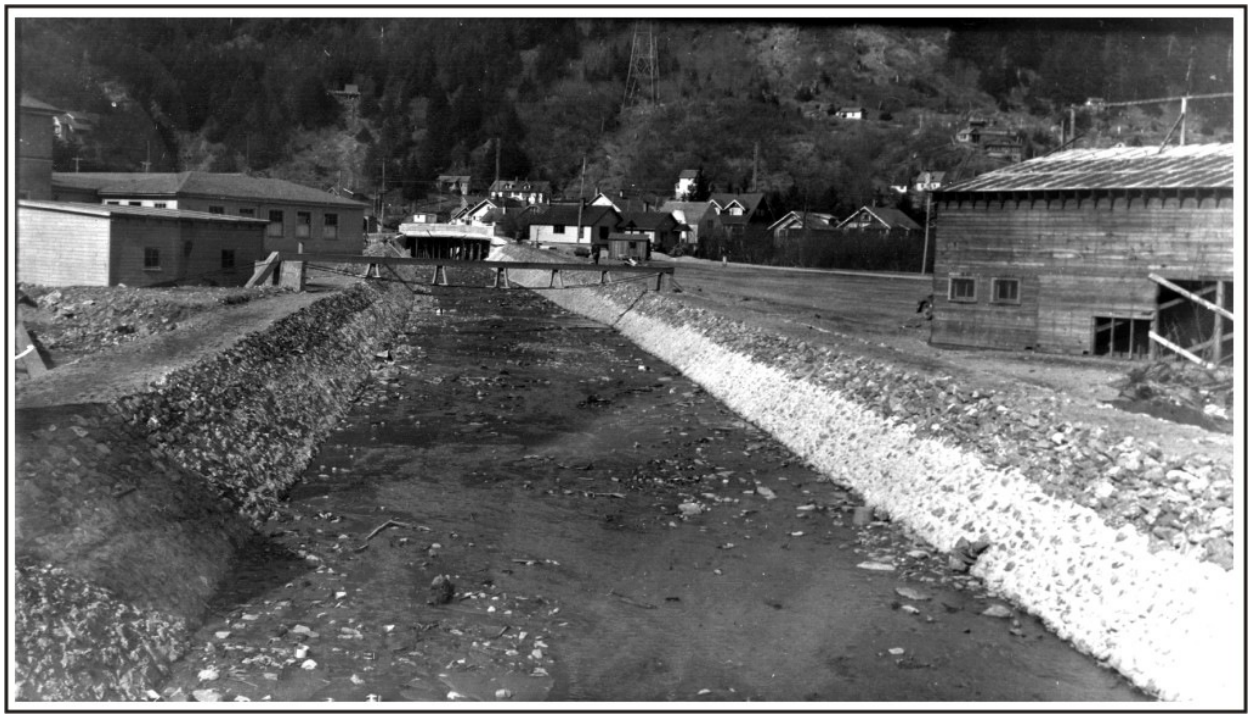

Figure 83. A timber piling bridge at Gold Creek in Juneau, 1933. This bridge was built in the 1920s. U.S. Alaska Road Commission Collection, PCA 61-14-126, Alaska State Library.

VI. BRIDGE BUILDING IN THE 1930s

The Great Depression, which began with the stock market crash in October 1929 and spread through the country in the early 1930s, had a significant impact on the building of bridges in Alaska. Congress slashed the budgets of federal agencies, including the ARC and BPR in Alaska. After more than two and a half decades of rapid expansion of its trail, road and bridge building activities in the territory, the ARC began to cut back its support of many trails and roads in remote mining districts to concentrate on improving main roads, building several new roads, and improving rural roads around major population centers. An increase in traffic and in the weight of motor vehicles, particularly trucks, prompted the ARC to begin using all-steel bridges as a cost effective means of bridging important water crossings. In the late 1930s, Congress appropriated funding to generate economic recovery. Some of that funding in Alaska was used for major bridge projects. Bridge building in Alaska during the 1930s was characterized by shifting funding sources, changing priorities, and experiments with different bridge types and materials.

Significant changes in the design of bridge substructures and superstructures occurred in the States during the 1930s. Battered steel piling abutments were introduced in the early 1930s, along with open steel pile bents, a simplification of earlier concrete-encased bent designs. Steel truss bridge types reached their zenith in terms of widespread use in the States during the 1920s, but few new steel truss spans were built in the states by the mid-1930s. Steel truss types were supplanted by I-beam construction that increased the length of a span from 30 to 60 feet. States started building concrete slab bridges with substructures made of creosoted timber piles capped with reinforced concrete beams. Aesthetic concerns led to widespread use of the rigid frame, a monolithic, flat-arch concrete bridge type developed in 1920s. Concrete rigid frame bridges were widely used in the States during the 1930s (Potter and Puschendorf 1999:46-47).

Wooden bridges remained the standard during the 1930s in Alaska, where most roads had light traffic loads. The ARC built about two dozen steel truss bridges for long crossings on routes with heavy traffic. It also began building steel stringer bridges in the late 1930s, but the vast majority of ARC bridges were timber stringer structures. Ninety percent of the roads that ARC crews worked on in those days were pioneer roads, which they improved and rebuilt over time (Soberg 1991:22-23). The BPR built several steel stringer and rigid form concrete bridges, but most BPR bridges were built of wood. Several communities in southeast Alaska built their own bridges in the 1930s. Most were timber piling and trestle structures, but a few southeast cities experimented with steel stringer and concrete bridges.

ARC Bridges in the 1930s

Due to funding cuts, the work of the ARC in the early 1930s was confined largely to maintenance and improvement of existing routes (ARC 1933:9). One of the defining characteristics of the ARC was that it did "very little engineering" on roads and most of its bridges. The vast majority of the mileage of trails and roads maintained by the ARC were pioneer in nature (ARC 1937:10). The "low type of construction undertaken" on most roads and bridges allowed the ARC to dispense with a large engineering force, thereby reducing costs materially without "adversely

affecting the work to any extent" (ARC 1933:12; ARC 1936:11; ARC 1938:10; ARC 1940:10). The volume of traffic that the ARC expected on Alaskan roads was "much smaller than in settled countries," allowing, according to the ARC, less durable types of construction than in regions where a larger traffic volumes had to be provided for immediately (ARC 1932:15). This applied to both road and bridge construction. ARC crews built most of its bridges using standard plans, which construction crews adapted to field conditions. The ARC built bridges of native or imported timber or steel, depending on each bridge's volume of traffic. Timber stringer spans with substructures made of timber piling and trestle were the mainstay of bridges built by the ARC in the 1930s. Timber was the most cost effective material, particularly in view of cutbacks in funding and the low volume of traffic on most bridges. ARC engineers found Douglas fir to be the most suitable material for bridges, but construction crews continued to use native timber for short spans on remote trails and roads (ARC 1930:37; ARC 1933:9; ARC 1937:6; ARC 1940:6). The ARC used creosote pile foundations on selected timber bridges as early as 1930 and intermittently through 1940 (ARC 1930:54; Hesse 1941:49). The switch from native timber to imported fir for heavy bridge construction resulted from increased traffic and heavier truck loads on Alaska's roads. Traffic volume and the weight of wagons, automobiles and trucks influenced decisions made by engineers on the types of bridges and construction materials. In 1935, the ARC began building steel truss bridges rather than timber truss structures for longer bridges (Table 1). Two years later, the ARC built its first short span bridges using steel stringers, but timber remained the dominate material for bridge construction in the 1930s.

Most timber bridges constructed in the 1930s were short stringer structures (Figure 84) or bridges supported by pilings or pile trestle (Figure 85). These bridges were used to cross creeks and

Table 1. New ARC Bridge Construction by Bridge Type (in linear feet), 1931-1940.

Year	Timber truss bridges 30 feet or longer	Timber truss bridges 60 feet or longer	Steel truss bridges with spans 170 feet or longer	Steel truss bridges with spans 80 feet or longer	Steel truss bridges with spans 60 feet or longer	Steel trestle span bridges	Timber trestle span bridges
1931	–	60	–	–	–	–	411
1932	–	520	–	–	–	–	3,158
1933	–	340	–	–	–	–	1,732
1934	–	820	–	–	–	–	4,703
1935	848 *	–	–	1,120 **	–	–	1,836
1936	231	–	2,200	–	–	–	2,021
1937	74	–	–	230	–	56	1,757
1938	90	–	–	740	–	180	3,205
1939	?	–	–	80	–	120	624
1940	60	–	–	–	360	160	711

* = over 38 feet in length ** = over 300 feet in length

(Source: ARC 1932:2; ARC 1933:9; ARC 1934:1; ARC 1935:1; ARC 1936:8; ARC 1937:8; ARC 1938:7; ARC 1939:7; ARC 1940:7).

Figure 84. The timber stringer bridge at Bonanza Creek, September 21, 1938. U.S. Alaska Road Commission Collection, PCA 61-12-463, Alaska State Library.

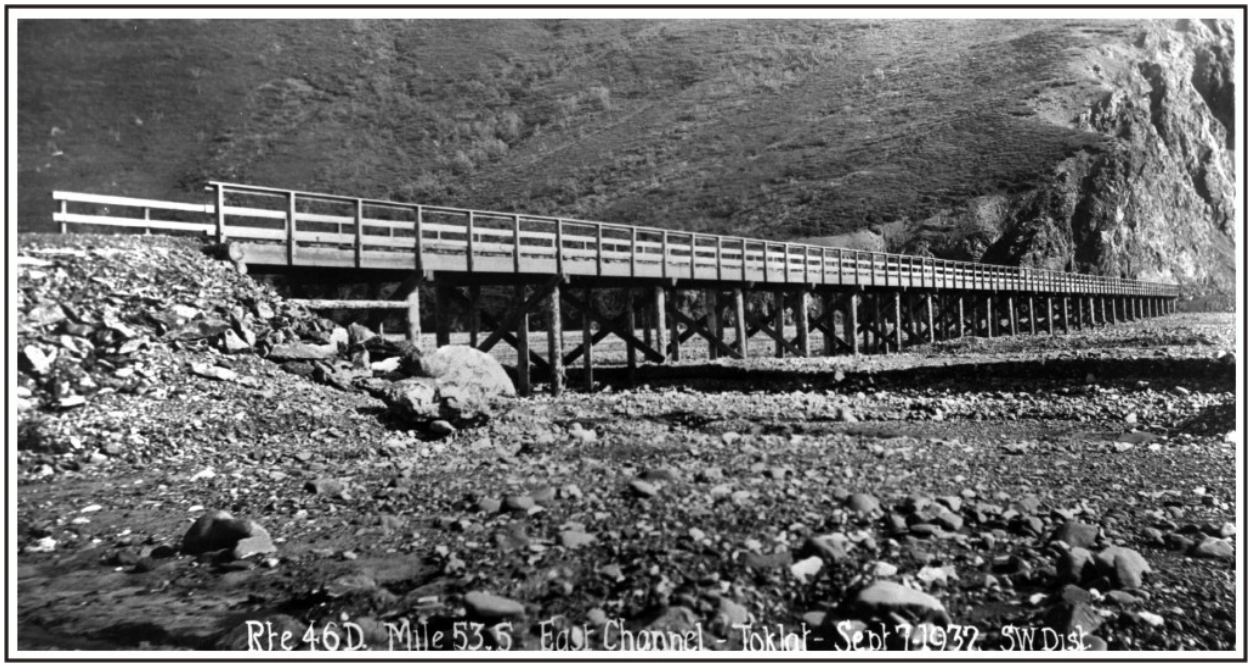

Figure 85. Pile trestle bridge at Mile 53 of the McKinley Park Road, 1937. U.S. Alaska Road Commission Collection, PCA 61-2-320, Alaska State Library.

streams, and in some cases rivers, where the crossing was shallow and not subject to heavy flooding or ice flows during winter and spring breakups. Pile and frame bent timber bridges (Figure 85) were built over canyons where the reinforcements between bent piles were needed to give these tall structures lateral strength. Pile, pile trestle and pile and frame bent timber bridges were built from standard plans. In 1931, the ARC embarked on a "bridge renewal program" to replace important bridges that had deteriorated or needed upgrading. Many of these were pile or trestle bridges (ARC 1932:15). Examples of these bridges built by the ARC in the early 1930s include the pile and frame bent trestles at East Fork (Figure 86) and at Teklinika River and the 1,176 foot long standard pile trestle bridge over the Toklat River on the McKinley Park Road (ARC 1931:51; ARC 1932:35); the 75-foot pile trestle at Graehl near Fairbanks (Hesse 1933:62); a 134-foot trestle at Baker Creek, which replaced an 85-foot decayed native timber Howe truss bridge on the Hot Springs Landing-Eureka Road (Hesse 1933:68-69); a 48-foot trestle bridge constructed on the Ruby-Poorman Road (ARC 1932:32); three pile trestle bridges on the Tuluksak-Foothills Road (ARC 1932:38-39); an 825-foot pile bridge over the Chilkat River at Mile 24.5 of the Haines-Pleasant Camp Road was replaced (Hesse 1935:11); 1,600 feet of pile driven trestle connecting Mineral Creek to Valdez (Hesse 1937:20, 44; ARC 1937:7); 1,436 linear feet of standard pile trestle on Bull River Road from the railroad station to the West Fork of Chulitna River (Hesse 1939:24); 100-foot trestle bridge over Gold Run Creek at Takotna (Hesse 1939:31); and a 70-foot native timber pile bridge on Haines-Pleasant Camp Road near Big Boulder Bridge (Hesse 1941:37).

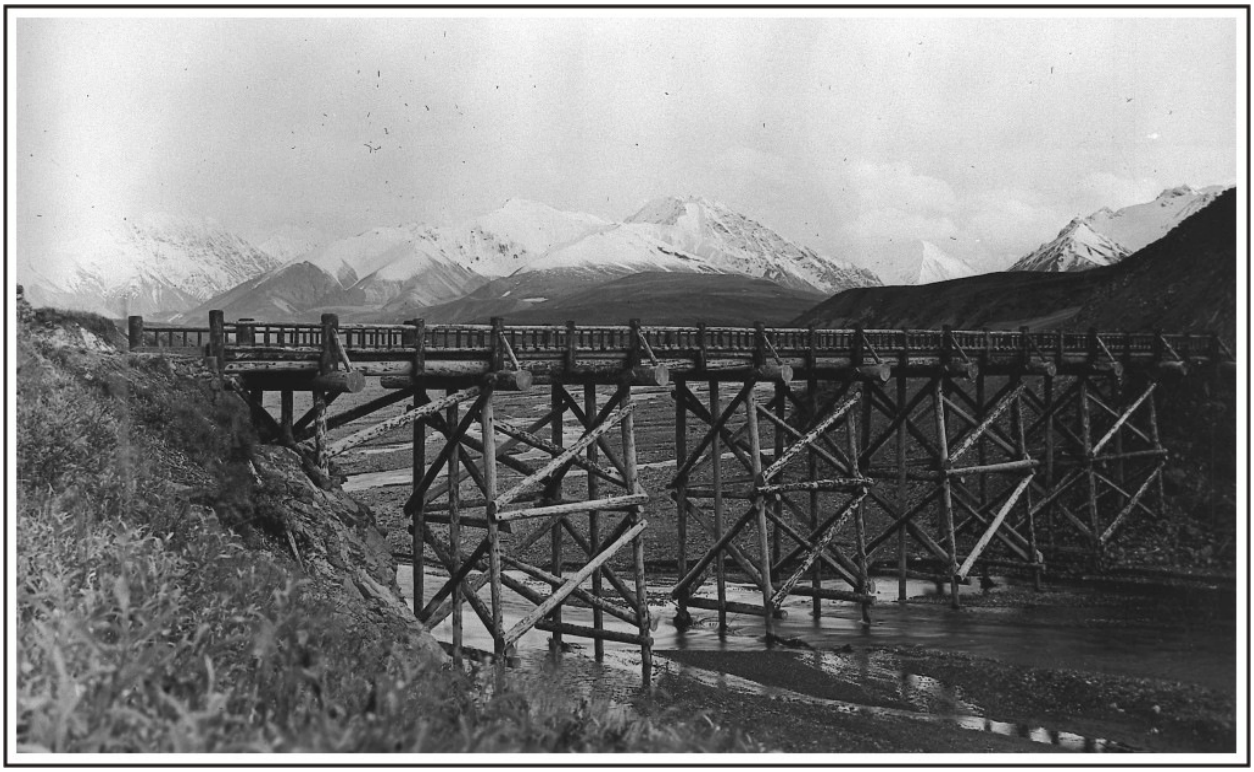

Figure 86. The pile and frame bent trestle bridge at East Fork, Mile 43.25 of McKinley Park Road, August 1932. U.S. Alaska Road Commission Collection, PCA 61-14-208, Alaska State Library.

The ARC used a timber A-Frame truss design during the early 1930s for short crossings. The A-Frame timber truss was built from standard plans drawn up by an ARC engineer in Juneau. Bridges of this type built in 1930-1931 included five 38-foot spans erected in the Delta River-Rapids section of the Richardson, four 38-foot spans that replaced old bridges on the Salchaket-Fairbanks section of the Richardson Highway (ARC 1931:41, 46; ARC 1932:27), a single 38-foot span erected over Gold Stream on the Goldstream-O'Connor Road outside of Fairbanks, and a single 38-foot span erected over the Tatalina River (Figure 87) on the Olnes-Livengood Road in 1934.

Figure 87. The 38-foot A-Frame timber bridge at the Tatalina River on the Olnes-Livengood Road north of Fairbanks, September 3, 1934. U.S. Alaska Road Commission Collection, PCA 61-13-330, Alaska State Library.

The ARC preferred the timber pony truss for medium length water crossings where the channel was deep. Pile or trestle spans were often used as approaches to timber pony truss spans, and in some instances timber pony truss spans were linked to other truss spans. Examples of timber pony truss bridges built by the ARC in the early 1930s included: a 60-foot bridge at the Delta River on the Richardson Highway; the three span Moose Pass-Takotna Bridge (Figure 88); the Sunset Bridge, a single span pony bridge with pile trestle approaches at Mile 8 on the Bessie-Snake River Road near Nome; and a two span bridge at the West Fork River on Bull River Road.

Figure 88. The Moose Pass-Takotna Bridge, a timber pony truss bridge, 1930s. U.S. Alaska Road Commission Collection, PCA 61-1-325, Alaska State Library.

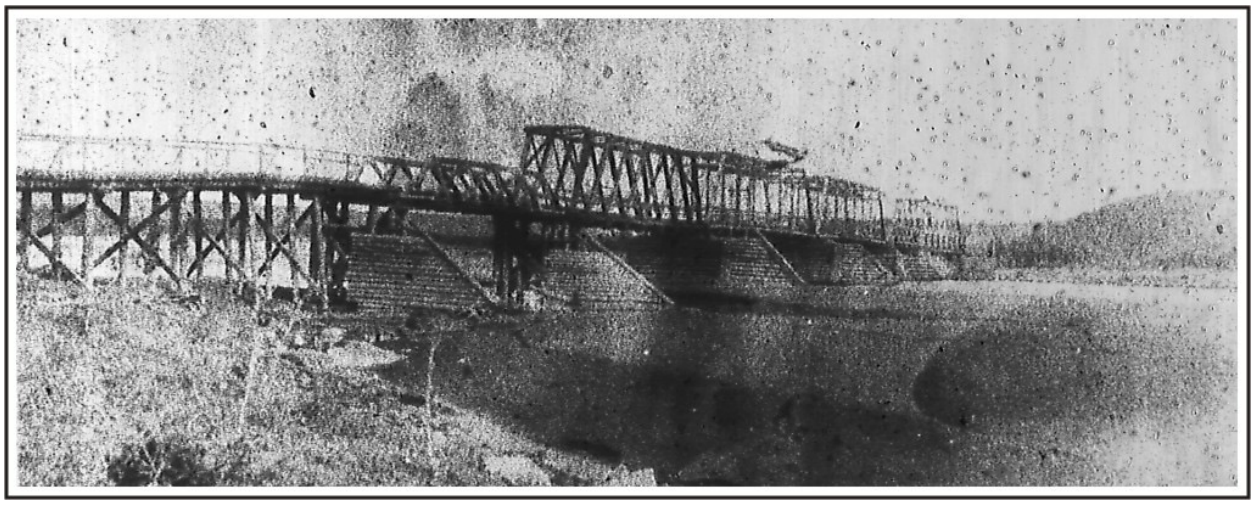

Figure 89. The Tazlina Bridge, consisting of Howe, Pratt and pony timber truss spans, 1930. U.S. Alaska Road Commission Collection, PCA 61-3-105, Alaska State Library.

During the early 1930s, the ARC built Howe timber truss bridges for long water crossings. These bridges ranged from single spans to multiple Howe spans, and they often combined Howe spans with other truss and stringer approach spans. The ARC built two Howe timber truss bridges in 1930 and 1931 to replace bridges on the Richardson Highway. One was the Jarvis Creek Bridge that had two "standard 100-foot [Howe] timber spans" and 115 feet of pile trestle (ARC 1932:31). The other was the Tazlina Bridge, consisting of two Howe truss spans, two Pratt timber spans and a timber pony truss span (Figure 89). Other Howe timber truss bridges built by the ARC in the 1930s included a 100-foot span with piling approaches at Hot Springs Slough (Figure 90) on the Hot Springs-Eureka Road; a 100-foot span built at Eagle River on the Palmer-Anchorage highway; a 100-foot span built at the Slana River (ARC 1932:28); a 100-foot span with a 60-foot timber pony span

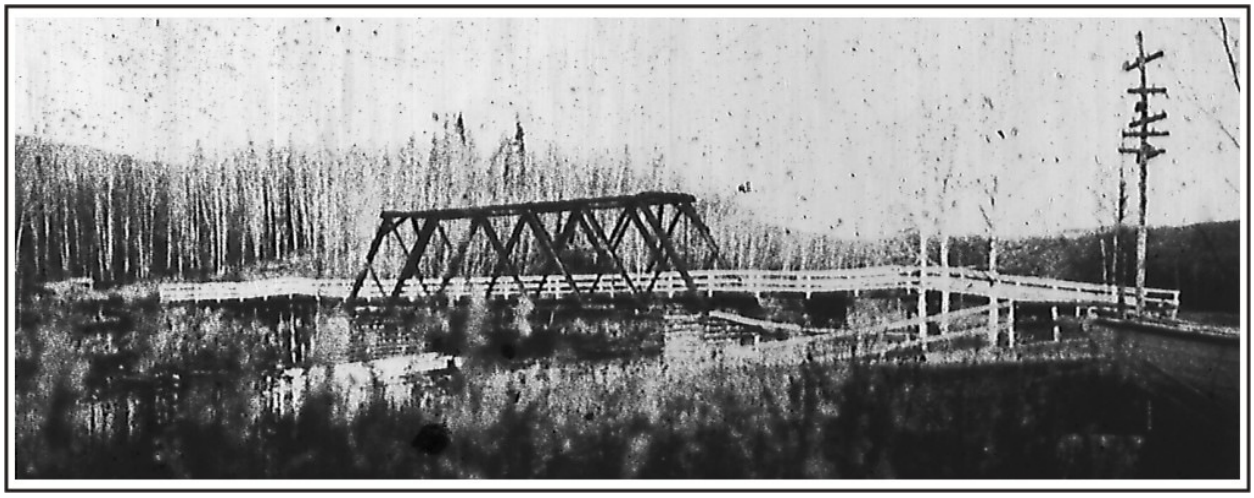

Figure 90. The Hot Springs Slough Howe timber truss bridge, October 24, 1938. U.S. Alaska Road Commission Collection, PCA 61-12-468, Alaska State Library.

at the Chatanika River Bridge and an 80-foot span at Tolovana Creek, both on the Olnes-Livengood Trail (ARC 1932:31); and a 100-foot span at West Fork River on Bull River Road (ARC 1952a:30).

The ARC Begins the Switch to Steel Truss Bridges

The ARC erected two dozen steel bridges during the 1930s, the decade when the ARC began the change from building timber stringer and truss bridges to building steel stringer and truss bridges. This change in preference took over two decades and it was not until the early 1950s that steel became the predominate material for Alaskan highway bridges. In the States, steel had been preferred over wood since the 1910s because of its greater strength. Concrete became the predominate material in bridge construction by the 1930s, but in Alaska timber was still the predominate material used for bridge superstructures. Steel bridges built in Alaskan during the Depression years replaced timber structures that failed or had significant increases in traffic and vehicle weight. Some steel bridges were on new routes and were the first bridges at crossings that required long truss spans. The construction of these steel bridges was a significant departure for the ARC, even though the number of steel structures built in the 1930s was low compared to the number of timber bridges and to the overall number of timber bridges in the territory. Steel bridges were considered permanent structures, a significant departure from the frontier character of most of the ARC's bridge construction (Soberg 1991:22-23). Steel bridges built in the 1930s were constructed with concrete piers and abutments or steel "H" piles, rather than the timber pilings. Steel bridges could handle significantly heavier vehicles and had significantly longer life spans. Some of those steel bridges were still in use in 2006, more than sixty-five years after they were built.

The switch to steel bridges began gradually in the 1930s with the construction of a 120-foot Pratt steel truss span bridge over Noyes Slough in Fairbanks. The bridge (Figure 91), which was completed in 1930, was 16 feet wide and had 42 linear feet of pile driven approach trestle. It replaced a pile timber stringer bridge destroyed by high water during 1929 (ARC 1930:57). In the mid-1930s,

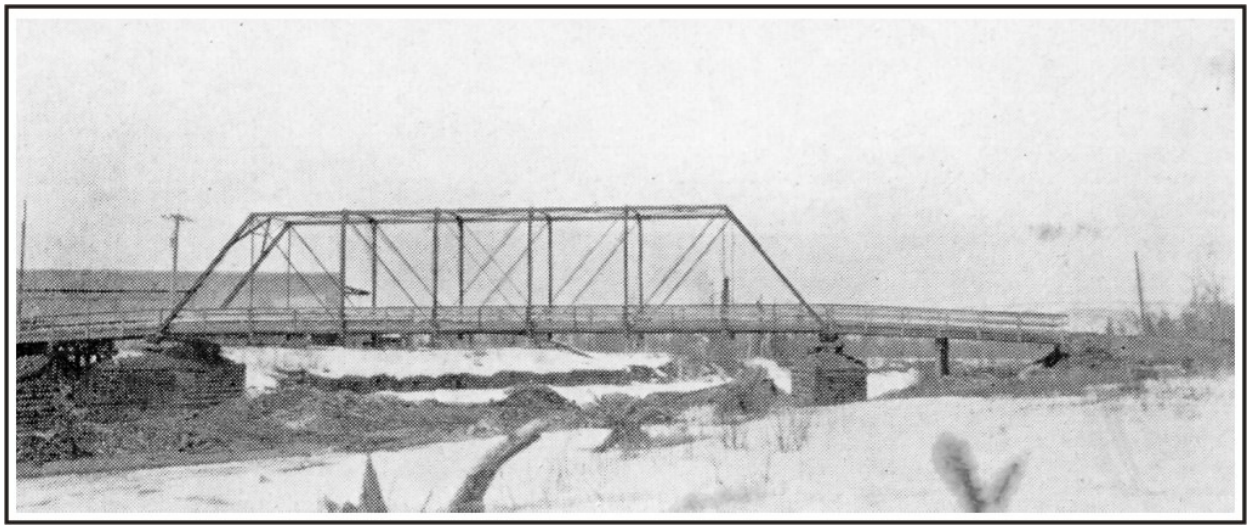

Figure 91. The steel Pratt truss bridge at Noyes Slough in Fairbanks, April 15, 1930. U.S. Alaska Road Commission Collection, PCA 61-12-425, Alaska State Library.

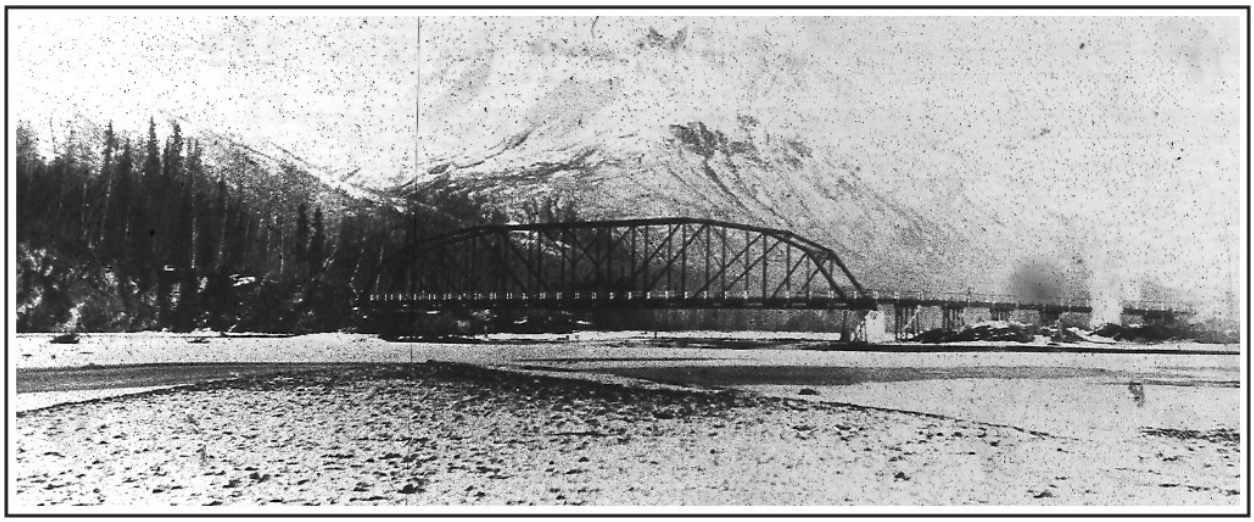

Figure 92. The Matanuska River Bridge, a steel Pennsylvania truss with pile trestle approach, 1935. U.S. Alaska Road Commission Collection, PCA 61-10-377, Alaska State Library.

the ARC erected three major steel bridges using Work Progress Administration funds from the Emergency Relief Act to build the Anchorage-Matanuska Road. During 1934, the ARC erected a steel through truss bridge over the Matanuska River at Palmer. The bridge (Figure 92) consisted of a 300-foot Pennsylvania truss span and 120 feet of pile trestle approach (ARC 1934:10; Hess 1935:30). The second steel bridge on the Anchorage-Matanuska Road, at Eklutna River, was completed in June 1935. The Eklutna River Bridge (Figure 93) was the first steel arch bridge built for automobiles in Alaska. The one-lane bridge consisted of a 172-foot steel arch and 50 feet of steel

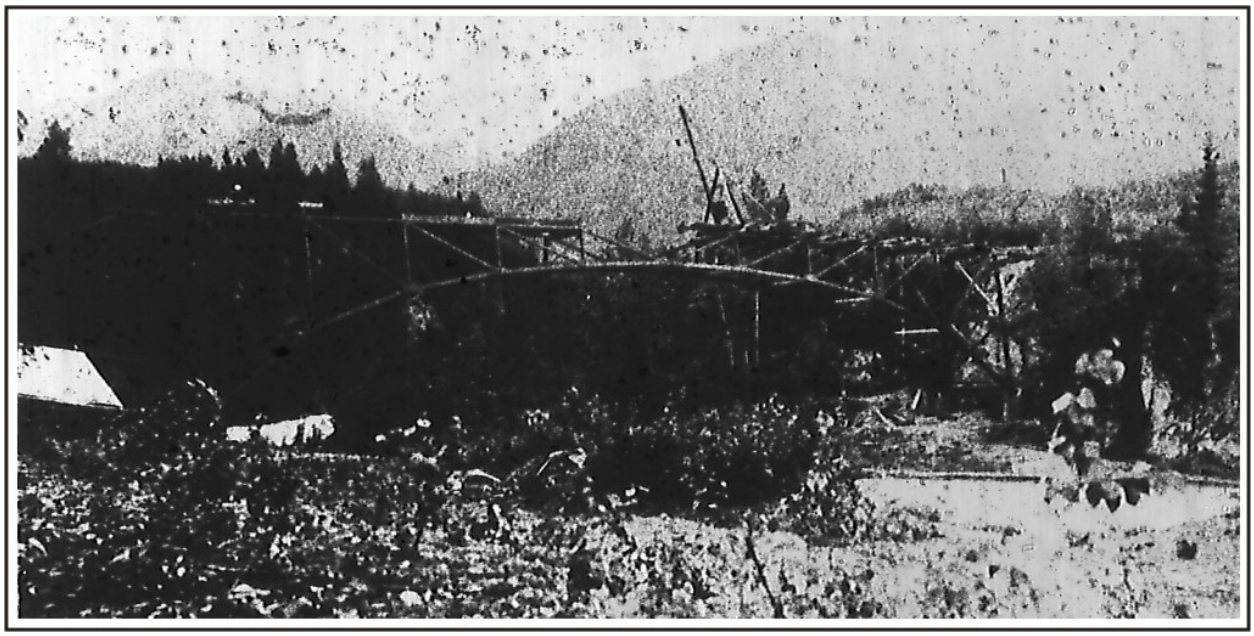

Figure 93. The steel arch bridge at Eklutna River under construction, 1935. U.S. Alaska Road Commission Collection, PCA 61-10-163, Alaska State Library.

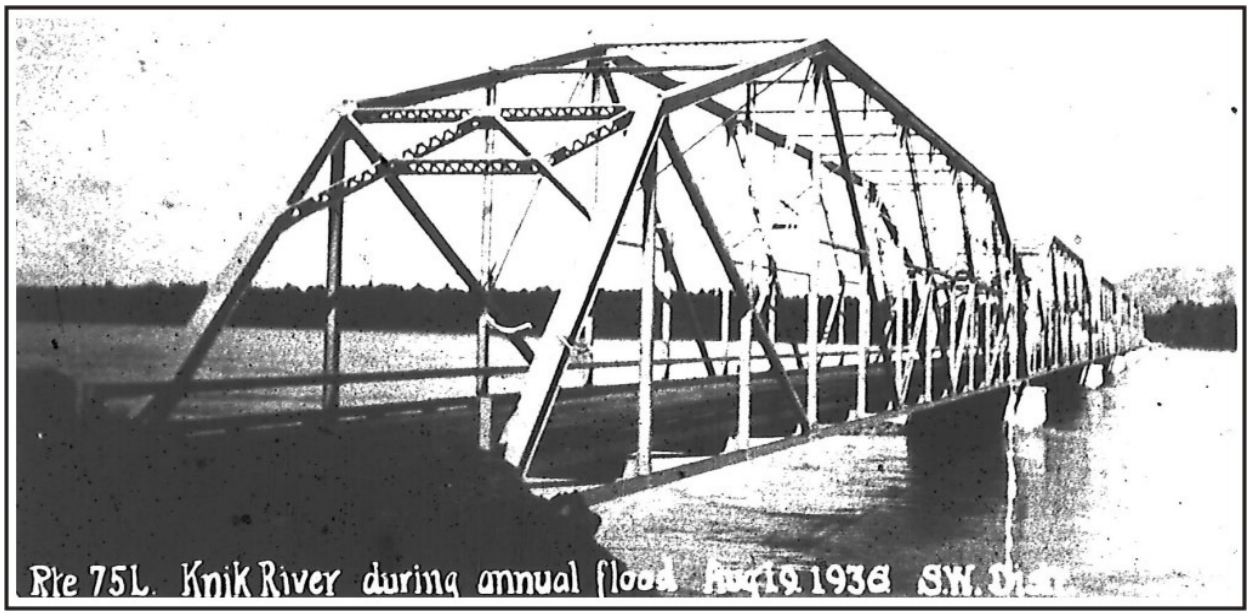

Figure 94. The Knik River Bridge, a steel camelback truss, August 19, 1936. U.S. Alaska Road Commission Collection, PCA 61-1-242, Alaska State Library.

stringer approach spans (ARC 1935:10; ARC 1936:7). The bridge was designed by ARC engineers erected by a contractor, Munter Construction Company of Seattle (Soberg 1991:18). The ARC completed the third bridge in April 1936 over the Knik River. It consisted of six 250-foot steel camelback spans on concrete piers (Figure 94) and 500 feet of pile driven trestle approach and was completed in April 1936 (ARC 1936:7; Soberg 1991:31-33).

The ARC also built steel bridges on roads in outlying areas in western and interior Alaska. In the winter of 1936, the ARC erected a steel Pratt truss bridge (Figure 95) on the Poorman-Long

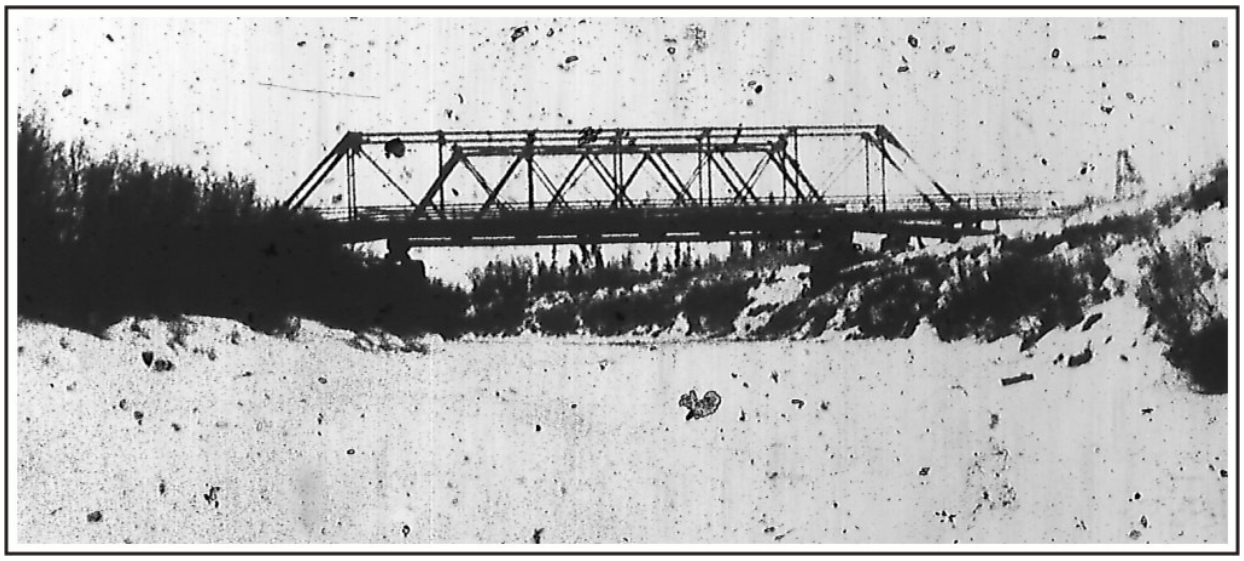

Figure 95. The Sulatna Creek Bridge, a steel Pratt truss, completed December 1, 1936. The old Howe timber truss bridge is in the background. U.S. Alaska Road Commission Collection, PCA-61-12-494, Alaska State Library.

Road to replace a wooden Howe truss bridge over the Sulatna River. The ARC crew worked throughout the winter, sometimes in 40 below temperatures (Soberg 1991:47-51). A year later, the ARC erected a 181-foot steel camelback truss bridge at the Iliamna River on the Iliamna Bay-Iliamna Lake Road (Figure 96). In 1937, ARC crews also built an 81-foot steel stringer bridge across Moose Creek, on McKinley Park Road just outside McKinley National Park boundary near Kantishna (Soberg 1991:55).

Figure 96. An ARC crew bolting up the top cords of the Iliamna River Bridge, 1937. U.S. Alaska Road Commission Collection, PCA 61-9-373, Alaska State Library.

During 1937, the ARC replaced three worn out timber bridges on the Sterling Landing-Ophir Road with steel bridges. ARC crews installed single span 44-foot steel stringer bridges at Yankee Creek (Bridge No. 464) and California Creek (Bridge No. 466). They also erected a 100-foot steel pony truss bridge (Bridge No. 467) at Ganes Creek (ARC 1937:9; Hesse 1939:31). The Ganes Creek Bridge (Figure 97) is the oldest steel pony truss bridge built for automobile still in use in Alaska.

Figure 97. The steel pony bridge at Ganes Creek, 1937. The old timber Howe truss is in the background. U.S. Alaska Road Commission Collection, PCA-16-1-07, Alaska State Library.

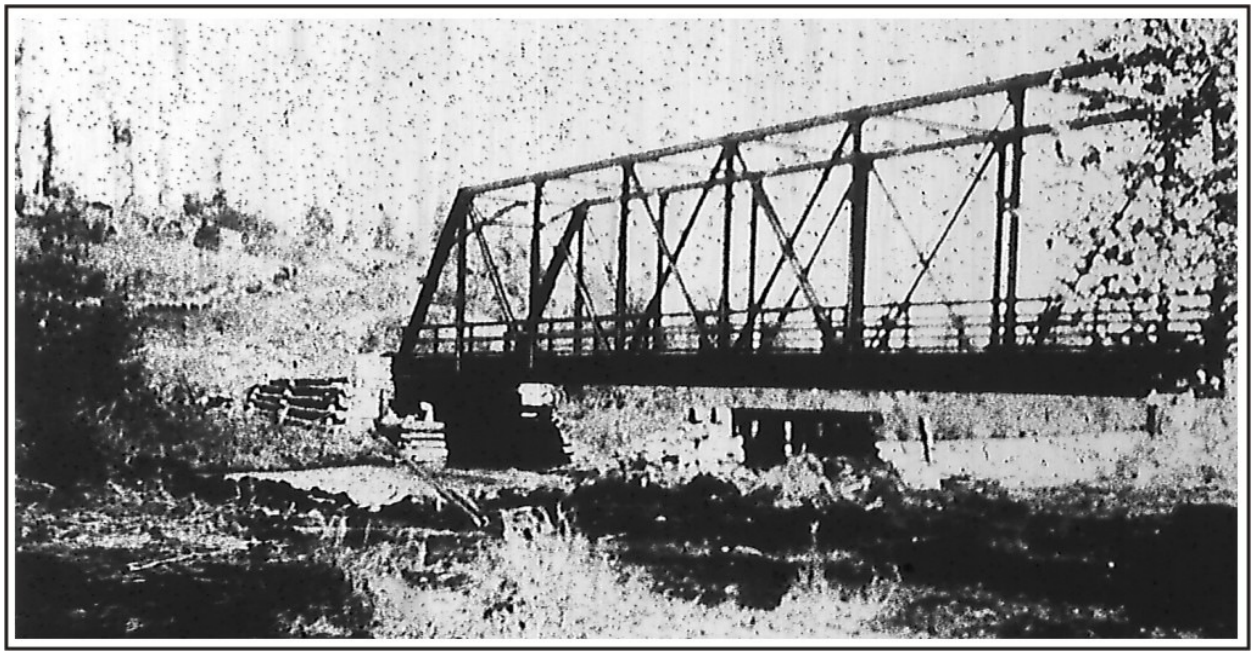

Figure 98. The Peters Creek Bridge, a steel Pratt truss, at Mile 23 of the Talkeetna-Peters Creek Road, 1938. U.S. Alaska Road Commission Collection, PCA 61-10-11, Alaska State Library.

The ARC replaced three wooden bridges with steel bridges in 1938 on the Talkeetna-Peters Creek Road, known today as the Petersville Road. The first replacement bridge was a 152-foot Pratt steel truss bridge (Figure 98) at Peters Creek that rested on steel piling piers (Bridge No. 812). The second replacement was an 80-foot steel pony truss at Croto Creek (Figure 99). This bridge had two 18-foot steel stringer approaches that rested on steel piling piers. The third replacement was a 56-

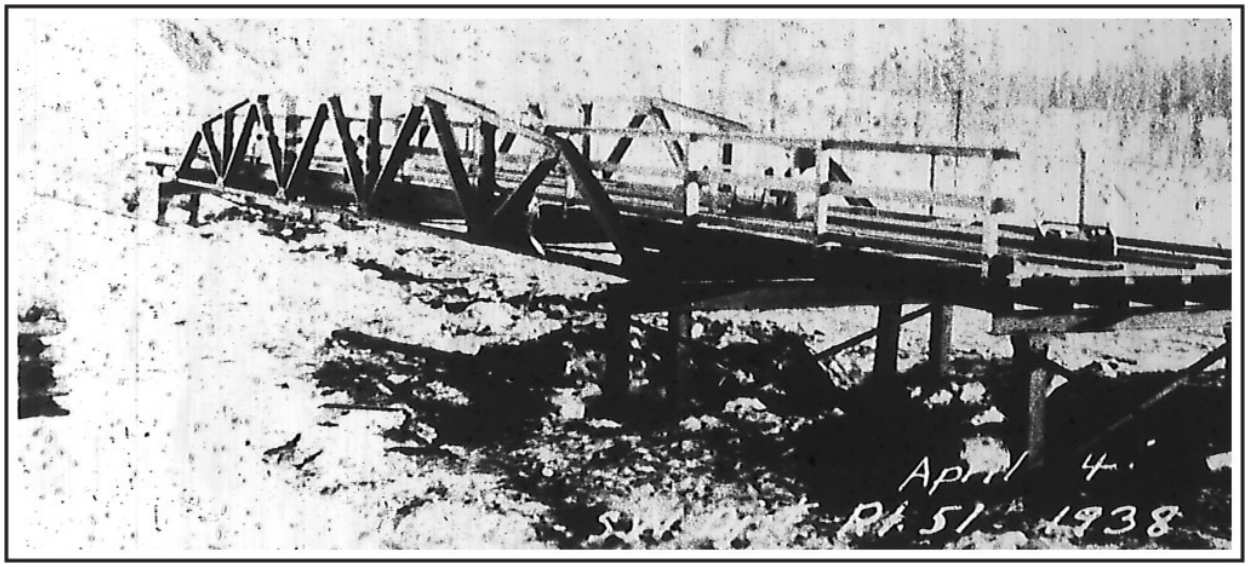

Figure 99. An ARC crew building a steel pony bridge at Croto Creek, April 4, 1938. U.S. Alaska Road Commission Collection, PCA 61-10-116, Alaska State Library.

foot steel stringer bridge on upper Peters Creek (Figure 100). The upper Peters Creek Bridge rested at one end on solid rock and at the other on a concrete abutment (Bridge No. 815) (ARC 1936:9; Hesse 1939:25).

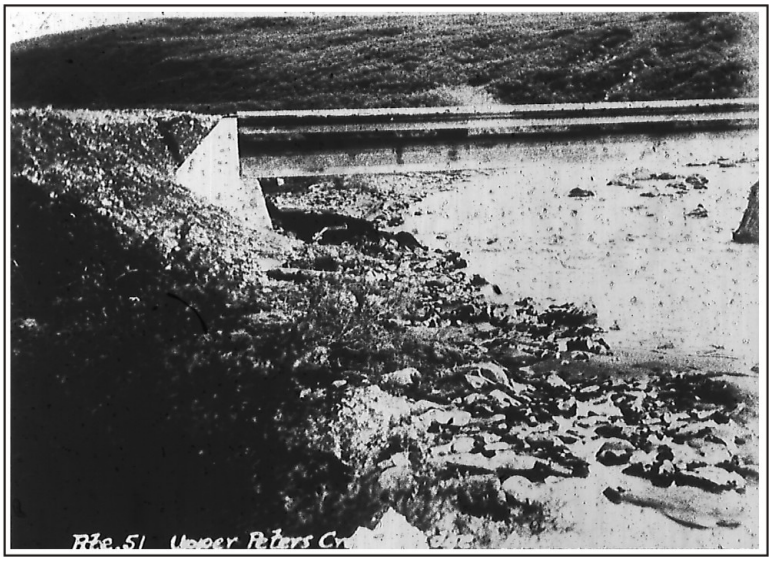

Figure 100. The steel stringer bridge on upper Peters Creek, 1938. U.S. Alaska Road Commission Collection, PCA 61-10-133, Alaska State Library.

The ARC erected an 80-foot steel truss bridge over Jack Creek on the Gulkana-Nabesna Road near Mile 102.5 in 1937 (ARC 1937: 7; ARC 1952a:33). During the summer of 1938, ARC crews built two steel stringer bridges on Eagle-Liberty Road. One was at Star Gulch at Mile 10 (Figure 101) and the other was at Discovery Fork at Mile 11 (Figure 102). The ARC built a 52-foot steel pony truss on the Gold Mint Road in 1937, a 61-foot steel pony bridge at the Tatalina River in 1939, and a 53-foot plate girder bridge in 1939 at Little Boulder Creek on the Haines Highway (ARC 1952a:15).

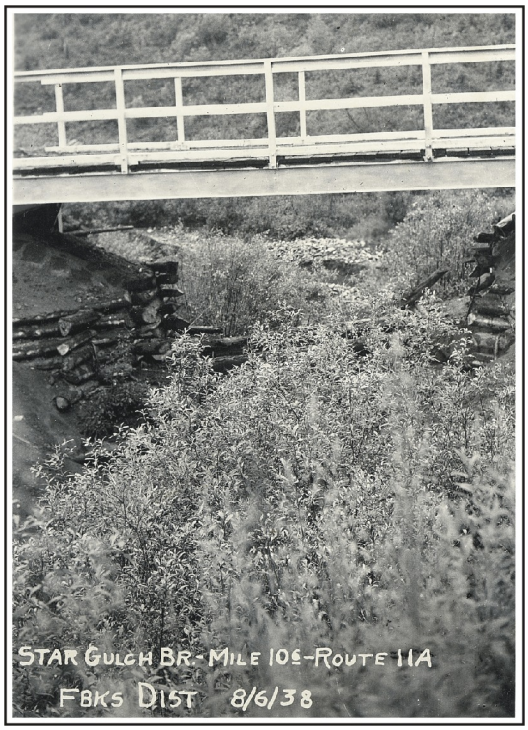

Figure 101. The steel stringer bridge at Star Gulch, August 6, 1938. U.S. Alaska Road Commission Collection, PCA 61-13-396, Alaska State Library.

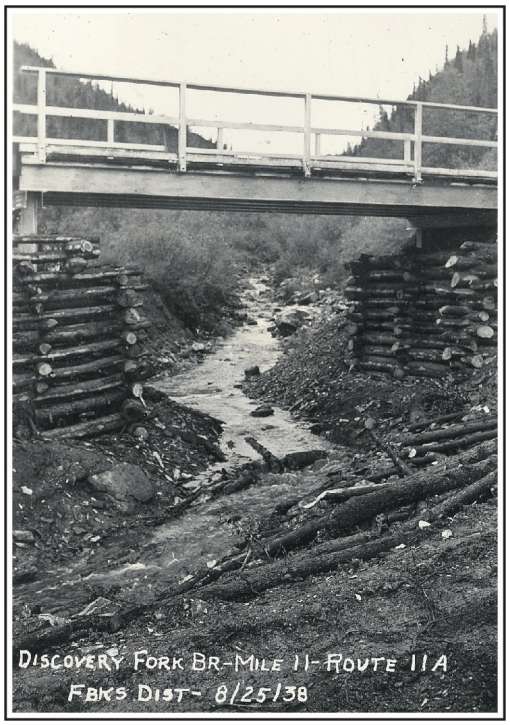

Figure 102. The steel stringer bridge at Discovery Fork, August 25, 1938. U.S. Alaska Road Commission Collection, PCA 61-13-387, Alaska State Library.

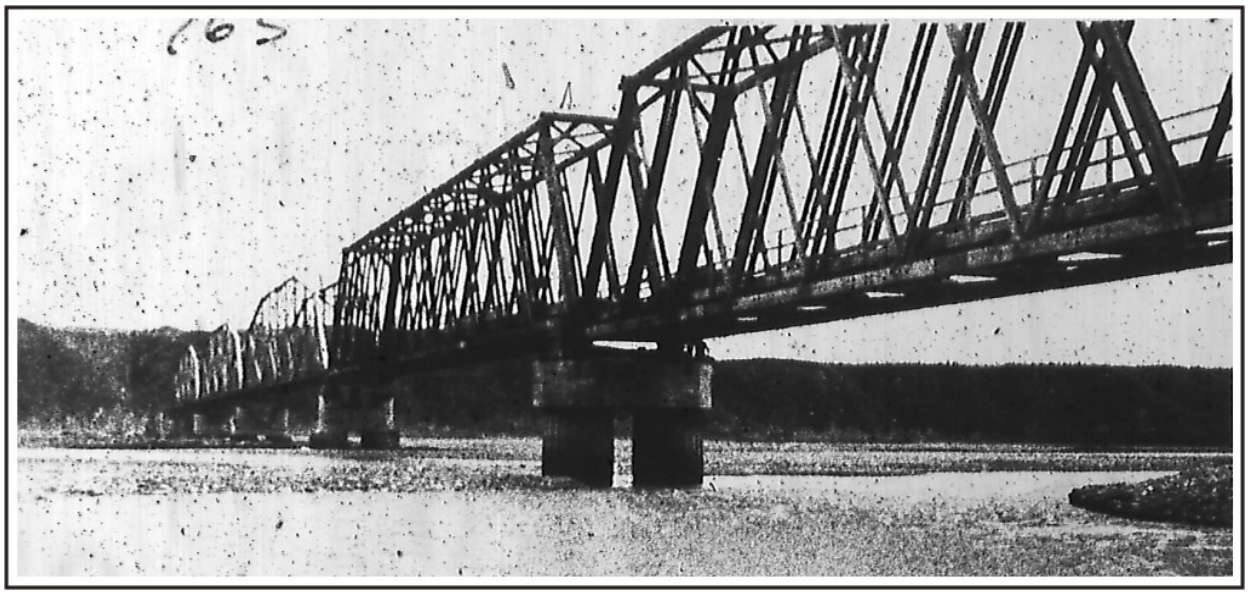

Figure 103. The Nizina River Bridge, with two Howe timber truss spans (right and center) and three steel camelback steel truss spans (left), after reconstruction in 1935. U.S. Alaska Road Commission Collection, PCA 61-4-165, Alaska State Library.

The ARC replaced three other timber truss bridges with steel truss bridges in the 1930s due to flooding and storm damage. The most problematic bridge in the 1930s was the Nizina River, which was periodically inundated when Skolai Lake broke out next to a glacier in the upper Chitina River drainage. Floods in 1929 and 1930 damaged the two 160-foot Howe timber spans and 2,000 feet of trestle built in the 1920s. ARC crews made repairs, but extreme high water in 1932, took out 24 bents of piling. Crews drove 120 piles and added additional bracing on 12 bents to make the bridge passable (Cole 1931:61; Hesse 1933:48). Due to the recurrent and severe flooding from Skolai Lake, the ARC erected three 180-foot steel camelback truss spans (Figure 103) on concrete piers to replace trestle approaches that had washed away. An ARC crew built the falsework, then set the steel, and by October 1935 they laid the decking (ARC 1935:12; ARC 1936:7; Soberg 1991:23).

A huge storm damaged the suspension bridge at the Nome River on the Nome-Council Road in 1938, requiring repairs. The bridge was damaged a year later and failed. The ARC replaced it with a new 180-foot steel through truss span supported on steel piles (Hesse 1939:18; Hesse 1941:40). In 1939-1940, the ARC erected a 190-foot bridge 10 miles upstream across the Nome River at Mile 14 of the Seward Peninsula Tram. The new bridge consisted of a 100-foot steel truss span and five 18-foot approach spans, and it replaced the timber Howe truss bridge built by the ARC in 1924 (Hesse 1941:41).

The Gastineau Channel Bridge between Juneau and Douglas was the most important steel bridge built by the ARC during the 1930s. Prior to construction of the bridge, the only access between Juneau and the town of Douglas, located two miles to the south, was by ferry. A bridge had been contemplated as early as 1900 and the project finally became a reality during the Great Depression when the federal Public Works Administration allocated funds for a bridge (McClanahan 2006:J-4). The ARC contracted in 1934 with Alfred Dishaw Construction Company to construct

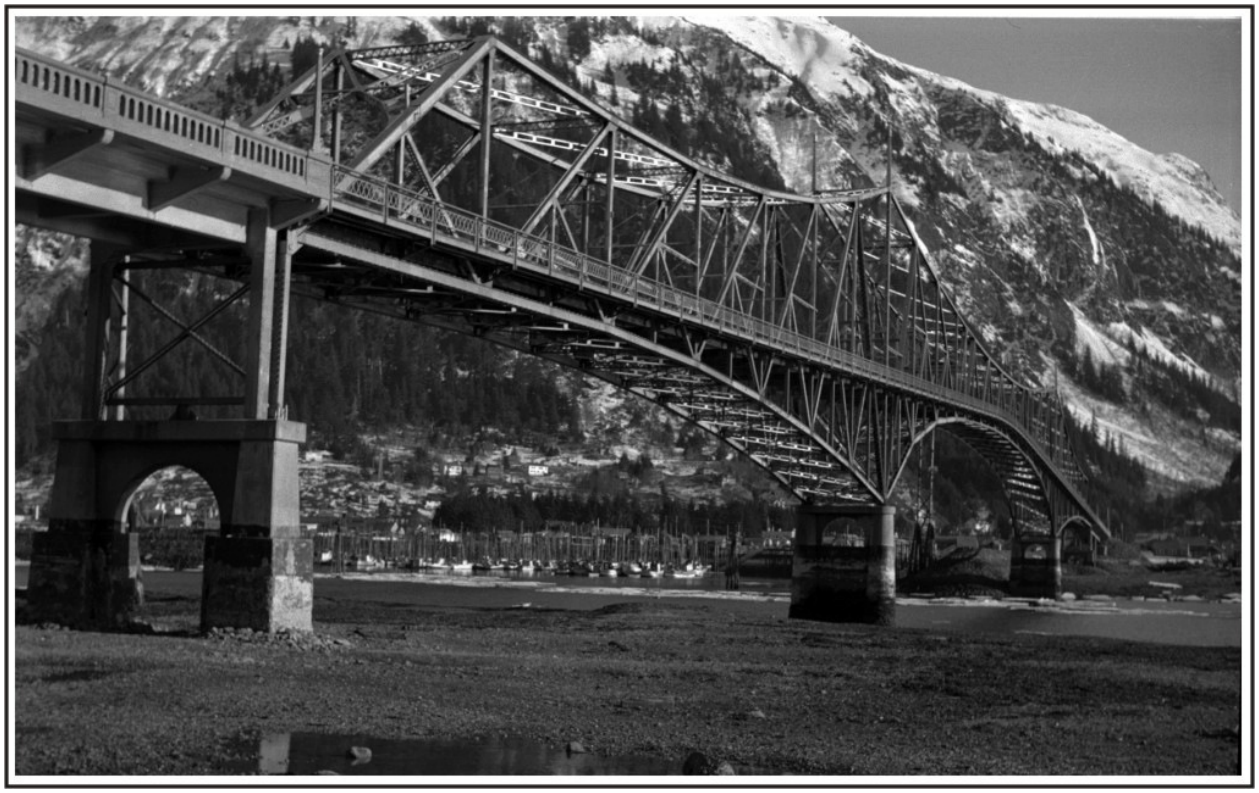

Figure 104. The Gastineau Channel Bridge with Juneau in the background, March 7, 1950. The concrete girders on the approach span at left were the first on an ARC bridge in Alaska. U.S. Alaska Road Commission Collection, PCA 61-95-83, Alaska State Library.

the concrete piers, J.B. Warrack to construct the concrete approaches, Pacific Car and Foundry Company of Seattle to erect the steel, and A.W. Quist to lay the deck (*Daily Alaskan Empire*, June 7, 1935; Soberg 1991:18). The total length of the bridge (Figure 104) was 2,701 feet. The structure consisted of a three span steel cantilever sub-divided Warren truss that was 1,120 feet long and 66 feet above the water, 432 feet of concrete girder approaches and over 1,000 feet of rock fill (McClanahan 2006:J-4; ARC 1935:9-10). The first automobile drove across the Gastineau Channel Bridge on September 2 and the ARC formally dedicated the bridge on October 13, 1935 (ARC 1936:7). The concrete approaches were the first concrete girders built for an ARC bridge.

The ARC built few foot and suspension bridges during the 1930s. Its crews erected a 300-foot suspension footbridge across the head of Noyes Slough (Figure 105) in Fairbanks during 1930 (Cole 1931:76; ARC 1931:46). During the same year, ARC crews rebuilt a 60-foot section of bulkhead protecting the west abutment of the Indian River Footbridge near Sitka in 1930 (ARC 1930:48). The ARC erected several suspension footbridges on the Mumtrack-Goodnews Bay Trail in 1934 and a 300-foot suspension bridge across a slough of the Yukon River in 1935 (Hesse 1937:45). A suspension footbridge across the Porcupine River at Fort Yukon was relocated after one of the towers was carried away by high water during breakup in the spring of 1937 (Hesse 1939:49). The ARC replaced a foot bridge destroyed by torrential floods on Jack Wade Creek in the Fortymile

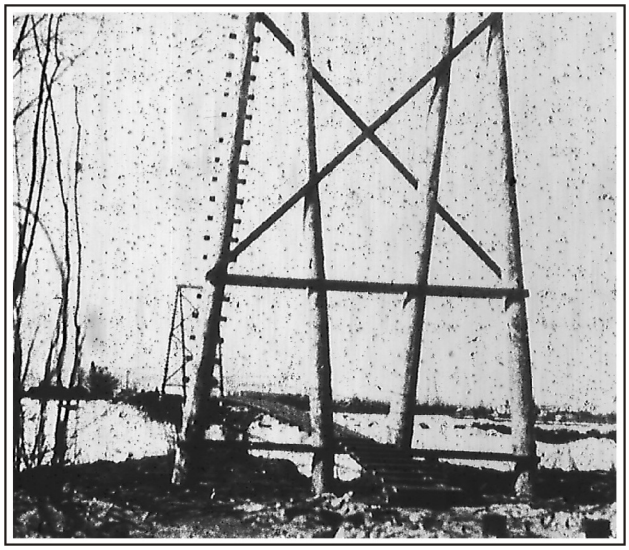

Figure 105. The Graehl suspension footbridge over Noyes Slough, Fairbanks, 1934. U.S. Alaska Road Commission Collection, PCA 61-13-250, Alaska State Library.

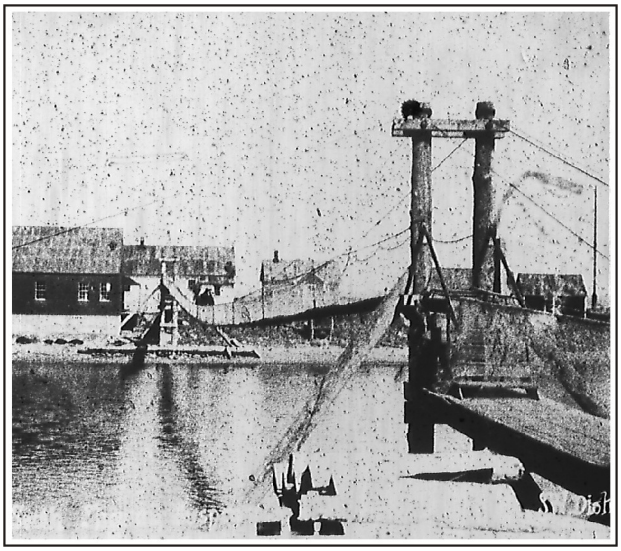

Figure 106. The Karluk suspension footbridge, 1936. U.S. Alaska Road Commission Collection, PCA 61-11-191, Alaska State Library.

Mining District (Hesse 1939:47). The ARC maintained suspension bridges at Bear and Sheep creeks on the Richardson Highway during the 1930s. In 1940, the ARC built a 300-foot suspension footbridge over the Karluk River (Figure 106), linking the village with the school (Hesse 1941:40, 49).

The ARC continued to maintain the Brooks and Seward Peninsula tramways during the 1930s. ARC crews built 430 linear feet of trestle on the Brooks Tram during 1930 (ARC 1930:60). The ARC built a temporary bridge during the summer of 1931 over the slough at Shelton at the end of the Seward Peninsula Tramway, only to remove it later that fall (Hesse 1933:33). In 1939, the ARC replaced the timber Howe truss bridge over the Nome River at Mile 13 with a steel Pratt truss bridge. Another change involving bridge types was the replacement in 1936 of the Salmon River Bridge in southeast Alaska, eliminating the territory's only draw span. The replacement bridge was a 276-foot pile driven trestle that raised the channel crossing eight feet, allowing small boats to navigate under the bridge (Hesse 1937:11).

The ARC relied heavily on culverts (Table 2), ferries and aerial trams for water crossings to avoid the time, labor and expense of building

Table 2. Types and Number of Culverts Installed by the ARC, 1930-1940

Year	Timber	Metal	Rock
1930	10	536	1
1931	51	800 *	-
1932	-	486	-
1933	-	**	-
1934	-	450	-
1935	-	586	-
1936	-	793	-
1937	-	681	-
1938	-	871	-
1939	-	410	-
1940	-	479	-

* = Estimated
**= No number for the year

(Sources: ARC 1930:49, 52-57, 60, 63-64; ARC 1931:42, 46-47, 51; ARC 1932:32; ARC 1933:9; ARC 1934:1; ARC 1935:1; ARC 1936:8; ARC 1937:8; ARC 1938:7; ARC 1939:7; ARC 1940:7).

bridges. ARC crews continued throughout the 1930s to replace timber culverts with metal culverts (ARC 1930:37; ARC 1932:16; ARC 1934:9; ARC 1936:6; ARC 1938:6; ARC 1940:6). Metal culverts were installed on main roads in large numbers (Figure 107). Timber and rock culverts were installed in remote mining areas when ARC crews ran out of metal culverts. In a few cases, short timber bridges were constructed to replace culverts (ARC 1932:31), but in other instances culverts were installed as substitutes for short timber bridges. For example, the Pioneer Cemetery Bridge at Sitka was replaced in 1934 with a culvert and fill (Hesse 1935:12).

Figure 107. A temporary timber stringer bridge over two metal culverts, Mile 9 of the Seward Highway, October 17, 1937. U.S. Alaska Road Commission Collection, PCA 61-66-22, Alaska State Library.

The ARC built and maintained several aerial cable trams in the early 1930s as alternatives to bridging rivers that could not be forded (Figure 108). The ARC erected a cable crossing for foot travelers over Chitistone River in 1930 and did maintenance for the cable passenger tram on Chulitna River, 20 miles from the Alaska Railroad, which had been installed in the 1920s (ARC 1930:54, 63). An ARC crew installed a 478-foot aerial tram at Old Woman in 1932 to replace a suspension foot bridge that was washed out by high water (Hesse 1933:16). The ARC also continued to maintain the cable tram at the Matanuska River near the mouth of Chickaloon River. Most aerial cable trams in the territory that had been built in the 1920s were on remote trails. In the late 1930s, the ARC decided that overland use of those remote trails had been sup-

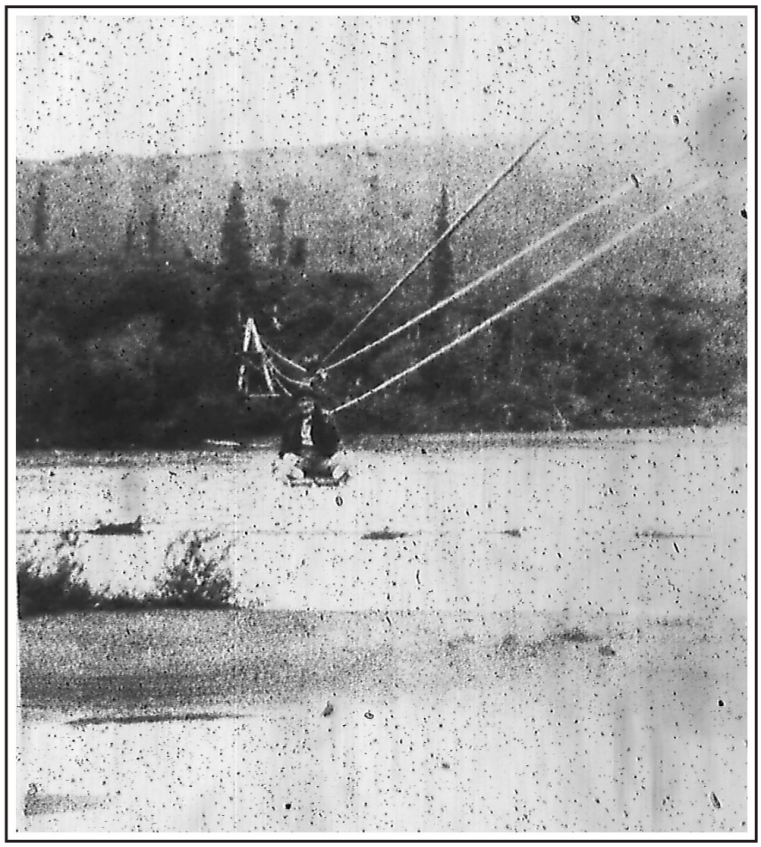

Figure 108. A man crossing an unknown river in Alaska on an aerial tram, 1930s. U.S. Alaska Road Commission Collection, PCA 61-10-434, Alaska State Library.

Figure 109. A suspension footbridge built by miners at Scandinavian Creek in the Innoko District, May 18, 1931. U.S. Alaska Road Commission Collection, PCA 61-11-13, Alaska State Library.

planted by airplanes and the ARC stopped maintaining aerial cable trams along those trails. The ARC continued to maintain ferries at a small number of river crossings with low traffic during the 1930s, but created no new ferries. An ARC crew installed a replacement ferry at the Bonanza River crossing near Solomon in the Nome area in 1930. The ARC operated ferries during the 1930s at three river crossings on the Nome-Council Road; at the Cripple River, Kougarok River and Sinrock on the Nome-Teller Trail; at a river crossing on the road north of Teller (Cole 1931:27, 42-43; ARC 1931:66 Hesse 1933:27; Hesse 1935:19, 25), and at Big Delta on the Richardson Highway.

Miners in remote mining camps also built bridges during the 1930s. These structures were usually simple timber stringer bridges or suspension footbridges such as at Scandinavian Creek in the Innoko Mining District (Figure 109) and at Cache Creek in the Cache Creek mining district. The TBRC provided funds to miners in 1939-1940 to build a bridge across the USSR & Mining Company ditch at Bell Creek and the Chatanika River to access mines in the Ophir District (Hesse 1941:31). In 1939, miners built a bridge across Ahtell Creek with funds for materials provided by the TBRC (Hesse 1941:28). Hatcher Pass miners constructed a 40-foot bridge (Bridge No. 2128) in 1940 over Willow Creek on the Grubstake Road using surplus Alaska Railroad flat cars (Hesse 1941:46).

In mining districts connected to roads built or maintained by the ARC, miners sometimes contributed to building bridges if the ARC lacked funds. In 1930, miners furnished $500 worth of labor to construct two bridges and several culverts on the Iron Creek-American Creek Sled Road north of Nome (Cole 1931:49). Miners constructed a bridge in 1934 at Quartz Creek on the Bear Creek Trail in the Nome area (Hesse 1935:22). During the early 1930s, the ARC converted a miners' winter sled trail into the Willow Station-Lucky Shot Road on the west side of Hatcher Pass. The ARC erected a 100-foot Howe fir truss bridge at Willow Creek (Figure 110) in 1934. The Lucky

Shot Mine Company paid for part of the cost of the bridge (AHRS No. ANC-490), which is still standing but not used for automobile traffic (ARC 1932:35; Hesse 1935: 10, 31; Buzzell 2003a: 43-44).

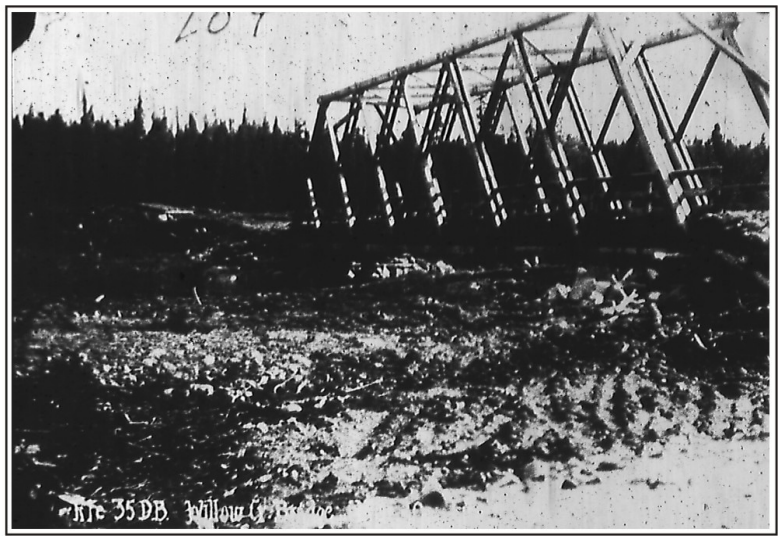

Figure 110. Howe timber truss bridge at Willow Creek on the Willow Station-Lucky Shot Road, 1934. U.S. Alaska Road Commission Collection, PCA 61-9-104, Alaska State Library.

Natural disasters took a toll on bridges during the 1930s. Flooding on Big Minook Creek at Mile 13 of the Rampart-Eureka Road in 1932 destroyed a 48-foot timber truss span that had been built the year before. The ARC built a new 60-foot timber truss span to replace the one taken out in the flood (ARC 1932:31; Hesse 1933:64). During spring breakup in 1933, one of the three 100-foot Howe timber truss spans on the Gulkana River at Mile 128 on the Richardson Highway was carried away by ice and ended up on a bar 1.5 miles downstream. ARC crews salvaged materials from the wrecked span to build a new pier for the replacement span (Shipp 1933; Shepard 1933; Naske 1986:158). In 1934, flooding destroyed the Jack Wade Bridge in the Fortymile Mining District and the Sutton-Chickaloon King River pony truss bridge (Figure 111), and heavily damaged the Chistochina River pile trestle bridge (Hesse 1937:46). The ARC replaced or repaired each of those structures. A year later, a 60-foot timber truss span washed out on the road to the Seward Cemetery.

Figure 111. Damage to the Sutton-Chickaloon King River Bridge, a railroad bridge converted for automobiles, after flooding, September 4, 1934. U.S. Alaska Road Commission Collection, PCA 61-11-265, Alaska State Library.

The span was replaced with two pile spans. The Big Brother Bridge on the Haines-Pleasant Camp Road washed out in 1938, prompting the ARC to make temporary repairs (Edna, Hudson and Johnson 1960:79; Hesse 1937:43; Hess 1939:15).

ARC employees who oversaw construction in the 1930s used standardized bridge plans and adapted those plans to conditions in the field. Limited funding and a shortage of trained personnel prevented the ARC from specialization in engineering in the 1930s. Road building agencies in the States during the same period were moving toward professionalism in the field of engineering and required engineers to be licensed as professional engineers. Engineers became more specialized and some focused on bridge design and construction (Potter and Puschendorf 1999:46). ARC headquarters in Juneau during the Depression era consisted of a chief engineer, an assistant engineer, a locating engineer, a master mechanic, a draftsman and clerical staff. The five district offices were run by a supervisor who oversaw seasonal construction and maintenance staff (ARC 1933:7; ARC 1937:5; ARC 1939:5; ARC 1941:5; ARC 1942:5). ARC crews built most of the agency's bridges during the 1930s. Construction of only a few bridges were contracted out, the most important of which were the Gastineau Channel and Eklutna River bridges (Soberg 1991: 22-23).

Ike Taylor was the chief engineer for the ARC from 1932 to 1948. A.F. "Gil" Ghig-lione (Figure 112), the assistant engineer, created standard bridge drawings in the early 1930s. He also supervised construction of many of the steel truss bridges built during the Depression years, including the steel arch at Eklutna River, and the truss bridges at the Knik and Nizina rivers, and Moose, Peters, and Croto creeks (Naske 1983:380-381; Soberg 1991:18, 22-23, 31-33, 55). In 1935, the ARC hired its first bridge engineer, O.H. Stratton. Stratton had previously worked for the Wallace Bridge and Structural Steel Company designing bridges. From 1935 through 1943, Stratton designed standard steel pony and thru truss bridges for the ARC. He was also was responsible for identifying and adopting standards used by the States for bridge design and construction in Alaska.

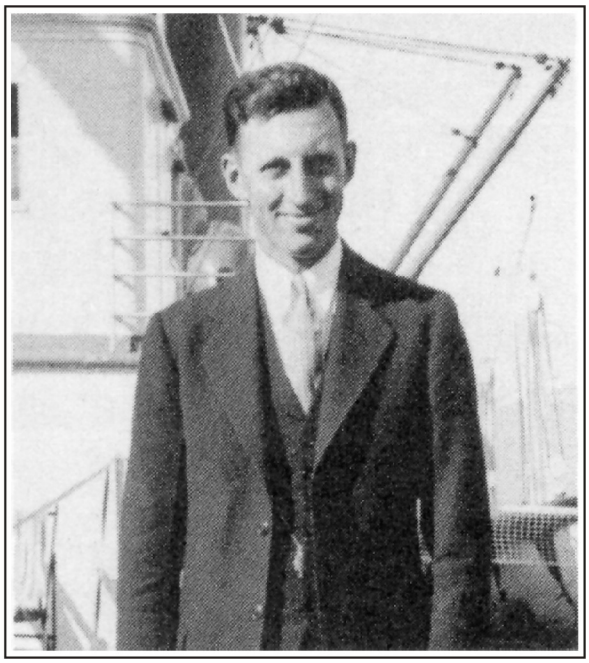

Figure 112. A.F. "Gil" Ghiglione, 1930s. Photo reprinted from Soberg 1991:119.

Bridges Built by the BPR During the 1930s

Professional engineers designed the bridges built on national forest highways in Alaska during the 1930s. Engineers in the San Francisco office of BPR designed the bridges, which were erected in Alaska by BPR crews or contractors. Most BPR bridges built during the Depression were timber stringer bridges such, as the Bird Creek Bridge on the Wrangell Highway in 1930 (Figure 113), or timber trestle bridges, such as the Donaldson Creek Bridge on the Moose Pass-Hope Road in 1939.

Figure 113. A timber stringer bridge at Bird Creek on the Wrangell Highway, August 10, 1930. U.S. Alaska Road Commission Collection, PCA 61-59-143, Alaska State Library.

In the late 1930s, the BPR began using treated timber for the main structural elements on stringer bridges. An example, the Trollers Creek Bridge (Bridge No. 864), on Knudson Cove Road north of Ketchikan, was designed in 1937 and constructed in 1938. The structure is the oldest BPR treated timber stringer bridge still in use by automobiles in Alaska. The BPR built a treated timber stringer bridge at Peterson Creek (Bridge No. 383), 20 miles north of Juneau in 1940. The BPR also built timber pony and Howe through truss bridges, such as the pony span at the Kenai River (Figure 114).

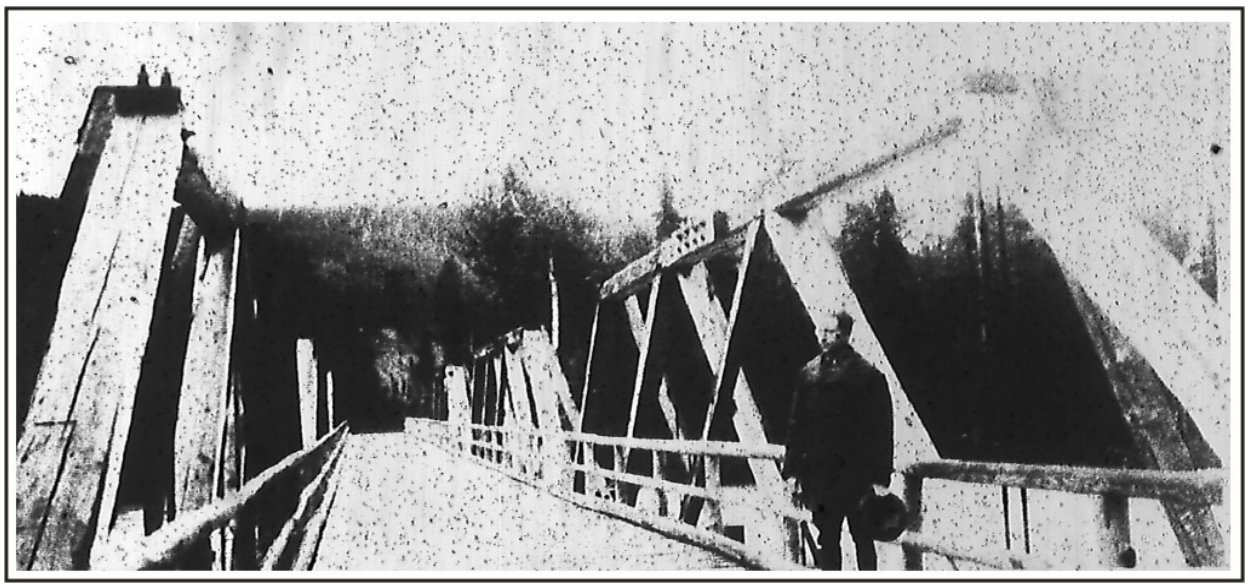

Figure 114. The BPR timber pony bridge over the Kenai River, 1930. U.S. Alaska Road Commission Collection, PCA 16-10-384, Alaska State Library.

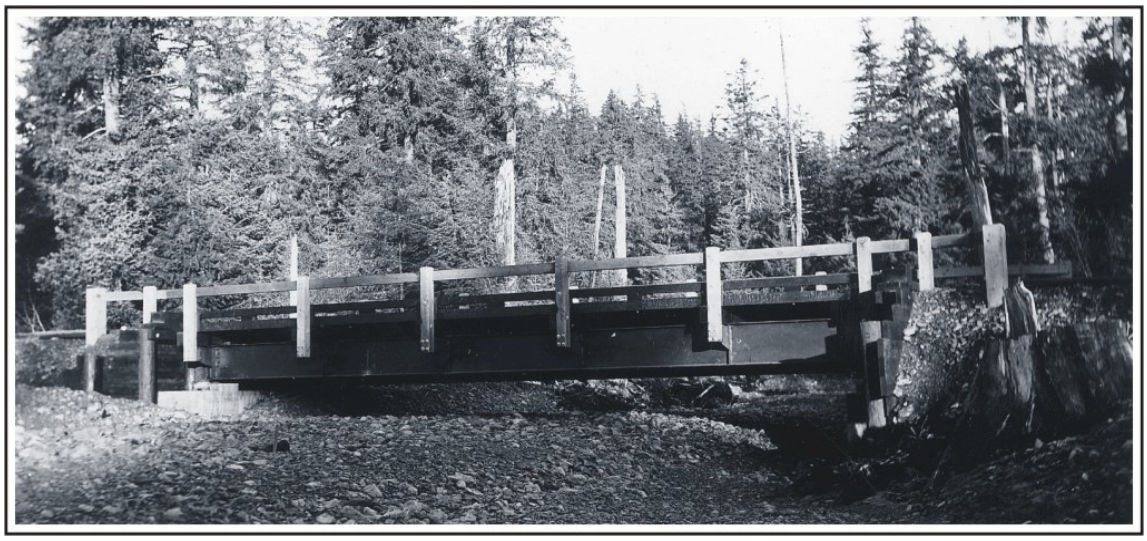

Figure 115. The steel I-beam bridge at Heney Creek on Point Whiteshed Road at Cordova, 1937. U.S. Alaska Road Commission Collection, PCA 61-54-151, Alaska State Library.

The BPR began building steel stringer and girder bridges in the 1930s as replacements for medium length and long timber bridges. Crews erected single span steel stringer bridges at Whipple Creek on Knudson Cove Road north of Ketchikan in 1934; at Cascade Creek (Bridge 867) on Halibut Point Road near Sitka in 1935; at Heney Creek (Bridge No. 844, Figure 115) and Eccles Creek on Point Whiteshed Road near Cordova in 1936; at Hydaburg Creek near Hydaburg in 1935; and at Victor, Pass and Frenchy creeks on the Seward Highway in 1938 (ADOH 1972:32, 36). The BPR built steel girder bridges at Cannery Creek on the North Tongass Highway and at Falls Creek and Trail River (Figure 116) on the Seward Highway in the late 1930s.

Figure 116.The Trail River steel girder bridge,1936. Photograph by G. M. Williams U.S. Alaska Road Commission Collection, PCA 61-43-33, Alaska State Library.

Figure 117. The two span camelback steel truss bridge at Resurrection Creek on the Seward Highway, 1935. U.S. Alaska Road Commission Collection, PCA 61-10-419, Alaska State Library.

The BPR built three steel through truss bridges in the 1930s. The first was a Parker truss bridge, consisting of two 120-foot spans, that replaced a three span Howe timber truss at lower Mendenhall River on the Glacier Highway, 10 miles north of Juneau. The BPR erected a two span steel camelback truss at Resurrection River (Figure 117) on the Seward Highway that replaced a pile trestle bridge and a single span camelback truss bridge at Salmon River on the Texas Highway near Hydaburg. The BPR contracted with Alfred Dishaw and Son to build a bridge at Lawson Creek (Bridge No. 788) on the Douglas Highway (Figure 118). Completed in 1935, the Lawson Creek Bridge was the first continuous steel girder automobile bridge in Alaska. It is still in use.

Figure 118. Erecting steel on the Lawson Creek steel stringer continuous bridge on the Douglas Highway, 1935. U.S. Alaska Road Commission Collection, PCA 61-38-62, Alaska State Library.

Figure 119. A BPR crew building a timber box culvert on the Wrangell Highway, 1939. Photo by Mr. Cohn. U.S. Alaska Road Commission Collection, PCA 61-59-33, Alaska State Library.

The BPR replaced wooden culverts with metal culverts at stream crossings during the 1930s and installed metal culverts on new roads. In a few instances, BPR crews built timber box culverts, including one on the North Douglas Highway in 1934 and another on the Wrangell Highway in 1939 (Figure 119). The BPR also experimented in the late 1930s with concrete rigid frame bridges, which were popular in the States for short water crossings. BPR engineers designed and built a number of them in the 1930s, 1940s and early 1950s. They built two on the Seward Highway in 1937, at Station 106 at Mile 8.4 (Figure 120) and at Grouse Creek at Mile 8.6. Grouse Creek No. 2 Bridge (Bridge

Figure 120. Workers finishing forms for the concrete deck slab on Bridge Station 106 at Mile 8.4 of the Seward Highway, October 1937. Photograph by F.E. Swartz, U.S. Alaska Road Commission Collection, PCA 61-66-43, Alaska State Library.

Figure 121. The Forks Creek Bridge at Mile 7 of the South Tongass Highway, 1938. U.S. Alaska Road Commission Collection, PCA 61-49-42, Alaska State Library.

No. 4003) is the oldest rigid frame concrete bridge built for automobiles in Alaska that is still in use. The BPR built a third rigid frame concrete bridge in 1938 at Forks Creek (Bridge No. 4031) on the South Tongass Highway (Figure 121). The Forks Creek Bridge was still in use in 2006.

Basin Road, which extended from Juneau up Gold Creek to the mines at Silver Bow Basin, was a spur of the Glacier Highway in the 1920s and 1930s. Miners built the first trail to Last Chance and Silver Bow basins in the early 1880s and widened it to a wagon road in 1889. They widened Basin Road to accommodate trucks in 1912 and built a 400-foot, one-lane timber trestle at the lower end of the road (Boily 2004:9, 12-13). The BPR took over maintenance of the first mile of Basin Road in the 1920s and rebuilt the trestle in 1925. During 1936, the BPR rebuilt the Basin Road Trestle (Bridge No. 948), widening it two lanes (Figure 122).

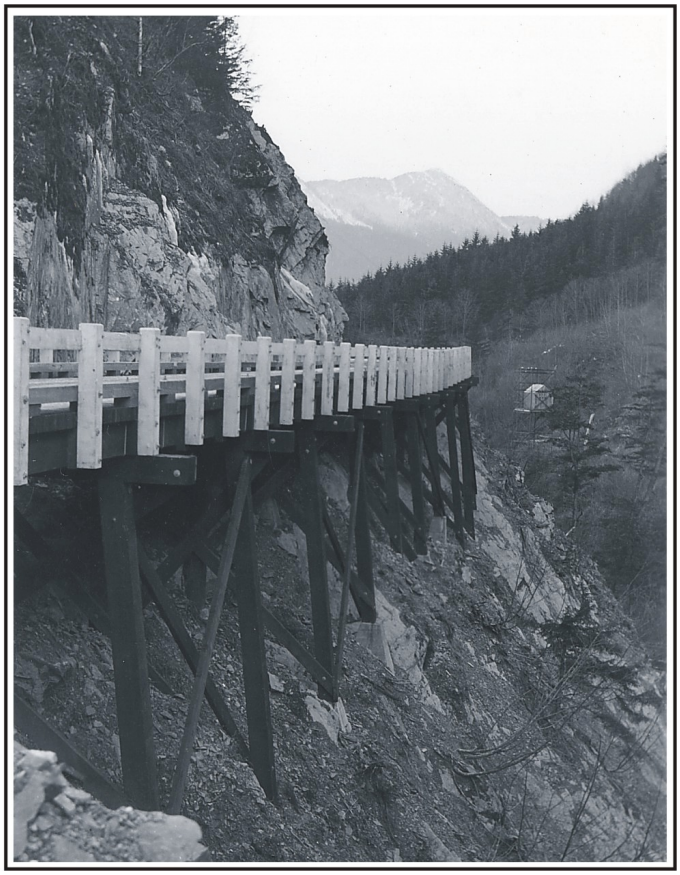

Figure 122. Basin Road Trestle, December 4, 1936. Photo by C.F. Wyler, U.S. Alaska Road Commission Collection, PCA 61-85-17, Alaska State Library.

Figure 123. The steel girder bridge at Gold Creek, Mile 0.2 of Basin Road, December 4, 1936. Photo by Mr. Gerwels, U.S. Alaska Road Commission Collection, PCA 61-85-2, Alaska State Library.

Basin Road crossed Gold Creek 0.2 miles from the start of the road. A timber queen post truss bridge spanned Gold Creek in the 1910s and early 1920s. The BPR built a timber pony truss bridge at Gold Creek in 1926. Contractor R.J. Summers erected a single span steel girder bridge (Figure 123) at Gold Creek (Bridge No. 949) on Basin Road for the BPR during August 1938 (*Daily Alaska Empire* August 5, 1938:3).

WPA funded Bridge Projects

The Great Depression put millions out of work and devastated the U.S. economy in the early 1930s. New Deal legislation funded a number of relief programs that benefitted the nation's road system. The Federal Emergency Relief and Construction Act of 1932 distributed millions of dollars, about half of which was used for roads. The federal government required states to match part of the funds, but that provision was later rescinded (Potter and Puschendorf 1999:44). Several Alaskan towns applied for Congressional economic recovery funds to build bridges during the 1930s. The most visible bridge project was the Gastineau Channel Bridge, which had been sought by both Juneau and Douglas. The funding for the project went to the ARC which oversaw construction of the bridge.

The Works Progress Administration (WPA) was the largest source of federal emergency relief funding for projects in Alaska during the 1930s. The WPA built four concrete bridges for the City

of Juneau. During 1934, contractors for the WPA built concrete bridges at Gold Creek on Willoughby Avenue (Bridge No. 315) and at Gold Creek on Ninth Street (Bridge No. 314, Figure 124), replacing timber trestle bridges built in the 1920s. About the same time, another WPA project established a definite channel from the mouth of Gold Creek to the Calhoun Avenue Bridge and lined the channel with cemented rubble and riprap (Hewitt 1949:13-14). The Willoughby Avenue and Ninth Street bridges are the oldest concrete girder bridges still in use by automobiles in Alaska. The City of Juneau obtained a WPA loan to build a third concrete bridge (Bridge No. 1069) to replace a queen post timber truss bridge at Gold Creek and Calhoun Avenue. The city contracted with Eikland and Kinney in December 1934 to construct the three span concrete girder bridge, which was completed in May 1935. The Alaska Emergency Relief Corporation began building bulkheads bordering the creek above the bridge for flood control in early 1935. When that agency halted work, the City of Juneau hired workers to finish the bulkheads (*Daily Alaska Empire*, December 11 and 31, 1934 and May 10, 1935).

Figure 124. The concrete girder bridge under construction at Gold Creek on Ninth Street in Juneau, 1934. U.S. Alaska Road Commission Collection, PCA 61-14-130, Alaska State Library.

The fourth concrete bridge built for the City of Juneau was the Calhoun Viaduct (Bridge No. 1068), the oldest concrete girder continuous bridge built for automobiles in Alaska and still in use. Construction of the multiple span structure (Figure 125) was overseen by the city using WPA funds. The city solicited bids to build the concrete viaduct in December 1934 (*Daily Alaska Empire*, December 28, 1934), and construction was completed in 1935. The viaduct replaced a timber trestle

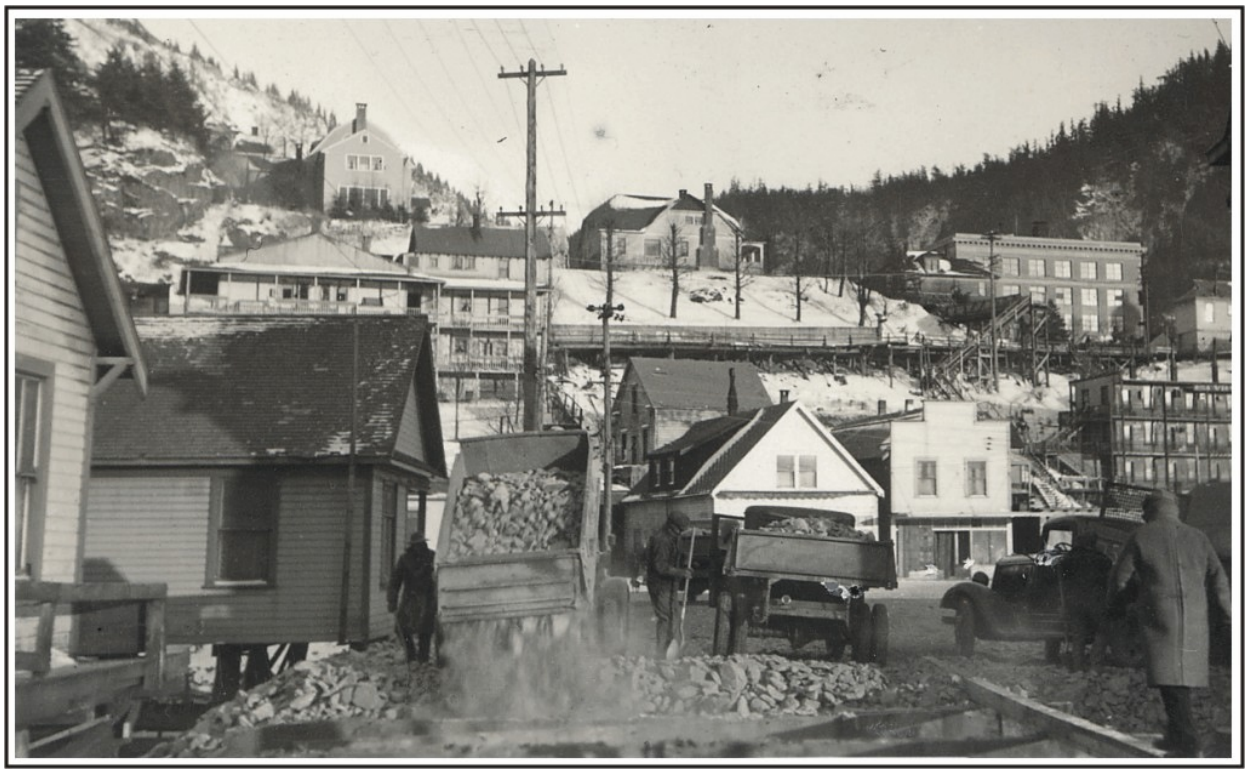

Figure 125. The Calhoun Viaduct (center, running along the hillside), 1930s. U.S. Alaska Road Commission Collection, PCA 61-14-151, Alaska State Library.

viaduct that had extended Calhoun Avenue south from the residential area near the Governor's Mansion, along a steep side slope to the business district in downtown Juneau (*Daily Alaska Empire*, December 13, 1932).

The Civilian Conservation Corps (CCC) program was another source of federal relief funding that was used to build bridges in Alaska during the 1930s. CCC projects were labor intensive and designed to provide temporary employment to as many people as possible. Most CCC work in Alaska's national forests focused on transportation improvements. Workers employed through the CCC program helped the U.S. Forest Service convert a dog sled trail between Moose Pass to Cooper Landing into the Copper Landing Truck Trail in 1937. The project included construction of timber trestle bridges at Mud Lake, Quartz Creek, and Lost Creek, and a timber pony truss bridge across the Kenai River at the outlet of Kenai Lake. CCC crews also built bridges in the Tongass National Forest (Buzzell 1986:II-27; Otis et al. 1986:67-68). The CCC also built several foot bridges on the Kenai Peninsula, including a 50-foot timber piling bridge at the Ninilchik River and a 35-foot timber span with 40 feet of approach at a creek on Seldovia's Sawmill Road (Hesse 1939:45).

VII. BRIDGE CONSTRUCTION DURING WORLD WAR II, 1941-1945

The United States entry into the Second World War had a profound impact on bridge building in the States and in Alaska. The onset of WWII brought highway construction plans in the States to an abrupt halt as funds and construction materials, particularly steel, were diverted to the war effort. In Alaska, the needs of national defense forced the ARC to abruptly change its priorities. The ARC shifted away from its traditional goals--connecting roads to water and rail ports and building pioneer roads--to building new roads and improving existing roads that linked military bases with major population centers. The military buildup in Alaska belied the nation-wide trend of building fewer roads and bridges. The U.S. Army built the Alaska and Tok Cutoff highways, and pressed the ARC to build the Glenn Highway and upgrade roads deemed necessary for defense needs. Wartime construction brought higher traffic volumes and loads, resulting in construction standards for heavier bridges on main feeder roads. Several new road and bridge building agencies entered the Alaskan scene during the war years as the U.S. military rushed to prepare for the defense of the territory.

ARC Bridge Building During the War

During the war years, the ARC continued to build bridges of native timber, imported Douglas fir and steel, depending on the importance of each bridge (ARC 1941:6; ARC 1942:6: ARC 1943:6; ARC 1944:6; ARC 1945:6). Most bridges were built with timber, but the proportion of steel bridges increased during 1943-1944 (Table 3).The ARC built bridges 14 feet wide until 1944 when it adopted

Table 3. New ARC Bridge Construction by Bridge Types and Materials, 1941-1945.

* = 60 ft or longer		Timber Trestle	Steel	Steel Through	Steel Pony	Suspension
Year		Bridges	I-beam	Truss	Truss	Bridges
1941	Number	Unknown	–	5	2	1
	Linear Ft.	1,386	–	726	108	350
1942	Number	Unknown	2	7	1	–
	Linear Ft.	579	108	1,888*	128	
1943	Number.	Unknown	2	10	4	–
	Linear Ft.	884	Unknown	2,634	380	
1944	Number	Unknown	1	3	1	1
	Linear Ft.	315	Unknown	800	100	324
1945	Number	Unknown	1	–	–	–
	Linear Ft.	1,076	Unknown	–	–	–

(Sources: ARC 1941:7-8; ARC 1942:6-7; ARC 1943:7-8; ARC 1944:7; ARC 1945:7-8; ARC 1952a:6-9, 12-15, 21, 24, 48, 51-52; Soberg 1991:78)

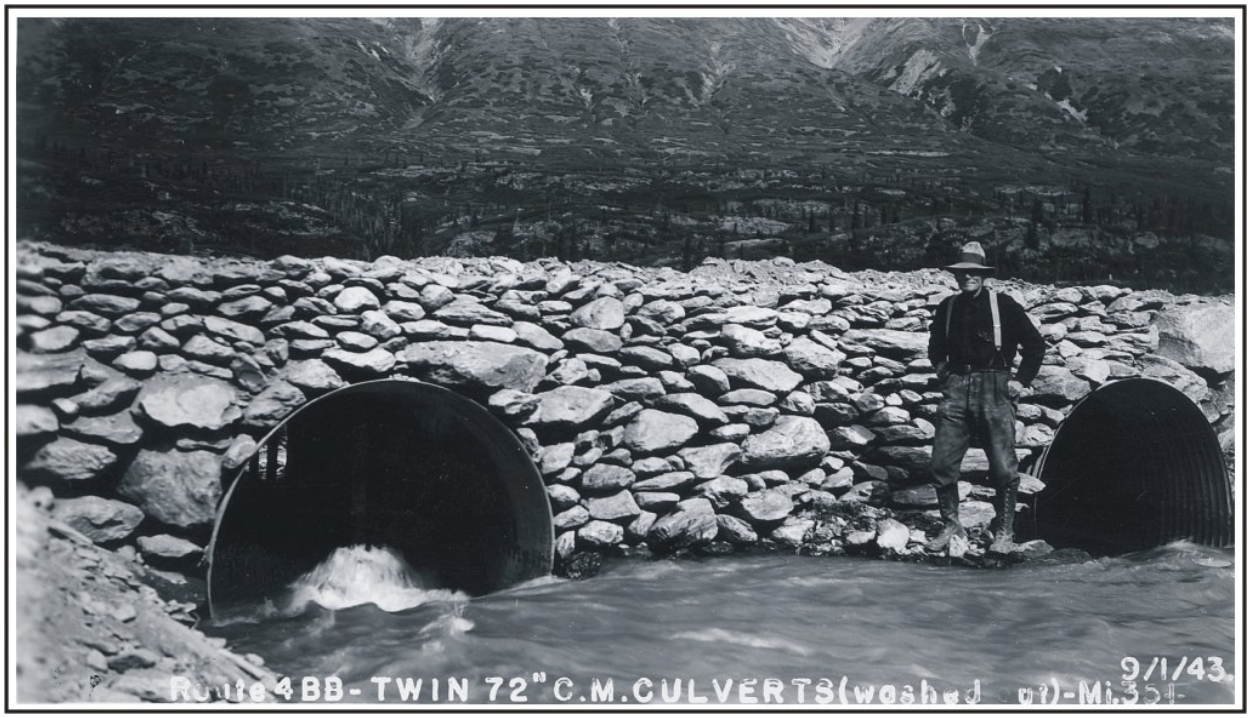

Figure 126. Twin corrugated metal culverts at Mile 354 of the Richardson Highway, September 1, 1943. U.S. Alaska Road Commission Collection, PCA 61-21-177, Alaska State Library.

a 20-foot standard for the width of bridges on main roads and highways. The ARC was forced to limit much of its work around the territory to emergency construction and maintenance. A shortage of steel caused the ARC to revert to constructing timber trestles in some cases where it would have preferred to build steel structures. ARC crews continued to replace culverts made of native timber with metal culverts (Figure 126) and to install metal culverts when building new roads (ARC 1941:6; ARC 1942:6; ARC 1943:6; ARC 1944:6; ARC 1945:6). The ARC installed 528 metal culverts during 1941 and 499 metal culverts in 1942, most of them replacing wooden culverts (ARC 1941:8; ARC 1942:7). ARC crews also built a few timber box culverts, including one at Mile 27 of the Richardson Highway (U.S. Alaska Road Commission Collection, PCA 61-21-155). The ARC operated during the war years with a core staff at its Juneau headquarters consisting of a chief engineer, an assistant engineer, a chief clerk and a few assistants (ARC 1941:5; ARC 1943:5; ARC 1945:5). The agency recruited hundreds of seasonal construction workers to meet wartime construction needs.

During the war, much of the ARC's resources focused on building a new highway from Palmer to Glennallen and upgrading the Richardson Highway to meet military standards. The draft and enlistments cut into the ranks of experienced ARC workers. Ghiglione, a reserve naval officer, was called up and left Alaska for the duration of the war. The draft took supervisors and construction workers with bridge building experience, leaving the ARC with only two experienced bridge men in early 1942. Some of the Glenn and Richardson highway steel truss bridges were designed by U.S. Public Roads Administration (PRA) engineers in Washington, D.C. The design engineer on one of the bridges visited Alaska to observe and assist with erection of the bridge (Soberg 1991:66, 78).

In 1941, the ARC received a million dollar appropriation from Congress, endorsed by the War Department, to construct a highway linking Anchorage and Palmer with the Richardson Highway. The ARC began constructing the Glenn Highway in June 1941. One crew started at Moose Creek north of Palmer, another crew started in Glennallen, and they worked towards each other. Between Sutton and the old railroad bridge (Figure 127) at Chickaloon River, the crews converted an old railbed into a road. The rest of the route followed parts of the trail blazed by Castner in 1898 that became a pack trail during the Nelchina gold rush in the early 1900s. The ARC spent four years building the Glenn Highway. Up to 600 men were employed at one time working in three shifts round the clock during long summer days. Bridge crews worked during the winters installing footings and spans while creeks and rivers were low or frozen (Bauer 1987:7, 9-10).

Figure 127. Old Chickaloon railroad bridge, 1941. Russell Dow Collection, HMC-0396-14-1-993, Archives and Manuscript Department, University of Alaska Anchorage.

ARC crews built eight timber trestle bridges on the Glenn Highway in 1941 and five timber trestle and seven steel bridges on the route in 1942 (ARC 1942:6; ARC 1952a:12-15). Five of the steel bridges were through truss bridges, including a 206-foot camelback span at King River, a 206-foot camelback span at Chickaloon River, a 184-foot Parker span at Caribou Creek, a 150-foot Pratt span at Little Nelchina River (Figure 128), and a 150-foot Pratt span at Moose Creek. In addition,

Figure 128. The steel Pratt truss bridge at Little Nelchina River, September 1, 1943. U.S. Alaska Road Commission Collection, PCA 61-22-188, Alaska State Library.

the ARC built a 128-foot steel pony truss at Hicks Creek in 1942 (ARC 1952a:12-15). After the steel bridges were completed, the Glenn Highway was opened for traffic on November 5, 1942 (ARC 1943:7). The road remained primitive and crews continued to improve it for another two years. The ARC built one new bridge on the Glenn Highway in 1943, a 154-foot steel Pratt truss at Granite Creek. Crews constructed five timber bridges in 1944, including a timber trestle bridge at a glacial fan at Mile 114 (ARC 1952a:12-15). Construction on the Glenn Highway was completed in 1945, the year the war ended (Bauer 1987:10).

The other major ARC wartime project was improving the Richardson Highway by widening the roadbed and building replacement bridges that met military standards (ARC 1941:9). The ARC built 12 new steel bridges on the Richardson Highway during 1942-1943. They included a steel arch span at Bear Creek (Figure 129), a 180-foot camelback truss span at Sheep Creek, 100-foot pony

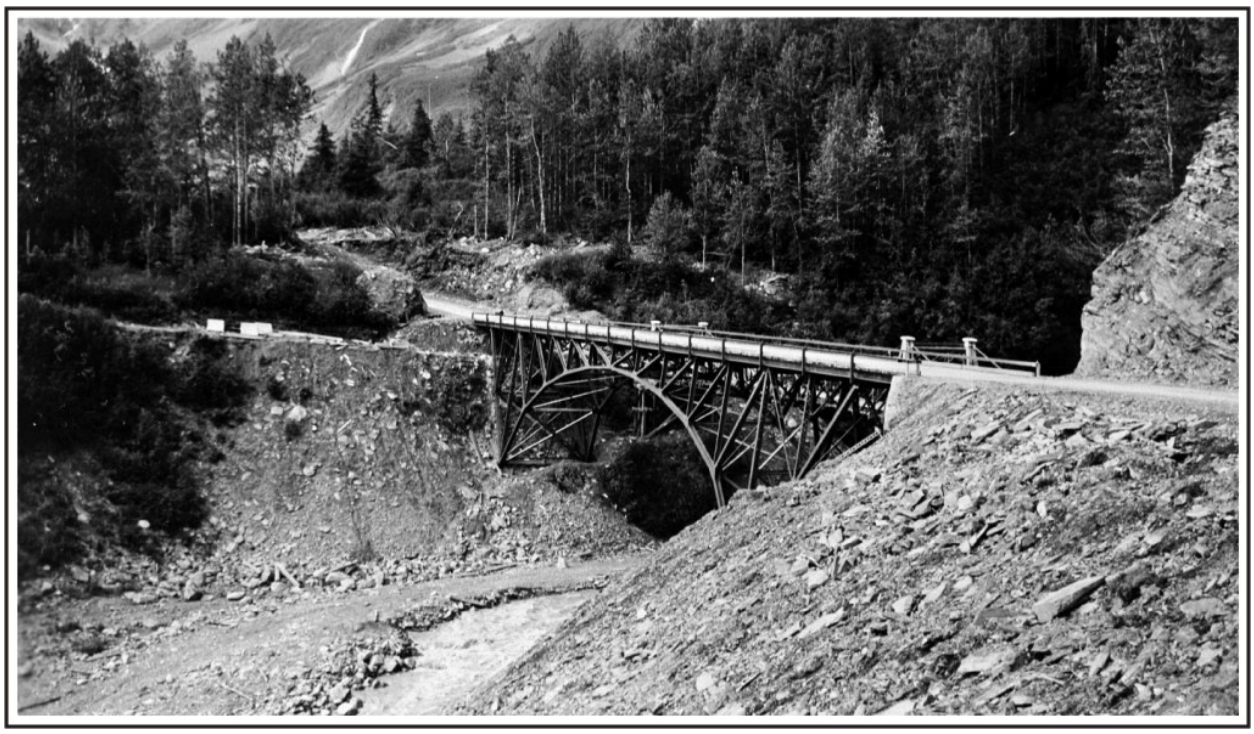

Figure 129. The steel arch bridge at Bear Creek on the Richardson Highway, September 1, 1943. U.S. Alaska Road Commission Collection, PCA 61-21-97, Alaska State Library.

truss spans at Tsaina River and Stewart Creek (ARC 1943:7; ARC 1952a:6), a 200-foot camelback truss span at the Tonsina River (Figure 130), a 200-foot camelback truss span at the Klutina River, a 300-foot steel Parker truss span with a 100-foot steel pony truss and 40 feet of wood trestle at the Tazlina River, a 300-foot Pennsylvania truss span at the Gulkana River, a 150-foot Parker truss span at Lower Miller Creek, a 180-foot camelback truss span at Upper Miller Creek, a 150-foot Pratt truss span at Jarvis Creek, a cantilevered subdivided Warren truss with two 300-foot spans at the Tanana River at Big Delta, a camelback truss with two 200-foot spans at Salchaket River, and an 80-foot steel pony truss span (Figure 131) at Phelan Creek (ARC 1952a:6-9; Soberg 1991:78). The bridge

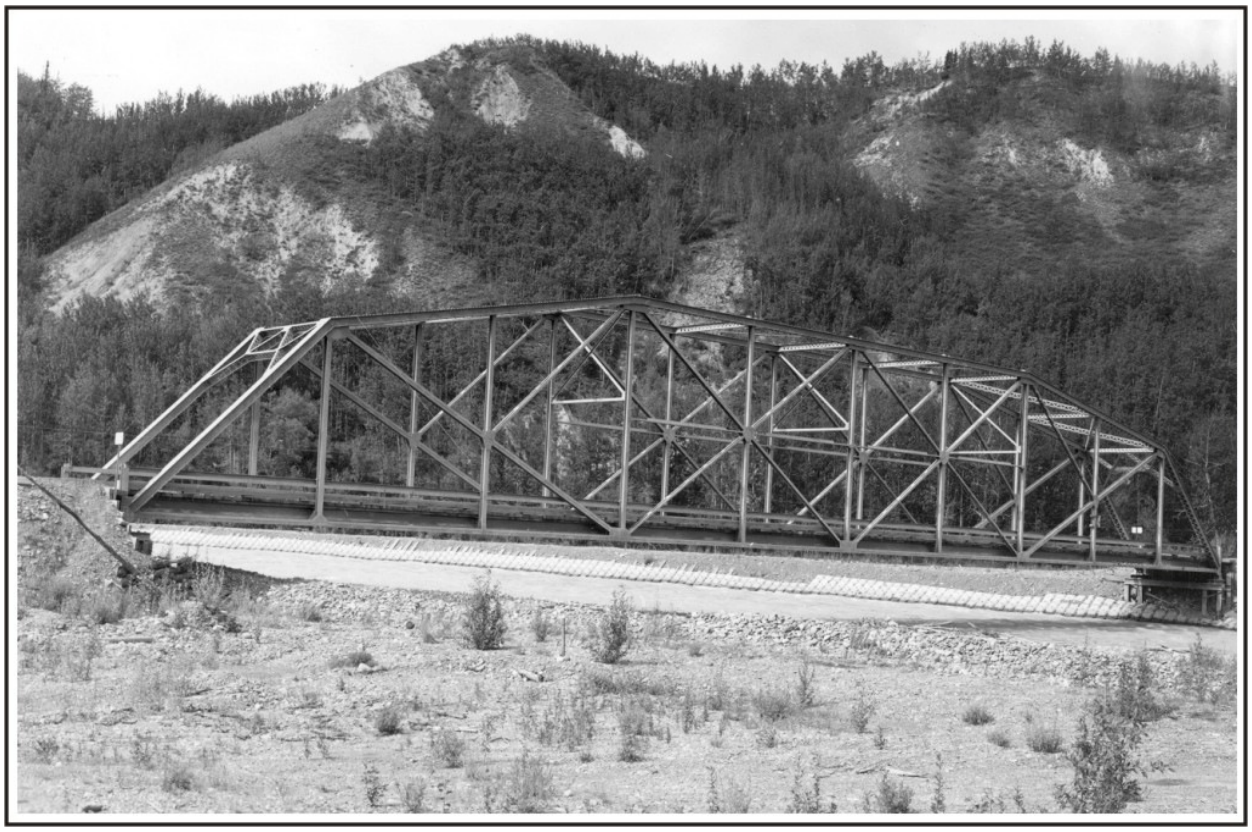

Figure 130. The steel camelback truss bridge built in 1942-1943 at Tonsina River on the Richardson Highway. Photo courtesy of ADOT&PF Bridge Section, Juneau.

Figure 131. Steel pony truss bridge erected at Phelan Creek on the Richardson Highway in 1943. Photo by L.D. Bruesch, August 1958, courtesy of ADOT&PF Bridge Design Section, Juneau.

at Big Delta replaced the last ferry on the Richardson Highway (ARC 1943:7). The U.S. Army decided that the ARC was not making enough progress on the bridge, so the military hired a civilian contractor to build a timber trestle bridge two miles above the steel bridge construction site. The military moved troops over the trestle to Fairbanks, but ice in the spring of 1943 destroyed the trestle bridge (Soberg 1991:73-75). During 1944, the ARC built a 150-foot steel pony truss bridge at Shaw Creek, two 250-foot steel camelback truss spans at the Salcha River, a 150-foot steel Pratt truss span at Mile 222, and a 150-foot steel Pratt truss span at Castner Creek (ARC 1944:7; ARC 1952a:6-8). In 1945, standard trestle bridges were built at Miles 3, 32 and 35.5 of the Richardson Highway. The ARC also built a temporary 134-foot trestle bridge in Keystone Canyon and a 320-foot combination steel girder and wood trestle bridge (Figure 132) at the upper crossing of the Lowe River (ARC

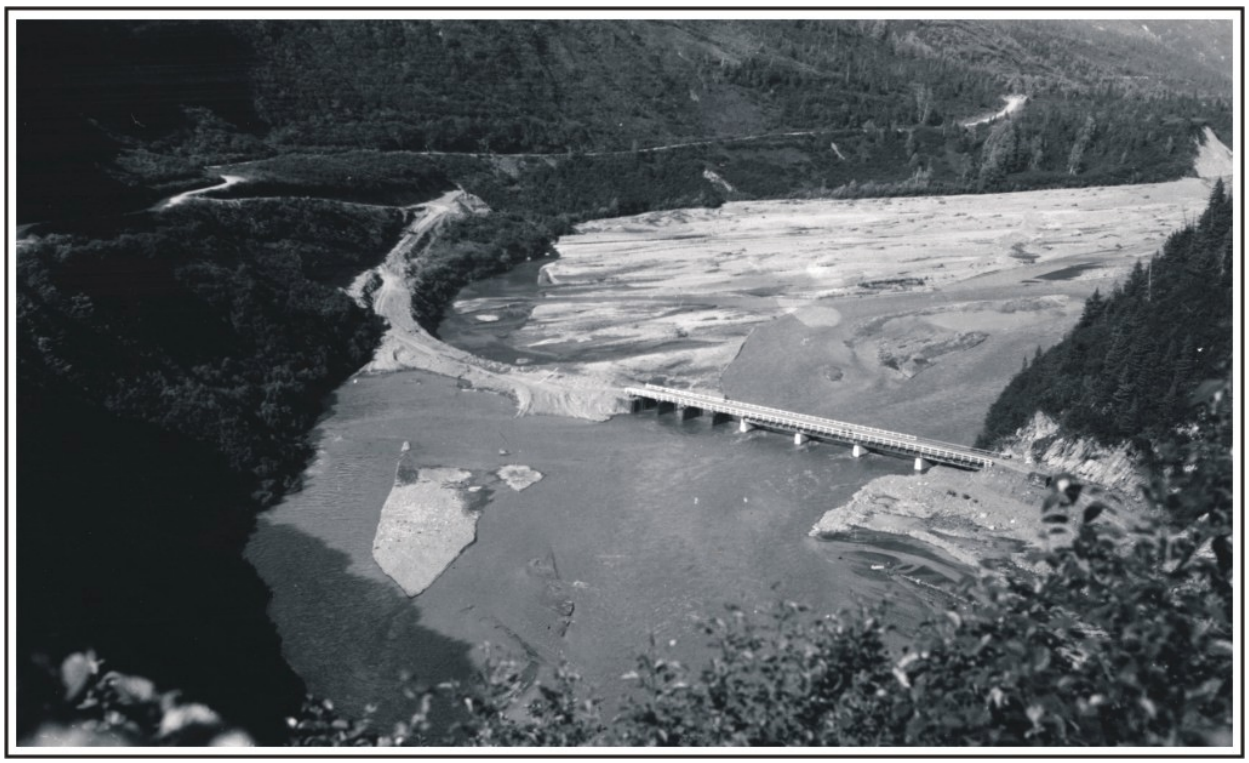

Figure 132. The steel girder bridge on the upper crossing of Lowe River on the Richardson Highway, July 1945. U.S. Alaska Road Commission Collection, PCA 61-21-102, Alaska State Library.

1945:7). The ARC also built timber trestle bridges on the Richardson Highway during the war. One of those timber trestle bridges replaced an "A" truss bridge at Ptarmigan Creek (Figure 133).

During the war, the ARC sought to balance its traditional responsibilities with the new initiatives that the U.S. Army forced on the ARC. The ARC had placed orders for steel fabrication for five bridges in late 1940, and the agency proceeded with those projects during 1941. The ARC erected an 182-foot steel camelback truss bridge at the Kougarok River (Figure 134), a 108-foot steel pony truss at North Fork and two bridges on the Bunker Hill-Kougarok Road. The ARC built two

Figure 133. The new timber trestle bridge and the old "A" truss bridge at Ptarmigan Drop at Mile 32 of the Richardson Highway, August 25, 1944. U.S. Alaska Road Commission Collection, PCA 61-21-139, Alaska State Library.

Figure 134. Camelback truss bridge at Kougarok River, September 30, 1941. U.S. Alaska Road Commission Collection, PCA 61-141-16, Alaska State Library.

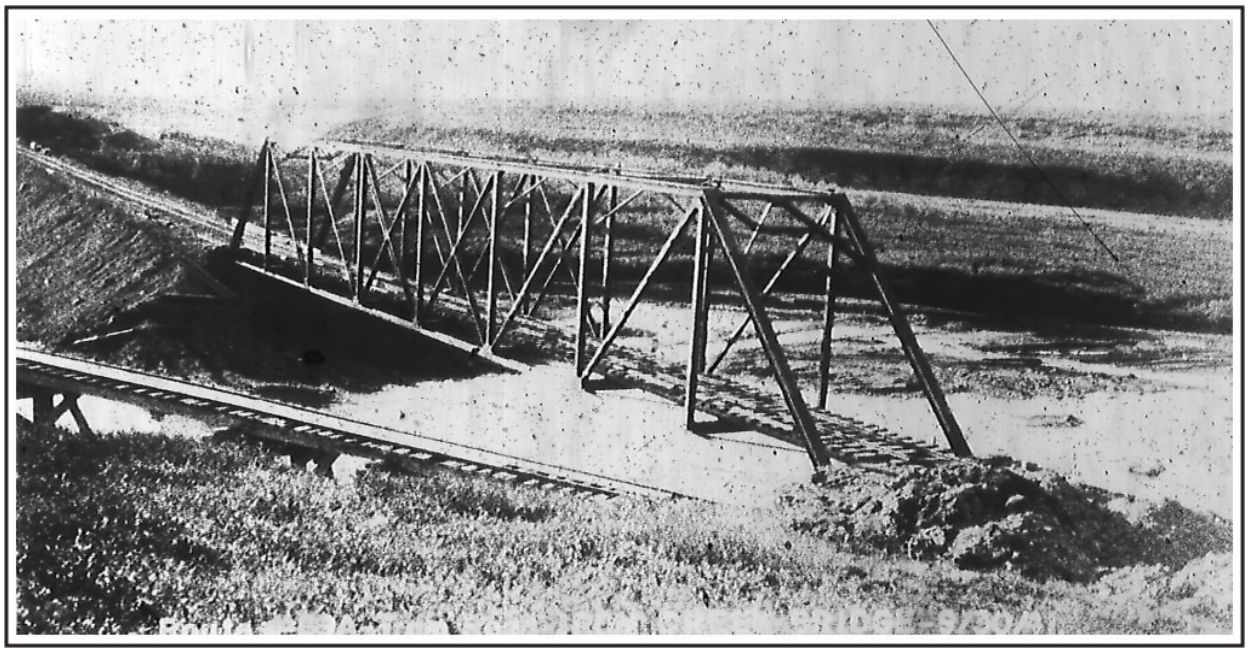

Figure 135. Steel Pratt truss bridge at Iron Creek on the Seward Peninsula Tramway, 1941, U.S. Alaska Road Commission Collection, PCA 61-8-224, Alaska State Library.

steel truss bridges on the Seward-Peninsula Tramway in 1941, a 152-foot Pratt truss span at Iron Creek (Figure 135) and a 62-foot pony truss at Sherrette Creek (ARC 1942:7; ARC 1952a:48, 52).

ARC crews in 1941 also erected an 80-foot steel pony truss bridge at the Little Susitna River on Fishhook Junction-Willow Road (ARC 1952a:24) and a 255-foot steel Pennsylvania truss bridge across the Takotna River (Bridge No. 463) on the Kuskokwim Landing-Ophir Road (Soberg 1991:58-59). The latter was the last bridge completed in a road started in the 1930s linking the Kuskokwim River with the mines in the Ophir area. During 1944, the ARC built a 324-foot pedestrian suspension bridge at Mile 1.0 of the Submarine-Paystreak Road and a 100-foot steel pony truss bridge at the Snake River at Mile 1.3 (ARC 1952a:51). Flooding in September 1945 washed out the camelback steel truss bridge at Sheep Creek (Figure 136). An ARC crew salvaged the span and reinstalled it later that year.

Figure 136. Sheep Creek Bridge, September 1945. Photo courtesy ADOT&PF Bridge Section, Juneau.

National Defense Intensifies Bridge Construction

American entry into World War II after the Japanese bombing of Pearl Harbor on December 7, 1941, brought the U.S. Army into bridge building in Alaska with construction of the Alaska and Tok Cutoff highways. The U.S. Army Corps of Engineers, with assistance from the U.S. Public Roads Administration (PRA), built the Alaska and Tok Cutoff highways using military personnel and private contractors in seven and a half months. American troops arrived at Dawson Creek in eastern British Columbia on March 9th and began construction of the Alaska Highway[1] while the ground was still frozen. Stretches of the route were located, surveyed and blazed. Clearing crews, using D-8 tractors with bulldozers, cut a corridor through brush and woods. Working round the clock, crews cleared three to four miles per day. Culverts were laid next, then ditches were dug, a finish grade added, and temporary bridges constructed. The Army used seven engineering regiments, consisting of 10,000 officers and soldiers drawn from the States. Three of the regiments--the 93rd, 95th and 97th Engineering--were black troops with no experience in the north. Contractors hired by the PRA followed the engineering troops, correcting the alignment and grade, and constructing culverts and bridges. Crews worked in challenging conditions, including hot, wet, and buggy weather in the summer and bone-chilling cold in the winter. The climate and terrain challenged the men and their equipment (Woodward 1997:190-192, 199-200).

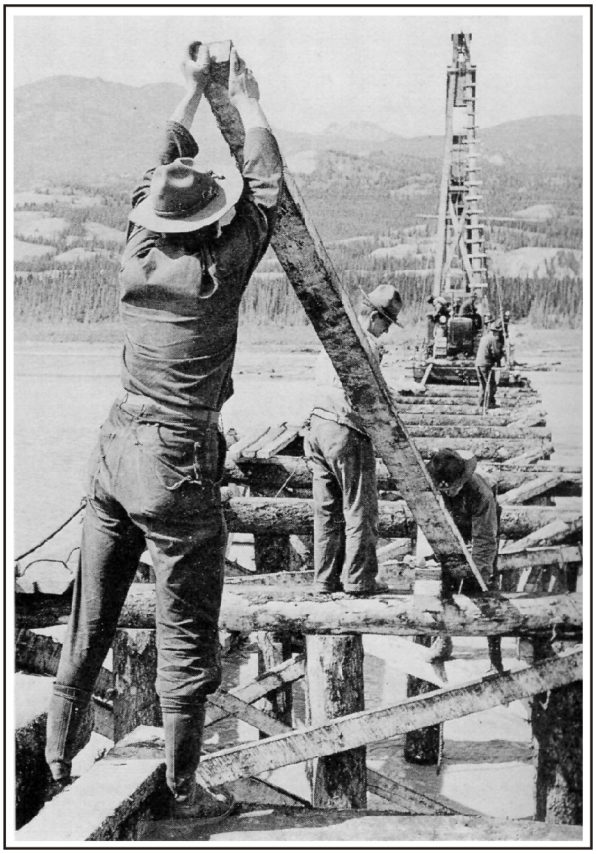

Figure 137. Army engineers building a timber trestle, Alaska Highway, 1942. U.S. Army photo, reprinted from Woodman 1997:196.

The 97th Engineering Regiment arrived in Valdez in May 1942 and proceeded up the Richardson Highway to Gulkana where they established their headquarters. The regiment widened the 65-mile road from Gulkana to Slana that the ARC had built in the 1930s, then pushed northeast through the wilderness constructing a road to what became known as Tok Junction. Much of the route from Gulkana to Tok paralleled the Valdez-Eagle Trail. The troops built timber pile and trestle bridges (Figure 137) and log

[1] The Alaska Highway was originally called the ALCAN (derived from Alaska-Canadian) High- way. American officials preferred the name ALCAN to symbolize joint cooperation in the venture. Canadian officials and people in the far northwest called it the Alaska Highway. An exchange of diplomatic notes between the two governments on July 19,1943, designated the official name as the Alaska Highway (Coates and Morrison 1992:149).

Figure 138. Army engineers from the 35th Engineers Battalion constructing a log culvert on the Alaska Highway, 1942. Photo from the Chief of Engineers, Office of History, U.S. Army, reprinted from Twitchell 1992:144.

culverts (Figure 138) at water crossings. During this phase of construction, engineers used portable sawmills and local timber to build timber bridges (Yost 1995:186). After reaching Tok Junction, the 97th Engineering Regiment cut a route south and east through the wilderness until October 25, 1942, when it met up with the 18th Engineering Regiment working its way west from Whitehorse. The crews then went back over the routes and improved the grade and constructed better wooden trestle bridges. To the northwest, a hundred mile gap in construction of the Alaska Highway existed between Big Delta and Tanacross in June 1942. The PRA selected a contractor, Lytle and Green, to build that segment of the road and timber bridges to span water crossings. On November 20, 1942, U.S. and Canadian officials marked the official opening of the 1,619 mile Alaska Highway at a ceremony conducted at Soldier's Summit near Kluane Lake in the Yukon Territory.

The original Alaska and Tok Cutoff highways constructed in 1942 were pioneer two-lane roads with many steep curves and only minimum attention given to cuts and fills. Wood trestles, wide enough for only one-way traffic and made of native timber, spanned the streams. The War Department reassigned five of the engineering regiments to other postings at the end of 1942, leaving two regiments and the PRA contractors to make improvements on the highway. After American's military position in the Aleutians and the Pacific improved, new specifications for the highway were drawn up in March 1943. During the following year, much of the grade on the pioneer road was improved to regulation standards, low spots were filled, gravel surfacing was done, 133 temporary wooden bridges were replaced with permanent structures, and 8,000 culverts were installed (Twitchell 1992:247; Associated General Contractors of Alaska 1998:32). The last soldiers departed

in July 1943, leaving further repairs, maintenance, realignment and construction of permanent bridges to the PRA and its thousands of civilian construction company workers under contract. Parts of the pioneer road were incorporated into the final road, while the rest was re-located and replaced by an all new road bed. The PRA hired four engineering companies as project managers, and through them 77 construction companies. The contractors used heavy equipment left over from Civilian Conservation Corps projects in the 1930s. At the peak of construction in September 1943, there were 10,400 Americans working for 63 contractors and 3,700 Canadians employed by 14 contractors. Worker turnover was estimated at 100 percent due in large part to the rigorous climate and difficult terrain (Woodward 1997:195-196, 200 202).

During the winter of 1942-1943, PRA architects and draftsmen prepared plans and specifications for 133 new bridges for the Alaska Highway while PRA purchasing agents scoured the States to find the necessary steel and concrete (Huntley and Royall 1945:59-67). The new 1943 construction specifications included two-lane bridges that had a roadway width of 24 feet. Bridges already built that were adequate in height and strength were not replaced, even though some were only one lane. Rains and flooding from swollen streams in the spring of 1943 made sections of the road unpassable and washed out many log bridges, delaying work. Heavy rains and massive mud slides in August 1943 blocked sections of the road and took out four bridges (Twitchell 1992:250). The 133 new bridges averaged 340 feet in length and, placed end-to-end, had a combined length of 8.5 miles.

Many of these new bridges were constructed at a different site than the first crude bridges. In those cases, construction crews in 1943 built a timber trestle bridge (Figure 139) or a pontoon ferry to provide a temporary crossing while constructing the permanent bridge. More than half of the bridges built in 1943 were replaced with short wooden trestle spans. Most of the rest were made of steel, but a few on the Canadian portion of the Alaska Highway were made of rein-forced concrete (Associated General Contractors of Alaska 1998:32). In August of 1943, the Army began to run short of funding. It ordered the PRA to stop work on relocation of some sections of road and to encourage the use

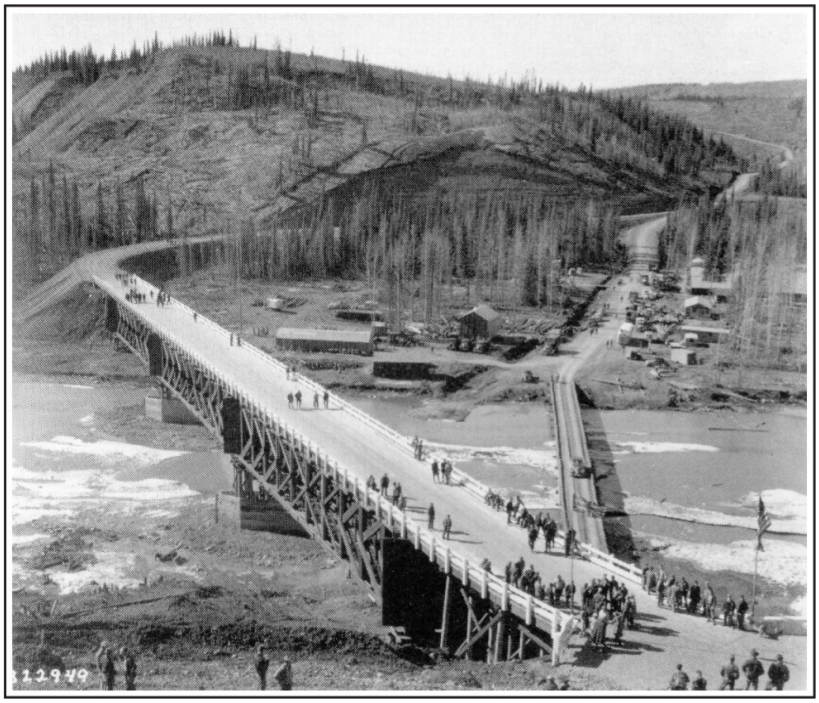

Figure 139. The temporary (right) and permanent (left) bridges at Sikanni Chief River on the Alaska Highway in Canada, April 1943. Photo from Chief of Engineers, Office of History, U.S. Army, reprinted from Twitchell 1992:144.

of less durable materials and time-consuming construction methods. Bridge decking, in some cases was made of wooden planks instead of poured concrete. Timber culverts were installed instead of corrugated steel or concrete culverts (Twitchell 1992:251). Some bridges were not completed until 1944 due to wartime shortages of steel. The PRA got around shortages by dismantling unused steel bridges in the States, shipping them north and reassembling them on new foundations (Huntley and Royall 1945:60-61, 66). The largest bridge constructed along the Alaska Highway was the through truss span across the Teslin River at Johnson's Crossing (Mile 836) in the Yukon Territory. All of the PRA's 1943 timber bridges and some of its steel structures have since been replaced, but the rest were still in use in 1992 and in good shape (Twitchell 1992:251-253).

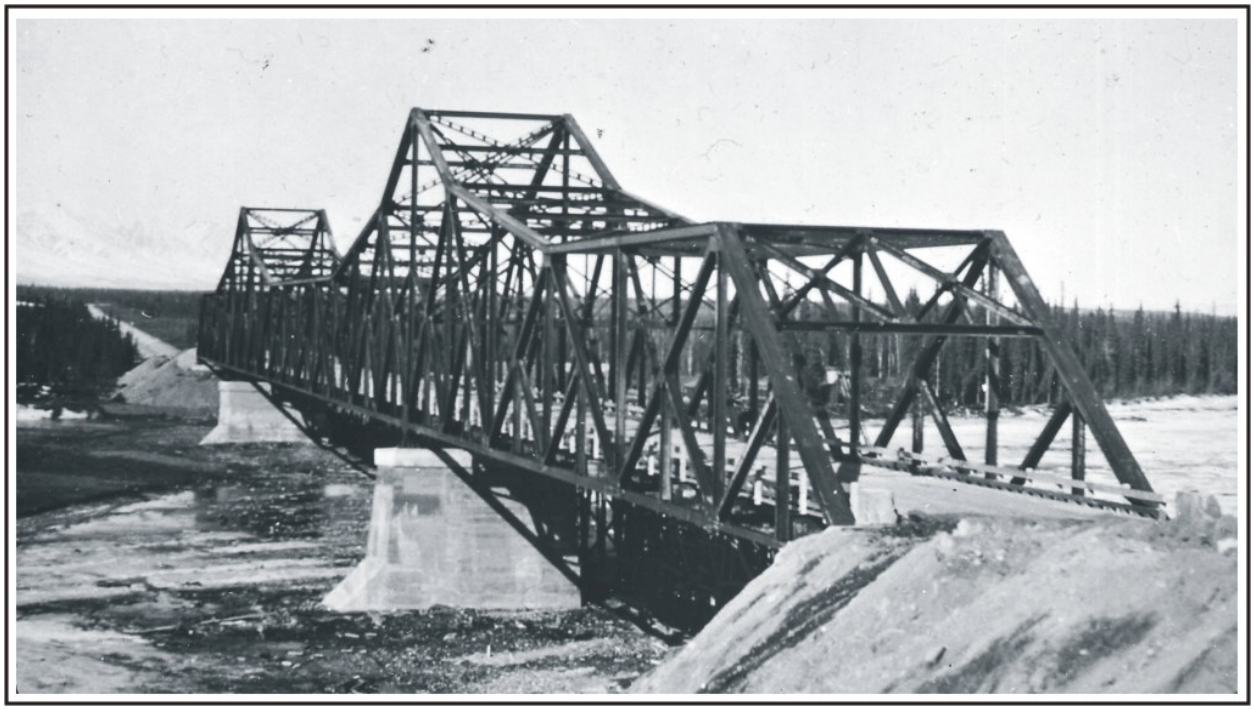

Figure 140. The cantilevered 3-span steel Warren truss bridge at the Tanana River on the Alaska Highway, 1944. U.S. Alaska Road Commission Collection, PCA 61-107-B69, Alaska State Library.

Twenty-five bridges were constructed along the Alaska portion of the Alaska Highway in 1943 and 1944, including 16 timber trestle bridges, three 50-foot I-beam bridges with timber trestle approaches, five steel through truss bridges, and one steel deck truss bridge. The steel through truss bridges were the 950-foot 3-span bridge at the Tanana River (Figure 140) (Bridge No. 505), the 256-foot single span bridge at Tok River (Bridge No. 506), the 974-foot 5-span bridge at Johnson River (Bridge No. 518), the 9-span 1,824-foot bridge at Big Gerstle River (Bridge No. 520) and the 205-foot single span bridge at Yerrick Creek. A 12-span 1,980-foot deck truss bridge (Bridge No. 509) (Figure 141) was built at Robertson River (ARC 1952a:10-11).

In addition, the military built five bridges on Northway Road to connect the Alaska Highway to the military airfield at Northway. Those bridges included a 240-foot single span steel Warren truss

Figure 141. The 9-span steel deck truss bridge at Robertson River on the Alaska Highway, June 1946. U.S. Alaska Road Commission Collection, PCA 61-15-125, Alaska State Library.

bridge at the Chisana River (Bridge No. 424), a 50-foot I-beam bridge with trestle approaches, and three wood trestle bridges (ARC 1952a:35). All of the steel truss bridges were built with concrete abutments, piers and decking. Five of the six steel through truss bridges were Warren truss types. The sixth, the Yerrick Creek Bridge, was a camelback truss. The Robertson River bridge was a Warren deck truss. The U.S. Federal Works Agency (FWA) of the PRA designed the steel truss bridges based in part on standard designs. The FWA was assisted in the design process on several of the truss bridges by major bridge manufacturing companies such as the American Bridge Company. The Virginia Bridge Company, the Des Moines Steel Company, the Pittsburg Des Moines Steel Company and the St. Joseph Structural Steel Company fabricated the steel for the bridges and the U.S. Steel Export Company and other specialty bridge contractors erected the superstructures.

The U.S. Army and contractors constructed 18 bridges on the Tok Cutoff during World War II. The bridges included a 225-foot steel Parker truss at Gakona River, 17 timber trestle bridges (Figure 142) ranging from 25 to 2,020 feet in length and numerous log and timber culverts. All of these bridges were one-lane wide. The longest of the trestle bridges was the 2,020-foot Chistochina River Bridge.

In southeast Alaska, PRA engineers surveyed a route from the U.S. border north of Haines to Tok Junction on the Alcan Highway during the winter of 1942-1943. The PRA hired several contractors who improved Haines Road, built in previous decades by the ARC, and built a 500-foot timber trestle at the Chilkat River (ARC 1952a:15). From the border, the contractors pushed north into Canada building a pioneer road until they linked up with a U. S. Engineers battalion that had

Figure 142. The timber trestle bridge at Porcupine Creek on the Tok Cut-off Highway, May 1949, was typical of one-lane timber trestle bridges built during World War II. U.S. Alaska Road Commission Collection, PCA 61-23-78, Alaska State Library.

started at Tok Junction and worked its way south (Woodman 1997:201-202). The contractors and Army engineers built a number of bridges in Canadian territory, but no information is available on the bridge types.

Wartime improvements and relocation of the route shortened the Alaska Highway from 1,619 miles in October 1942 to 1,422 miles by the end of 1945. When the highway opened to the public after World War II, about two-thirds (970 miles) consisted of the original Army pioneer road, all of which had been substantially improved and upgraded by the PRA. Another 450 miles of the original route was abandoned and replaced with new alignments. The wartime cost of constructing the highway was $138,312,166, less than $100,000 per mile (U.S. House Committee on Roads 1946; Twitchell 1992:253). After the 215 miles of the Alaska Highway in Alaska and the 125 miles of the Tok Cutoff Highway were completed in 1944, the ARC took over maintenance of them on a reimbursable basis (ARC 1944:8).

The timber and steel bridges constructed during the war were a crucial part of the route. The six steel truss bridges on the Alaska section of the highway were the first Warren through truss bridges built in the territory. Sixty-five years later, after repeated widening and realigning of the roadbed, the five remaining Warren through truss bridges and the Robertson River Warren deck truss bridge constitute the only original fabric left in Alaska that visually reminds one of the Alaska

Highway as it appeared during the war years. Construction of the Alaska Highway was an astounding engineering accomplishment (Naske 1976:12). The Alaska Highway was the largest construction project in Alaska and Canada during the war. The highway became the first overland route linking central and northern Alaska with highways in Canada and the contiguous 48 states. The building of the Alaska Highway profoundly changed the upper Tanana River Valley by opening it to settlement.

Other Bridges Built During the War Years

Several other government entities built bridges in Alaska during World War II, mostly in southeast Alaskan communities. The U.S. Navy built a timber trestle bridge over the Indian River in Sitka (Figure 143) after a storm in September 1942 took out the old bridge (Captions for photographs #17 and #18, U.S. Alaska Road Commission Collection, PCA 61-76, Alaska State Library). The Navy had a major base in Sitka during the war and lent its assistance to the community by replacing the bridge. Three years later, the City of Petersburg, or a contractor working for the city, built the Indian Street Viaduct (Bridge No. 1159). The viaduct is a multiple span treated timber trestle bridge that is 338 feet long.

Figure 143. Temporary timber trestle bridge built by the U.S. Navy at Indian River near Sitka, Fall 1942. U.S. Alaska Road Commission Collection, PCA 61-76-18, Alaska State Library.

Figure 144. The steel pony truss bridge at Ketchikan Creek, downtown Ketchikan, June 9, 1945. U.S. Alaska Road Commission Collection, PCA 61-89-10, Alaska State Library.

A contractor, David Nystrom of Seattle, built a 125-foot steel pony truss bridge at Ketchikan Creek (Bridge No. 724) in 1945 for the City of Ketchikan. The steel truss bridge (Figure 144) replaced a timber trestle that had been damaged on several occasions and was in poor condition. Funding for the new bridge came partly from the PWA and partly from the Thirteenth Naval District, The U.S. Coast Guard used the bridge to access other federal facilities in the city from its base at the south end of Ketchikan. Engineers in the San Francisco office of the PRA designed the Ketchikan Creek Bridge in July of 1944 from American Association of State Highway Offices (AASHO) standard bridge specifications as part of the Alaska Defense Access Project. Construction began in early November of 1944 and the bridge was completed on June 12, 1945 (Campbell 1996:3-5).

World War II disrupted the road and bridge building activities of the ARC and forced that agency to spend most of its resources on priorities established by the military. Construction of the Alaska and Glenn highways were major undertakings which began the process of tying Alaska's road system together. While the number of bridges constructed declined in the States during World War II, it increased in Alaska, which the federal government identified as a crucial theater for the defense of the country. The war drew the U.S. Army, the PRA, major bridge design and fabricating companies and private contractors from the States into the business of building bridges in Alaska. New steel bridges built in Alaska during the war, as measured in total linear feet, surpassed the construction of timber bridges for the first time (Table 4). Bridge builders during the war years introduced new steel truss bridge types to Alaska, such as Warren through and deck trusses. By the end of the war, the ARC had adopted a minimum 20-foot width to accommodate two lanes of traffic for new bridges constructed on major roads and highways.

Table 4. World War II Bridge Construction by Principal Material Type, 1941-1945.

Agency	Project	Timber Trestles (No. of Bridges)	Timber Trestles (in Linear Feet)	Steel Truss in (No. of Bridges)	Steel Truss (in Linear Feet)
ARC	Territory	Unknown	4,240	39	7,064
Army/PRA	Alaska Hwy	16	1,124	9	6,339
Army/PRA	Tok Cutoff	17	3,178	1	225
PRA	Haines Hwy	1	500	–	–
Total		34*	9,042	49	13,628

* = Number is incomplete for purposes of comparison

(Sources: ARC 1941:7-8; ARC 1942:6-7; ARC 1943:7-8; ARC 1944:7; ARC 1945:7-8; ARC 1952a:10-11, 13-15)

VIII. BRIDGE CONSTRUCTION IN THE POSTWAR YEARS, 1946-1950

During the immediate postwar years, the ARC tried to return to its primary mission of building and maintaining roads, trails and bridges from sea and river ports and railroad stations to communities and mining camps. The advent of the Cold War between the United States and the Soviet Union increased Alaska's importance as a strategic outpost, prompting the U.S. military to continue building and upgrading military installations in the territory. Congress, at the behest of the military, sharply increased appropriations to the ARC starting in 1948 to improve existing major roads between cities and military bases and to build several new roads. The goal of balancing its traditional goals with the new priorities set by Congress and the military in the postwar years severely challenged the ARC and BPR, forcing both road building agencies to reorganize and change the way they built roads and bridges.

ARC Bridge Building after World War II

After the end of World War II, the ARC's annual funding dropped significantly and reverted almost to pre-war levels. This impacted the choice of materials and the types of bridges and culverts built to bridge water crossings. The ARC, which had accumulated a long list of deferred maintenance on bridges from the war years, reverted to a reliance on timber for most bridges (Table 5), reserving steel for structures of greater length and traffic volume (ARC 1946:6; ARC 1947:6; ARC 1948:6). In addition to repair and replacement of bridges on existing routes, the ARC also undertook building new roads between Tok and Eagle and between Cooper Landing and Soldotna during the late 1940s.

Table 5. ARC Bridge Types Built During 1946-1948

	1946		**1947**		**1948**		**1949**	
Bridge Materials/Types	Linear Ft.	No.	Linear Ft.	No.	Linear Ft.	No.	Linear Ft.	No.
Timber trestles	4,316	16	523	11	261	11	1,002	13
Timber through truss	100	1	-	-	-	-	-	-
Suspension foot bridge	400	1	-	-	-	-	-	-
Steel through truss	250	1	200	1	480	2	780	4
Steel pony truss	-	-	-	-	-	-	125	1
Steel plate girder	-	-	56	1	-	-	53	1
Steel I-beam	-	-	-	-	-	-	205	1
Totals	5,016	18	779	13	741	13	2,1650	20

(Sources: ARC 1946:7; ARC 1947:7; ARC 1948:8; ARC 1951:Table 6; ARC 1952a)

ARC crews built six new standard timber trestle bridges on the Richardson Highway in 1946, six in 1947, four in 1948 and three in 1949. During the same period, the ARC built six timber trestles

on the Tok Cutoff, two on the Glenn-Palmer-Matanuska Highway, two on the Glenn Highway, two on the Haines Highway in 1949, and eleven on local roads throughout the territory. ARC crews built five timber trestle bridges on the Tok-Eagle Route and twelve on the Sterling Highway. The ARC re-built a 100-foot Howe timber truss bridge with 897 feet of timber trestle at the West Fork River on the Bull River Road in 1946. In addition, ARC crews salvaged and re-erected a 1,000-foot timber trestle span during 1947 (ARC 1946:7; ARC 1947:7; ARC 1952a:5-36).

Figure 145. The camelback truss bridge, lower crossing of the Lowe River, on the Richardson Highway, 1946. U.S. Alaska Road Commission Collection, PCA 61-21-39, Alaska State Library.

The ARC built 13 steel through truss bridges and three steel pony truss bridges in the late 1940s. Its crews erected a 250-foot camelback truss bridge (Figure 145) at the lower crossing of Lowe River 15 miles east of Valdez in 1946 (ARC 1946:7; ARC 1952a:5). The ARC erected a 200-foot camelback truss bridge at the Taiya River on the new Skagway-Dyea Road in 1947 (ARC 1948:8). A year later the ARC erected a 180-foot steel camelback truss bridge at Eagle River on the Glenn Highway and a 100-foot pony truss bridge at Ship Creek in 1949 on the same route (ARC 1947:7; ARC 1951:17-18; ARC 1952a:53). ARC crews replaced timber bridges on the Elliott Highway with a 180-foot steel through **(type ?)** truss bridge at the **Chatanika River**, a 100-foot steel pony truss bridge at the Tatalina River and a 125-foot steel pony bridge at the Tolovana River (ARC 1951:17-18). During 1948-1949, the ARC erected three steel through truss bridges on the new Sterling Highway, including a 300-foot Parker truss bridge at the Kenai River near present-day Soldotna (ARC 1947:7; ARC 1948:7), a 250-foot steel camelback truss at the Kasiloff River and a 150-foot steel camelback truss (Figure 146) (Bridge No. 910) at the Anchor River (ARC 1947:7; ARC 1952a:17; Soberg 1991:98, 102). Crews constructing the Tok Junction-Eagle Road (later renamed the Taylor Highway) in 1949 erected a 125-foot steel pony truss bridge at the West Fork

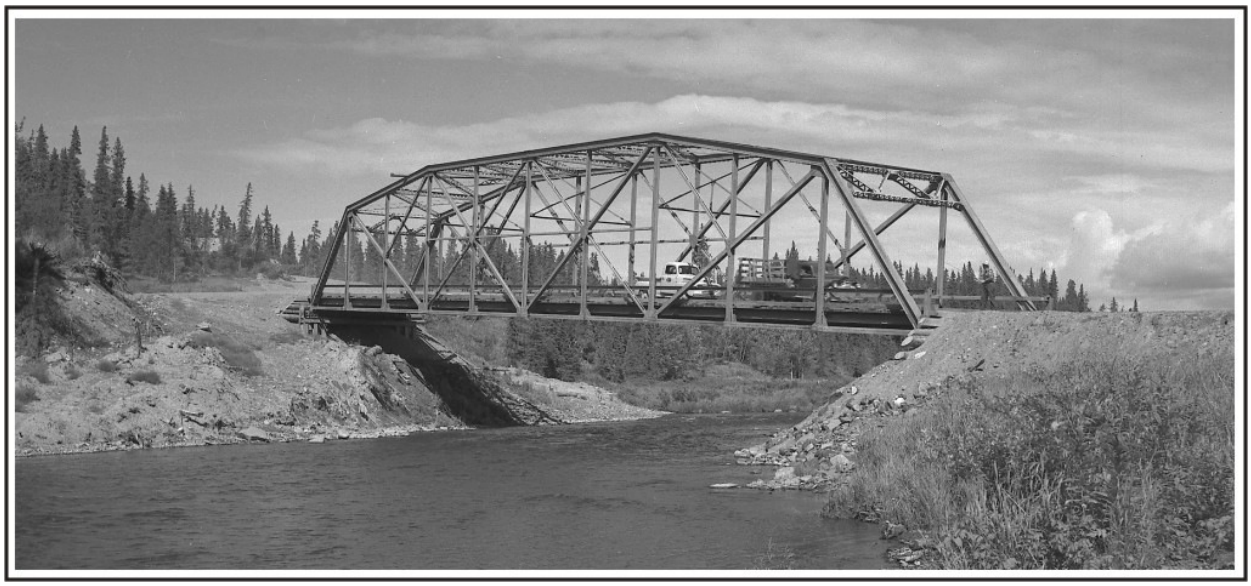

Figure 146. The camelback through truss bridge at the Anchor River, 1950. U.S. Alaska Road Commission Collection, PCA 61-29-88, Alaska State Library.

of the Dennison River, a 180-foot steel camelback truss bridge at Mosquito Fork of the Fortymile River, and a 200-foot camelback truss bridge at the South Fork of the Fortymile River (ARC 1951:17-18; ARC 1952a:35-36). ARC crews salvaged and re-erected 330 linear feet of steel truss span bridges during 1946-1947 as replacements for timber trestle bridges (ARC 1947:7). The ARC replaced a timber bridge on the Steese Highway in 1949 with a 5-span, 105-foot timber stringer bridge (Figure 147) at the North Fork of Birch Creek (ARC 1951:17-18).

Figure 147. The timber pile trestle bridge built in 1949 at North Fork/12 Mile Creek on the Steese Highway. Photo taken in 1959 courtesy of ADOT&PF Bridge Design Section, Juneau.

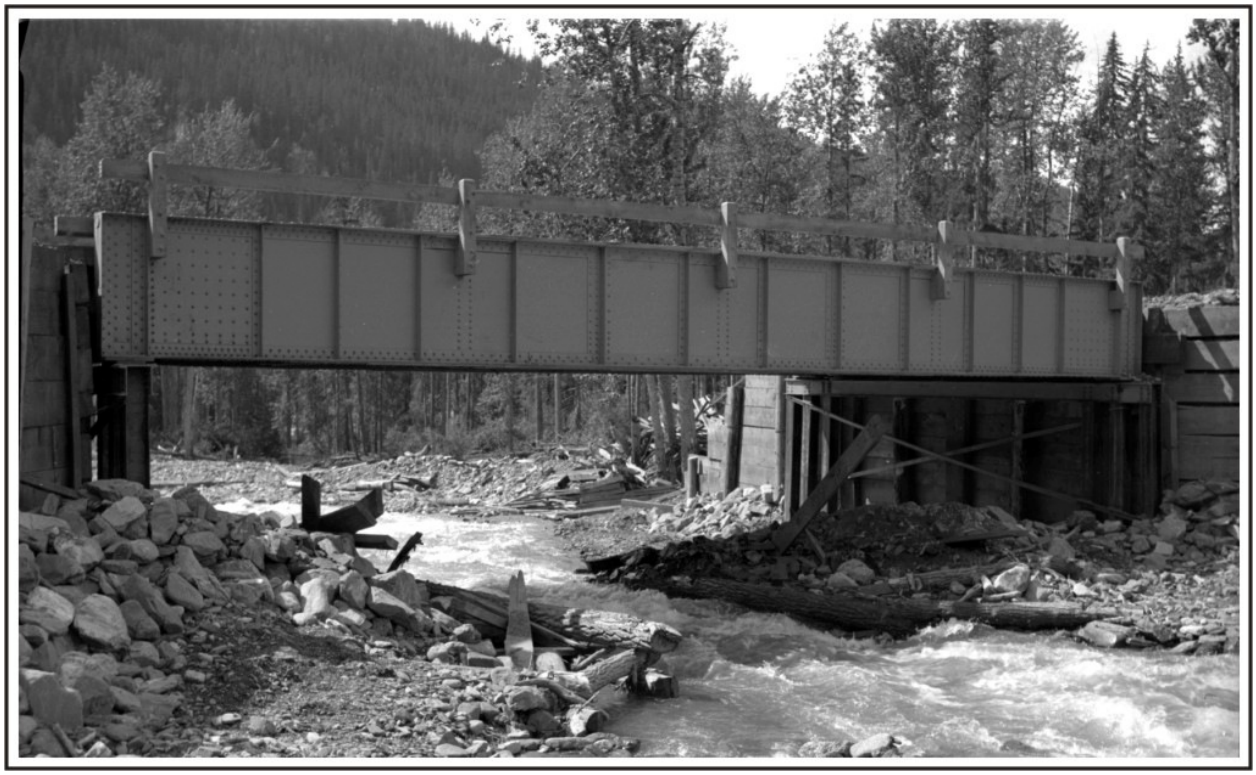

Figure 148. The steel girder bridge at Little Boulder Creek on the Haines Highway, July 23, 1949. U.S. Alaska Road Commission Collection, PCA 61-95-24, Alaska State Library.

ARC crews built four steel stringer/girder bridges in the late 1940s. They replaced a timber bridge at Otter Creek on the Flat-Iditarod Road with a 56-foot steel girder bridge (Bridge No. 461) in 1947. Two years later, they replaced a timber bridge at Little Boulder Creek on the Haines Highway with a 53-foot girder bridge (Figure 148). Snow slides during the winter of 1948-1949 destroyed the 1945 steel girder bridge at the upper crossing of the Lowe River at Mile 16 of the Richardson Highway. The ARC replaced the washed out bridge with a new 205-foot multi-span steel I-beam bridge in the spring of 1949 (ARC 1948:8; ARC 1951:8-9, and Table 5; ARC 1952a:5, 15, 22). The ARC also erected a new 400-foot suspension footbridge over the Skagway River in 1946 (ARC 1946:7).

Road construction and maintenance crews continued to replace timber culverts with corrugated metal culverts and to install new steel culverts on new roads in the postwar years (Table 6). The ARC installed 530 timber culverts in 1946, probably due to continuing shortages of steel in the aftermath of the war. All culverts installed in 1947 and 1948 were made of steel.

Table 6. Types and Number of Culverts (in Linear Feet) Installed by the ARC, 1946-1948

Year	Timber	Metal	Rock
1946	530	8,322	-
1947	-	8,333	-
1948	-	6,756	-

(Sources: ARC 1946:7; ARC 1947:7; ARC 1948:8).

Staff at ARC headquarters in Juneau from 1946 through 1948 consisted of a chief engineer, assistant engineer, several assistants and clerical staff (ARC 1946:5; ARC 1947:5; ARC 1948:5). O.H. Stratton, whose job it was to draw standard plans for bridges, left the ARC at the end of 1943. A.F. Ghiglione, the most experienced hand at building bridges, returned to the ARC in 1946 after he was discharged from the Navy and he became Assistant Superintendent of the ARC's Anchorage District Office (Soberg 1991:97). The ranks of experienced men were so depleted by 1948 that the ARC began using contractors on major road construction projects (ARC 1948:11). Shortages of steel, timber and personnel hampered construction, prompting ARC crews to salvage materials from old bridges.

The ARC Develops a Bridge Design Branch

With the beginning of the Cold War, Alaska became an important bastion of national defense. On October 28, 1947, Secretary of the Army Kenneth C. Royall wrote Secretary of the Interior Julius A. Krug that the limited capacity of the Alaska Railroad and deficiencies of "the road system in mainland Alaska jeopardize the mission of National Defense." Support of military bases in the North and development of strategic raw materials depended on a road and rail system "capable of sustaining the increased traffic which an emergency would impose" (Naske 1986:227). Congress made an additional $4 million available for road work in Alaska in 1948 and authorized a 6-year program to build and improve roads to paved quality that would interconnect military installations (ARC 1955:2-3). The new appropriation, a ten-fold increase in ARC funding over previous years, emphasized Alaska's strategic position in the Cold War (ARC 1951:1-2). The federal government, at the behest of the military, required the ARC to widen and pave its main roads and replace obsolete bridges. Congress eventually appropriated $28 million to connect Anchorage and adjacent military installations with Seward, Alaska's principal port. In addition, Congress authorized a 6-year road program (in excess of $170 million) to convert, improve and pave the primary road system in Alaska (ARC 1955:3). The ARC began upgrading its highways and replacing hundreds of first and second generation timber and steel truss bridges which were too narrow and not designed for the weight of a new generation of heavy trucks and military vehicles.

The dramatic increase in funding and the pressure to achieve these new objectives forced the ARC to reorganize and change the manner in which it did business. From 1932 to1948, Ike P. Taylor had served as Chief Engineer and presided over annual budgets of $2-3 million. In early 1948, the permanent year-round staff in Juneau headquarters consisted of 15 people, with small district offices at Fairbanks, Anchorage, Valdez and Nome, and a sub-district office at Haines. The ARC year-round staff was too small to handle the new work load. Much of the permanent staff was near retirement age and it had lost touch with the engineering profession in the U.S. as a whole (ARC 1951:2-3). The military desired hard surfacing of roads, but the ARC had little knowledge of this and little experience administering contracts. Most of the ARC's work had been done in the past by seasonal employees and force account. In June 1948, the Department of the Interior appointed Colonel John R. Noyes to lead the ARC. Noyes reorganized the ARC in 1948, creating a headquarters with a chief engineer (Ike Taylor) supervising four divisions: Administration, Engineering, Construction and Contracts Administration. Toward the end of 1949, the ARC combined the Contract Administration

and Construction divisions into the Operations Division with Ghiglione as chief. Ghiglione became Chief Engineer in early 1950 when Taylor retired and John Noble took over the Construction Division. Under the new system, most ARC employees were employed in the Construction Division (ARC 1951:5, 16). Paving roads and building dozens of new, heavy-duty bridges each year would require more attention to engineering design as well as hiring and monitoring contractors to carry out the massive construction work load. New personnel with knowledge of contract administration and hard surfacing were recruited and integrated with existing ARC staff.

Figure 149. Harold B. Schultz, Chief Bridge Engineer of the ARC, early 1950s. U.S. Alaska Road Commission Collection, PCA 61-138-1, Alaska State Library.

The ARC adopted a new code of construction standards, "Alaska Road Commission Memorandum No. 2--Road Standards," on January 1, 1949 (ARC 1951:6). An important element of the reorganization and new standards was the decision that "all bridge work would be handled separately from the reconstruction contracts." The ARC would use its force account organization to build smaller bridges, while major structures (defined as bridges 24 feet or wider) were to be constructed separately by contract. The standards adopted in ARC Memorandum No. 2 set new specifications for bridge construction, but the bridges had to be designed to conform to standards. Colonel Noyes recruited and hired Harold B. Schultz (Figure 149), formerly a bridge engineer with the State Highway Commission of Iowa, to establish the Bridge Design Branch in the Engineering Section of the Operations Division. Schultz arrived in Alaska in March 1949. He set about creating a professional bridge design shop and adopting new standards for bridge construction (Table 7).

Table 7. ARC Standards Adopted for Bridge Construction, August 1949

Type Standard	Through Roads	Feeder Roads	Local Roads
Clear Road Widths	24 Feet	20 Feet	20 Feet
Design Loads	H20	H15	H15
Vertical Clearance	15 Feet	14 Feet	14 Feet

(Source: ARC 1951:17).

The ARC's Bridge Design Branch adopted the standard specifications for highway bridges of the American Association of State Highway Officials (AASHO). The staff of the Bridge Design Branch prepared new standard plans for timber trestle spans of 13 feet, 17 feet, 21 feet and 25 feet for both 20-foot and 24-foot widths. Standard plans were prepared for steel truss bridges with 24-foot wide concrete decks, including 100-foot, 150-foot, 225-foot and 300-foot long spans. Steel I-beam bridges with 25-foot to 80-foot spans, and 3-span continuous I-beam designs of 150-foot and 180-foot lengths were also created. The Bridge Design Branch also adopted modern bridge design practices:

> Stringers and beams supporting concrete decks are designed to act with the concrete as a composite section. Shop welded connections are used wherever good practice and applicable requirements will permit. Low alloy (high strength) steel is used for beams, stringers and most of the truss members. Continuous I-beam and deck girder bridges are used whenever foundation and stream flow studies indicate that steel pile bents or open pedestal type concrete piers can safely be constructed in the channel. These design practices conserve structural steel and at the same time provide adequate and durable structures of pleasing appearance (ARC 1951:17).

As the reorganization was being completed in 1949, the ARC focused on the major road projects mandated by the military. These included building a new road linking Anchorage with the Seward Highway on the Kenai Peninsula, building a new highway from the U.S. Forest Service boundary near Cooper Landing to Kenai and Homer and reconstructing and paving the Richardson, Glenn and Alaska highways. These projects required construction of dozens of new and replacement bridges, which the Bridge Design Branch began designing. The largest project, the Turnagain Road, would link Anchorage and its military bases with the ice-free port in Seward (ARC 1951:4). This proposed 71-mile route extended through areas partly under ARC jurisdiction and partly through the Chugach National Forest where BPR maintained roads. The project was too large for either agency, so it was undertaken as a cooperative agreement between the ARC and BPR. The Department of the Interior provided the funding to the ARC, the lead agency. The cooperative agreement called for the BPR to do the engineering, including bridge design, and to oversee construction by contractors on the 48 miles of the 60-mile project that was located within Chugach National Forest (ARC 1951:4). The demands placed on BPR resources by this new project forced the Alaska BPR office to reorganize and begin developing a bridge design section of its own in Alaska.

BPR Starts Its Own Bridge Design Section

During World War II, the BPR confined its activities to maintaining roads and bridges in the Tongass and Chugach National Forests. After the war ended, the BPR took on two new projects. On February 5, 1947, the U.S. Forest Service added the 13-mile road linking downtown Cordova and the Airport to the Alaska Forest Highway System and assigned maintenance responsibilities for the one-lane road to the BPR. The route had been the first 13 miles of the railbed abandoned by the CR&NW at the end of 1938. The Civil Aeronautics Administration (CAA) built an airbase at Mile

13 during World War II and Army personnel stationed there used speeders and a diesel locomotive to travel along the rail line to Cordova. Soldiers pulled up the rails in early 1944 and created a crude, one-lane road between Cordova and Mile 13 airstrip, using planks for decking over the old railroad trestle bridges. During the summer of 1945, the CAA hired Morrison-Knudson Company to convert the railbed to a one-lane road. It was this road, which included 3,133 feet of old railroad trestle bridges, that the BPR designated as Route 32, the Copper River Highway, in 1947. BPR employees in Cordova were tasked with maintaining the road and the old timber trestle bridges, most of which were nearly 40 years old (Buzzell 2002:35-36).

The BPR built and maintained bridges throughout the Tongass and Chugach National Forests during the postwar years. Most of the agency's work between 1946 and 1949 involved road maintenance. Only a small number of new bridges built and most of those were timber bridges. One of the few steel bridges built during this period, a 283-foot steel Parker truss at the lower crossing of the Mendenhall River on the Glacier Highway north of Juneau, was erected in 1948 (Figure 150).

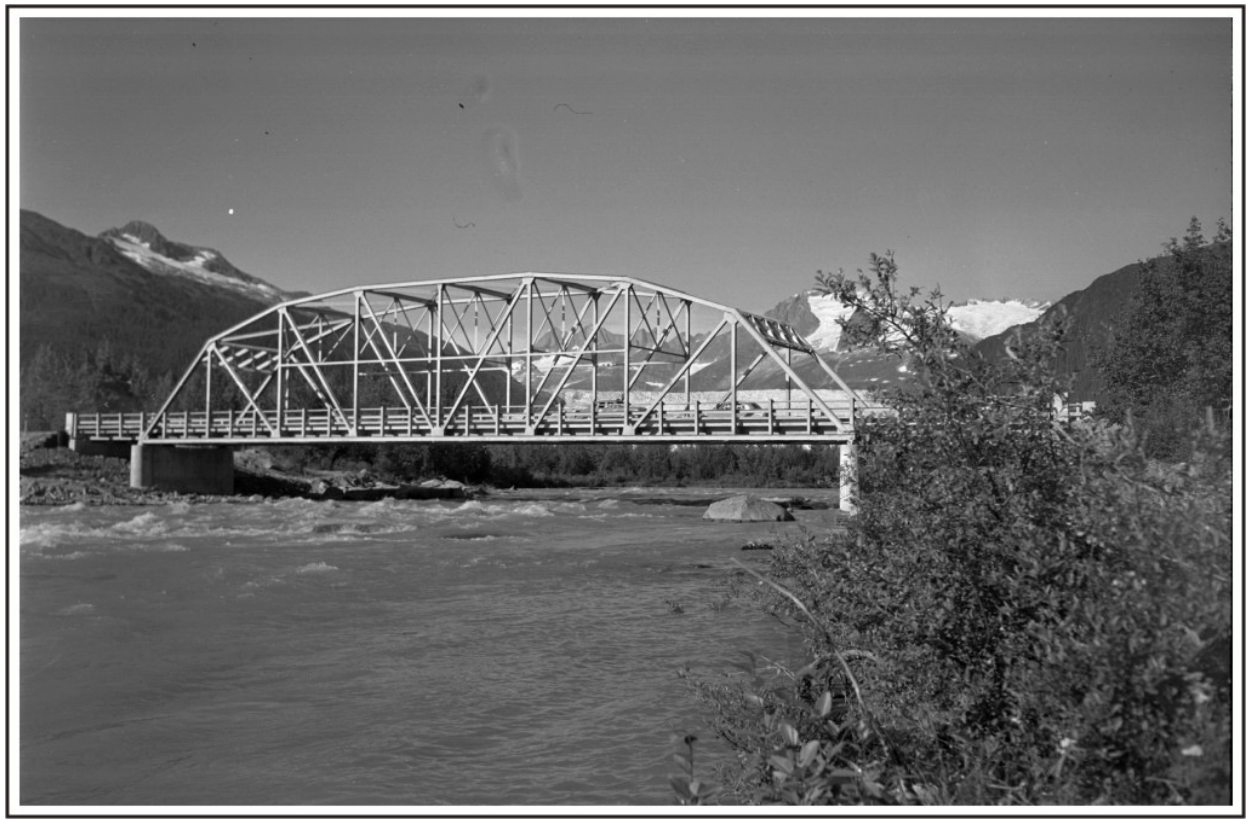

Figure 150. The steel Parker truss bridge built in 1948 at the Mendenhall River. Photo by H.A. Stoddart, BPR, August 11, 1951. Alaska Road Commission Collection, PCA 61-99-23, Alaska State Library.

The other new project undertaken by the BPR in the early postwar years was construction of the Turnagain Road that would link Anchorage to the Seward Highway. Under the ARC-BPR cooperative agreement, the BPR was tasked with doing the engineering, including designing the

bridges, for the road. The enormity of the engineering work on this project prompted the BPR to reorganize. BPR headquarters in Washington, D.C. detached the BPR district office in Alaska from Division 8 on August 16, 1948 and raised the Alaska BPR to division status. Washington designated the Alaska BPR as Division 10 with headquarters in Juneau and appointed Hugh A. Stoddart as Division Engineer in 1949. Stoddart established district offices for forest lands for southeast Alaska at Juneau and for forest lands in western Alaska at Seward (Stoddart n.d.; ARC 1951:1, 5). John Kiely, who had reviewed bridge shop plans and inspected of bridge materials at the BPR Division 8 headquarters in Portland, Oregon, transferred to Juneau on June 7, 1949. Stoddart appointed Kiely acting bridge engineer to oversee bridge design and construction for Division 10 (Stoddart 1949), but most of the BPR bridges were designed by BPR engineers at the Western Headquarters of the BPR in San Francisco (Stoddart 1951a).

Construction of the Turnagain Arm Road (later renamed the Seward Highway) began in 1948. The BPR supervised most of the construction because the highway traversed the Chugach National Forest. The ARC built 12 miles of road between Anchorage and Potter in the summer of 1948 and later supervised the paving of 39 miles from Anchorage to Girdwood (Naske 1986:263). While contractors cleared the alignment and ARC crews relocated the rail tracks along Turnagain Arm in 1949, bridge engineers in the West Coast Regional Office of the BPR in San Francisco designed 33 bridges to span the water crossings along the route. BPR bridge engineers designed 19 precast concrete girder bridges (Figure 151), 12 steel I-beam stringer bridges, one steel stringer continuous

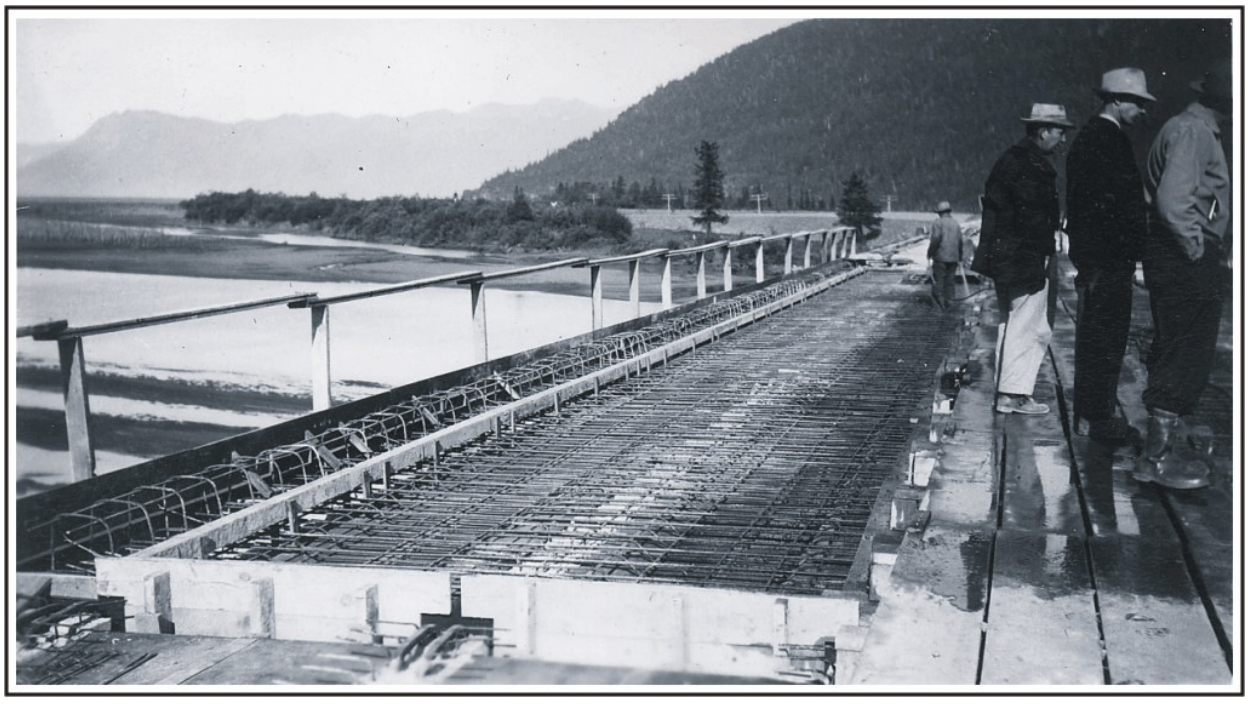

Figure 151. The Twenty Mile Bridge, built with precast concrete girders on timber pilings, under construction on the Seward Highway, September 1949. U.S. Alaska Road Commission Collection, PCA 61-29-183, Alaska State Library.

Figure 152. The Canyon Creek Bridge on the Seward Highway, completed in 1950. U.S. Alaska Road Commission Collection, PCA 61-94-79, Alaska State Library.

bridge, and one steel plate girder bridge and put them out to bid for the project. Most of the bridges rested on timber trestle pilings and all had a 24-foot curb-to-curb width (ARC 1952a:15; DOH 1963:9-10; DOH 1972:7-8). The most interesting of these bridges, from an architectural standpoint, was the 290-foot steel stringer bridge at Canyon Creek (Bridge No. 612). The bridge was built with a 20 degree curve and the deck was 70 feet above the creek bed (Figure 152). The Canyon Creek Bridge carried automobile traffic until 1997, after which it has served as a pedestrian/bicycle bridge. The only steel plate girder bridge was erected at the East Fork of Sixmile Creek at Mile 62 of the Seward Highway (Figure 153). Principal contractors who built the bridges were Manson, Osberg and Halverson, and the J.J. Badraun Company. Construction crews completed the highway alignment along the Arm in 1950 and the highway opened (in some places to controlled, one-way traffic) between Anchorage and Seward in 1951 (ARC 1951:4, 33, Table 2).

During the early postwar years, two other agencies built bridges in Alaska. The U.S. Forest Service began building "Forest Development Roads and Trails" in southeast Alaska and southcentral Alaska in 1945. USFS personnel built these roads rather than BPR employees, who were responsible for maintaining the Forest Highway System in Forest Service Reserve areas (Smith 1947:2; Metcalf 1949:7). The USFS roads were designed for use as logging roads and not for public use. The USFS built timber stringer and trestle bridges on these roads. The other agency that built bridges in Alaska

Figure 153. The two-span steel girder bridge at East Fork of Sixmile Creek on the Seward Highway, September 1949. U.S. Alaska Road Commission Collection, PCA 61-29-181, Alaska State Library.

was the Territorial Highway Engineer, who occasionally provided road and bridge building assistance to small communities. In 1948-1949, the Territorial Highway Engineer assisted with construction of bridges in Dyea and across the Klawak Lagoon (Metcalf 1949:14; Reed 1955:43).

The Postwar Legacy

Alaska's road transportation system underwent a revolutionary transformation in the immediate post World War II years and bridges played an important role. The revolution was driven by federal spending tied to Alaska's strategic importance in the Cold War. Alaska's two principal road building agencies were directed to widen, pave and tie Alaska's road system together with military bases, ice-free ports, and population centers. The new road system helped contribute to rapid postwar economic and population growth and an increase in automobile culture. It was not until the late 1940s that Alaska's roads, which were primitive by standards of the 48 states, surpassed railroads as the primary means of moving people and goods. The automobile revolution got into full swing in Alaska during the late 1940s, as the number of roads proliferated and the roads began to tie together major communities in the interior with coastal communities. New bridges in the postwar era had to be wider and stronger, to carry increased traffic, heavier vehicles, and military vehicles. For the first time, the two major bridge building agencies, the ARC and BPR, were blessed with a windfall of federal funding which forced each agency to begin developing a professional bridge design program.

Construction of the bridges on the Turnagain Road signaled the start of a major shift from the timber trestle and steel truss bridges of earlier decades toward the use of steel and concrete girders for superstructures. The project also marked a broadening of design types for bridge construction in Alaska. The BPR erected a few concrete and steel stringer/girder bridges in the 1930s and 1940s, but those had been designed by BPR bridge engineers in the States. The selection of steel and concrete for the Turnagain Road and the use of stringer and girder bridges types which were already in common usage in the States, reflected the experience of BPR bridge designers based in the States. It also signaled a harkening of things to come in terms of bridge design and construction on the Last Frontier.

IX. BRIDGE CONSTRUCTION IN THE 1950s

During the 1950s, the number of steel bridges built increased significantly as the ARC and BPR replaced narrow and worn out bridges on major roads around the territory. The ARC also undertook construction of several new roads, including the Copper River, Denali, Elliott and Parks highways. Many of the bridges built by ARC during the decade were steel stringer or girder structures, but timber stringer and steel through truss bridges were also built during this time period. The BPR built a number of concrete girder bridges, but the vast majority of bridges in use in the territory during the 1950s continued to be timber bridges.

While the ARC and BPR designed most of the bridges, bridge construction from 1950 on was done mostly by contractors whose work was overseen by the ARC and BPR. Initially, many of the contractors were based out of Seattle, but gradually a number of contractors specializing in road and bridge construction developed businesses in Alaska. Some of these were satellite firms of Seattle construction companies, but over the years people once employed by the Washington firms started their own businesses and got into the bridge building game.

Building Bridges in the Reorganized ARC

In the early 1950s, the ARC continued to upgrade the territory's major highways--the Richardson, Glenn and Tok Cutoff highways--at the behest of the military. ARC officials worked closely with military authorities in Alaska to improve roads between military bases, population centers and ports (ARC 1951:30). In addition to hard surfacing the main roads, the ARC set about widening all bridges on these roads to a standard two-lane width of 24 feet. Many of the bridges were narrow or of temporary construction, and the condition of the longer bridges varied widely. On the Alaska Highway, all of the bridges were 24 feet wide and most of them were steel structures in excellent condition. Parts of the Richardson Highway had bridges only 20-feet wide. Almost all of the main bridges on the Glenn Highway were one-lane structures with a width of 14 feet. The bridges on the Tok Cutoff, according to ARC officials, were "deplorable in condition" and were temporary (timber) structures except the steel through truss bridge spanning the Gakona River at Mile 2, which had a roadway width of 11 feet. The ARC decided to replace major bridges that were considered inadequate as quickly as funds were made available, using construction funds wherever possible. The ARC included a new item entitled "Improvement of Roads and Bridges" in its 1951 budget estimates to cover the replacement of inadequate major bridges on routes where construction funds for this purpose were not available (ARC 1951:17-18).

Such an ambitious program required considerable planning to design and construct the large number of bridges. In early 1951, the ARC proposed replacing 36 bridges on major highways during 1952-1954, plus a number of bridges in the Nome area. The highest priority was replacing 13 one-lane timber bridges on the Richardson Highway that had been built between 1929 and 1940. Seven bridges on the Richardson Highway built during World War II were also slated for replacement. Seven bridges on the Glenn Highway, and one each on the Haines, Edgerton and Sterling highways, and one each on the Manley Hot Springs, Slana-Nabesna, Ninilchik, Bull River, Tok and Knik roads were also to be replaced. Only one of the 36 bridges, the Welles Bridge on the Haines Highway built

in 1943, was two lanes wide (Shultz 1951a:1-2). In early 1952, the ARC revised its priorities and proposed replacing 49 bridges and building eleven new ones. The new bridges were for the Denali Highway. Most of the bridges that were slated for replacement were timber bridges that would be replaced with steel I-beam, steel high truss or treated timber structures (Shultz 1952a). As part of the planning effort, the ARC assembled its first inventory of bridges in Alaska in November 1952. The inventory included 267 bridges on primary highways, 251 on secondary or feed roads, 92 on local roads, 67 on remote mining roads, and 19 on military bases, for a total of 696 (ARC 1951:7).[2]

Prior to the accelerated construction program inaugurated in 1948, ARC personnel constructed most bridges based on standard plans that were modified in the field. Starting in 1950, proposed bridge sites were evaluated by engineers. The ARC's Bridge Design Branch prepared designs for individual bridges, starting in most instances with standard plans that the bridge design engineers adapted to the proposed construction site (ARC 1951:17). After 1948, major bridge construction and rebuilding projects were put out to bid and constructed by "experienced highway contractors" (ARC 1954:11).

William J. Niemi replaced John Noble as Chief of Operations in late 1950 and Noble became Chief of the Contracts Branch (ARC 1951:31). Harold Schultz con-tinued as the head of the Bridge Design Section until November 1951, when he became chief of the Engineering Division. R.J. DeLaHunt (Figure 154) took over as Chief Bridge Engineer. In 1953, the ARC combined the design of bridges and buildings into a "Bridge Building and Design Branch" and moved it from the Operations Division to the Engineering Division (ARC 1953a:4).

Figure 154. ARC officials R.J. DeLaHunt, William J. Niemi, and A.J. Gighlone, about 1954. Photo by J. Malcolm Greany. U.S. Alaska Road Commission Collection, PCA 61-138-2, Alaska State Library.

During the 1950s, the ARC built steel I-beam bridges to replace both timber bridges at crossings of medium length and also many of the steel truss bridges built during the 1940s. The new bridges were wider than the old timber and steel through truss bridges, which had overhead clearance restrictions. Steel truss bridges, unlike steel stringer bridges, could not be widened without taking them completely apart and rebuilding them. The switch to steel I-beam and girder bridges resulted in a gradual decrease in the number of timber and steel truss bridges and an increase in the number of steel I-beam and girder bridges (Table 8). Of the 57 bridges that the ARC proposed to replace in 1951, 21 were

[2] The inventory did not include bridges on BPR maintained roads, USFS logging roads and bridges built by towns and cities.

Table 8. ARC Bridge Types Built During 1949-1951

Bridge Type	1949	1950	1951
Timber trestles	12	8	11
Steel through truss	4	3	2
Steel pony truss	2	1	1
Steel plate girder	1	0	0
Steel I-beam	0	2	7
Steel I-beam, multiple span	0	0	1
Continuous I-beam (3-4 spans)	0	0	3
Steel arch & I-beam	0	0	1
Totals	19	14	26

(Source: ARC 1951:Table 7)

steel truss bridges that were too narrow. Most of the rest were timber trestle or timber "A" frame structures (Shultz 1951b). Steel superstructures and concrete floor slabs became the ARC's preferred materials for bridge construction. "It is planned that all of our permanent highway bridge structures designed for 1953 construction will have steel superstructures with reinforced concrete floor slabs," ARC Commissioner A.F. Ghiglione wrote on February 11, 1953. "The structural steel for this is now in stock or on order" (Ghiglione 1953). The Bridge Branch designed different "standard" designs for steel I-beam bridges, with different types of abutments depending on the length of the spans, character of the terrain and hydrological characteristics. In the early and mid-1950s, the ARC pulled up the 70-pound rails from the CR&NW railbed between the Cordova Airport and the Million Dollar Bridge. Crews cut the rails to standard lengths and used them to anchor abutments and pilings on steel and treated timber stringer bridges. The rails were made of hard steel, but could be brittle and break. Inspectors had to look for cracks in the rails used in the construction of bridges in the 1950s (Schultz 1952b; Mourant 2005:3-4).

The ARC continued to build steel through and pony truss bridges in the 1950s, but in smaller numbers than in previous decades. Steel through trusses were still preferred for spans of 200 or more. ARC crews began using creosoted and laminated decking as replacements for wood decking on bridges, particularly on steel truss spans. Throughout the 1950s, the ARC salvaged one-lane through and pony truss bridges from main roads and re-erected them wherever possible on secondary roads where the road width was only 14 feet. While wider bridges were preferred, economy dictated the use of the old bridges, when serviceable, on less important routes (ARC 1951:18). In 1951, a contractor working in California offered to sell the ARC seven used 162-foot steel truss spans that were 22 feet wide and were being replaced. The ARC declined the offer as the cost of the bridges plus shipping would have made the seven bridges more expensive than building new I-beam bridges (Shultz 1951c).

The ARC continued to build timber stringer and timber trestle bridges during the 1950s for short crossings because the use of timber was considered more economical than steel. ARC engineers

Figure 155. The Boulder Creek Bridge, one of four standard single span treated timber bridges built on the Richardson Highway in 1953. Photo courtesy of ADOT&PF Bridge Section, Juneau.

designed 24-foot wide timber bridges for main highways and stipulated the use of creosoted timber for stringers (Figure 155). Creosoted pilings had come into common usage in the 1930s and 1940s, but the early 1950s was the first time that creosoted timbers were used for the superstructure on highway bridges in Alaska.

While the ARC was shifting from timber stringer to steel stringer and girder bridges in the early 1950s, bridge building agencies in the states had already switched from steel stringer bridges to concrete girder bridges, a shift that occurred in the 1940s. The BPR built a few concrete bridges in Alaska during the late 1940s and early 1950s, experimenting with concrete girder bridges and concrete deck slabs. "It is with special interest that we note many highway departments are constructing bridges of pre-stressed concrete," A.F. Ghiglione wrote in 1953, "and it is quite probable that we will consider adoption of this type of construction, at least as an alternative for steel design, on some of our future bridges" (Ghiglione 1953). The ARC shied away from building concrete bridges in the 1950s, due to the absence of concrete plants in Alaska and the high cost of shipping prefabricated concrete girders to Alaska from the Pacific Northwest.

During the 1950s, the ARC replaced many of the narrow timber trestle and steel truss bridges on the Richardson Highway with steel I-beam bridges that had concrete decks. The first steel stringer

bridge on the Richardson Highway was erected at One Mile Creek (Bridge No. 591) in 1950. The bridge was an early prototype for the ARC's new generation of steel I-beam bridges and was the oldest such bridge designed by the Bridge Branch still in use in 2007. The ARC also replaced the steel pony truss bridge at Shaw Creek with a 150-foot steel Parker truss bridge (ARC 1951:18). J.J. Badrun Company of Seattle built a 300-foot steel stringer continuous bridge during 1951-1952 for the ARC on the upper Lower River to replace a bridge destroyed by a snow slide in 1949 (ARC 1951:21; ARC 1952b:16; ARC 1953a:18). Badrun also built I-beam bridges at Sheep Creek and Sourdough Creek in 1952 (ARC 1952b:14). Munter Construction Company of Seattle constructed four I-beam bridges north of Paxson for the ARC in 1952, including Darling Creek (Bridge No. 592, Figure 156), Bear Creek (Bridge No. 593), a bridge at Mile 230.4, and Ruby Creek (Bridge No. 594) (ARC 1951:33; ARC 1952b:15).

Figure 156. The single span steel I-beam bridge at Bear Creek on the Richardson Highway, built in 1952. The bridge was designed using standard plans. Photo by Larry A. Carlson, July 13, 1962, ADOT&FP Bridge Design Section, Juneau.

The ARC replaced eight narrow bridges on the lower Richardson Highway in 1953-1954. The bridges at Steward and Squaw creeks and at 59 Mile were steel stringer structures. The replacement bridge at Tsaina River was a steel deck truss bridge (Figure 157), while the replacement bridges at Boulder Creek (Bridge No. 566), Little Tonsina River, Squirrel Creek and Willow Creek were treated timber stringer bridges (ARC 1953a:19). Bridge replacements completed on the Richardson Highway in 1952-1953 included a 199-foot steel I-beam bridge at Glacier Stream near Valdez, a 190-foot steel plate girder bridge at Sheep Creek, and a 50-foot creosoted timber bridge at Sourdough Creek north of Glennallen. All but the Glacier Stream Bridge were built by contract (ARC 1953a:27; ARC 1954:

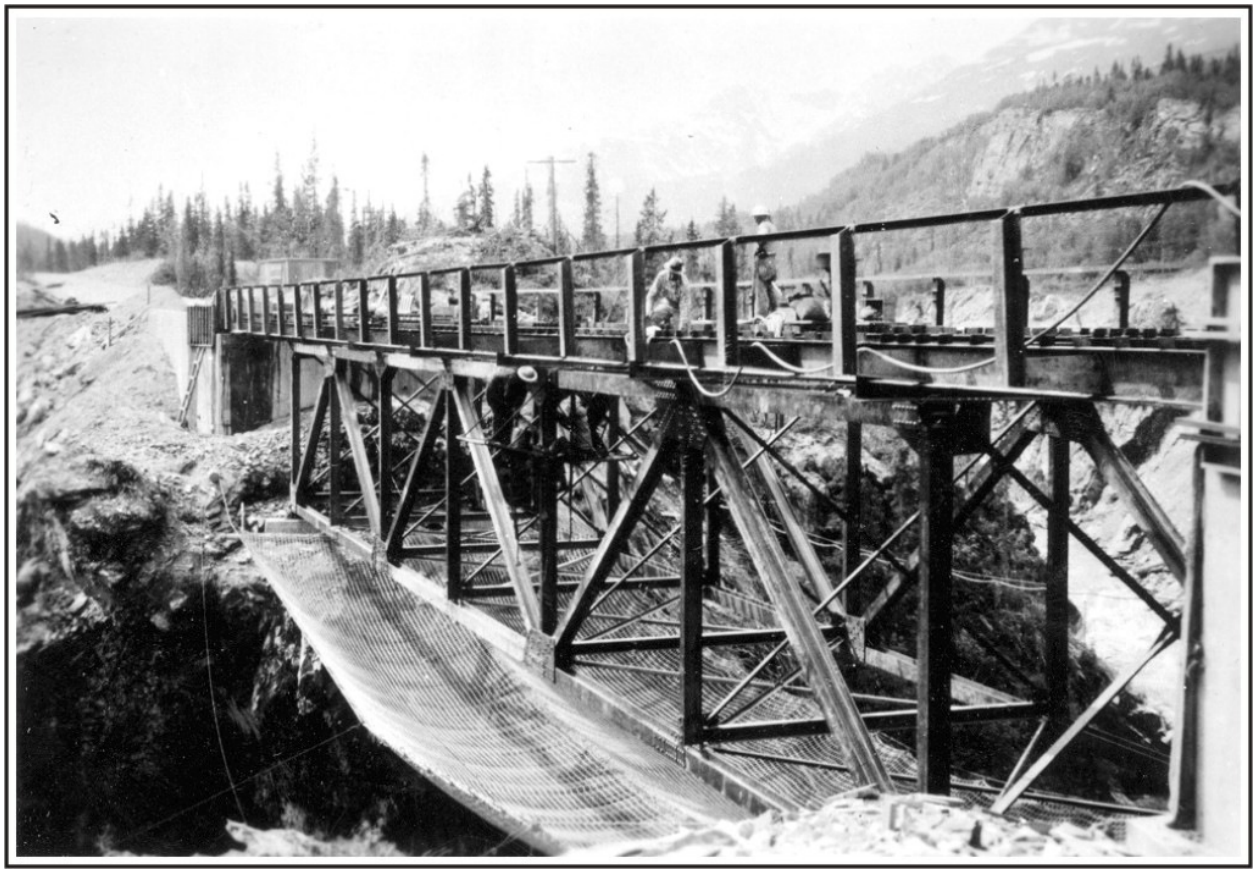

Figure 157. A crew constructing the steel deck truss bridge at the Tsaina River on the Richardson Highway, June 28, 1954. Photo courtesy of ADOT&PF Bridge Section, Juneau.

26). In 1954, contractors working for the ARC replaced 12 timber trestle bridges, varying in length from 17-120 feet, between Paxson (Mile 188) and Rapids (Mile 230)(ARC 1954:18-19). Eight of the new bridges were steel I-beam structures: Gun Creek (Bridge No. 578), McCallum Creek (Bridge No. 580), Trims Creek (Bridge No. 584), Michael Creek (Bridge No. 585), Flood Creek (Bridge No. 586), Whistler Creek (Bridge No. 587), Boulder Creek (Bridge No. 588) and Gunny Sack Creek (Bridge No. 590) (ARC 1954:19; ARC 1955:19). Contractors working near Fairbanks in 1954 replaced timber bridges at Banner Creek, Moose Creek and Jarvis Creek with steel I-beam structures (Bridge No. 595)(ARC 1954:20; ARC 1955:19).

Replacing one-lane bridges on the Tok Cut-off Highway was also one of the ARC's priorities in the early 1950s. An ARC crew replaced the steel through truss bridge at the Gakona River in 1950 with a two-lane 225-foot Pennsylvania steel truss span (Bridge No. 646) designed by Harold Schultz (Figure 15, page 22). Contractors constructed steel stringer bridges at Sinona Creek (Bridge No. 648), Tulsona Creek, Ahtel Creek, and Slana River (Bridge No. 654), and a steel stringer continuous bridge at Indian River during 1951-1952. They also built treated timber stringer bridges at Trail Creek (Bridge No. 660) and Little Tok River in 1952, and at Little Tok Overflow (Bridge No. 659), Spring Creek, Elizabeth Creek, and Ford Creek in 1954 (ARC 1951:21; ARC 1952b:14, 16; ARC

Figure 158. One of the two 330-foot multi-span steel stringer bridges at the Chistochina River under construction, May 14, 1955. The old timber trestle bridge is at right. U.S. Alaska Road Commission Collection, PCA 61-23-112, Alaska State Library.

1953a:26-27). In 1955, contractors replaced the 600-foot timber trestle bridge at the Chistochina River with two 330-foot multi-span steel stringer structures (Bridges No. 649 and 650, Figure 158) (ARC 1954:21; ARC 1955:21).

The ARC replaced one-lane steel truss and timber trestle bridges on the Glenn Highway in the 1950s. Contractors in 1950 replaced a timber trestle at Tolsona Creek with a steel stringer bridge (Bridge No. 552), replaced a steel pony truss span at Ship Creek with a pile trestle bridge, replaced a timber trestle bridge at Peters Creek with a steel pony truss structure (Bridge No. 536) and replaced a one-lane, 350-foot Pennsylvania steel truss bridge at the Matanuska River with a 24-foot wide, 300-foot steel Pennsylvania truss span and 50-foot I-beam approach span (Bridge No. 540) (ARC 1951:12, 18). ARC bridge engineers redesigned the one-lane Eklutna River steel arch bridge and contracted with Munter Construction to take the old bridge apart to widen and strengthen it to meet the two-lane standard for a paved road. Construction began in 1951 and was completed in 1952 (Bridge No. 537, Figure 159) (ARC 1951:21; ARC 1952b:15; ARC 1953a:19). During 1953, contractors replaced timber trestle bridges at Caribou Creek and Little Nelchina River with 230-foot and 180-foot (Bridge No. 594) multi-span steel stringer bridges (ARC 1952b:16; ARC 1953a:26). ARC crews replaced 500 feet of pile trestle approach at the south end of the Knik River Bridge with a steel continuous I-beam span in 1954 and re-decked the steel truss spans with creosoted timber. Contractors replaced the timber bridge at Mendeltna River with a 60-foot steel-I-beam bridge (ARC

Figure 159. The steel arch bridge at Eklutna River, July 11, 1952, after it was widened. U.S. Alaska Road Commission Collection, PCA 61-105-19, Alaska State Library.

1954:20-21, 39; ARC 1955:26). The Northern Corporation of Anchorage contracted with the ARC in 1955 and 1956 to replace the steel camelback truss bridge at Chickaloon River with a steel I-beam continuous bridge (Bridge No. 545), replace timber trestles at Cache and Mendeltna creeks with steel I-beam bridges, and replace the timber trestle at Hicks Creek with a steel I-beam continuous bridge (Bridge No. 547). Construction began in early 1955 and was completed July 2, 1956. The ARC paved the north trestle approach to the Knik River Bridge in 1955 and let contracts to paint the steel bridges at Eklutna, Matanuska and Little Susitna rivers (ARC 1955:21-22; ARC 1956:20).

ARC improvements to the Alaska Highway in 1952-1953 focused on replacing timber bridges at Mile 1410.4 and Mile 1422.5 with "modern creosoted timber structures" (ARC 1953a:27). During 1954-1955, the ARC replaced the World War II vintage steel I-beam structure at Gardiner Creek with a 131-foot steel stringer bridge, replaced the timber trestle bridges at Desper Creek and Scottie Creek with steel stringer bridges, and replaced the timber trestle at Sears Creek with a treated timber stringer bridge. ARC crews also re-decked the major steel truss spans at Johnson River, Yerrick Creek and Tanana River with treated timber and covered the decks with asphalt (ARC 1954:20, 27). Contractors for the ARC replaced timber trestles at Berry River and Beaver Creek in 1955-1956 with steel stringer bridges, and replaced the timber trestle at Little Gerstle with a steel stringer continuous bridge (ARC 1955:20).

The ARC continued construction of the Tok-Eagle Road (later renamed the Taylor Highway) in the early 1950s and erected three truss bridges salvaged from other road projects in 1952-1953.

An ARC crew disassembled the 300-foot steel camelback truss bridge at the Matanuska River on the Glenn Highway, freighted it to Mile 112 of the Tok-Eagle Road and re-erected it over the Fortymile River during the winter and spring of 1953. Crews also salvaged the 125-foot steel pony truss from Shaw Creek on the Richardson Highway and re-erected it at the Walker's Fork crossing of the Taylor Highway (ARC 1952b:7; ARC 1953a:22). The ARC salvaged a 200-foot steel through truss bridge from the Glenn Highway and re-erected it at O'Brien Creek in 1952. During the same year, the ARC built treated timber bridges at Alder, Columbia, and King Solomon creeks and the North Fork of King Solomon Creek (ARC 1953a:22; DOH 1972:31). Extreme high flood waters during spring breakup in 1954 damaged the camelback truss bridge at the Fortymile River. An ARC crew raised the 300-foot span and rebuilt the abutments (ARC 1954:24).

Construction of a new road from Paxson to Cantwell began in 1950 and the ARC built bridges along the route that came to be known as the Denali Highway. A contractor built a steel I-beam bridge at the Gulkana River (Bridge No. 681) in 1951-1952 (ARC 1951:20-21; ARC 1952b:16). Another contractor built four bridges, ranging from 80 to 305 feet in length, along the route in 1954-1955 (ARC 1954:23). Two of the bridges, the pony truss at Tangle River (Bridge No. 683) and the through truss at Fish Creek, were steel truss spans salvaged from the Glenn and Richardson highways. Contractors also built an un-treated timber bridge at Seattle Creek (Bridge No. 690) and a steel I-beam bridge at Rock Creek (Bridge No. 684) in 1954, and a steel I-beam bridge at Brushkana Creek (Figure 160) in 1955 (Bridge No. 689). Construction was completed in 1955 on a 295-foot steel deck truss bridge at Nenana River crossing No. 1, a 305-foot steel through truss at Nenana River crossing No. 2, and a timber stringer bridge at Jack River on the section of highway between Cantwell and Denali Park (ARC 1955:22). During 1955-1956, contractors built steel stringer bridges at MacLaren

Figure 160. Steel I-beam bridge at Brushkana River on the Denali Highway, May 20, 1955. U.S. Alaska Road Commission Collection, PCA 61-18-72, Alaska State Library.

River and Canyon Creek, and a steel deck truss bridge (Bridge No. 687) at the Susitna River (ARC 1955:22).

Contractors built three bridges for the ARC in the Fairbanks area in the early 1950s. Munter Construction Company completed the multi-span steel stringer Illinois Street Bridge over Noyes Slough (Bridge No. 283) in August 1951 (ARC 1951:21, 33; ARC 1952b:16). Boen-Sealand Contractors of Seattle began construction in 1952 on a 132-foot multi-span steel stringer bridge at Minnie Street across Noyes Slough (Bridge No. 295) and a 390-foot combination steel stringer and girder continuous bridge at Wendell and Hall streets on the Chena River (Bridge No. 532). The Chena River Bridge was fabricated in Portland, Oregon (Figure 161). Both bridges were completed in 1953 and the Chena River Bridge (Figure 162) replaced "the oldest steel bridge in the highway system of the territory"

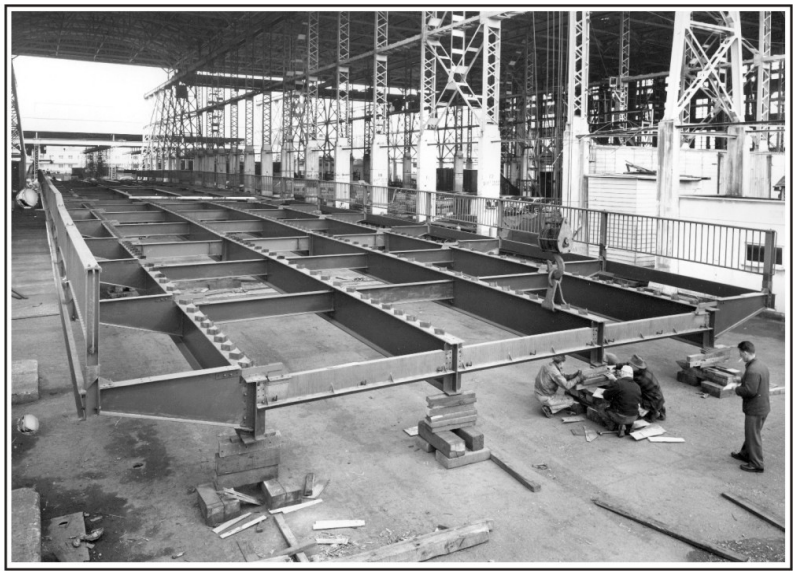

Figure 161. Fabricating the girders and I-beams in Portland for the Wendell Street Chena River Bridge, 1952. Achroyd photo, courtesy of ADOT&PF Bridge Section, Juneau.

Figure 162. The Chena River Bridge at Wendell Street, August 24, 1962. Photo by Harvey Golub, ADOT&PF Bridge Section, Juneau.

(ARC 1952b:10, 16; ARC 1953a:21; ARC 1954:22). The ARC also built a treated timber stringer bridge at Goldstream Creek on the Steese Highway in 1953.

The ARC built a number of other significant bridges in the early and mid-1950s. In 1951, crews installed steel corrugated metal culverts at Mile 156 at the Anchor River crossing (Bridge No. 4020) of the Sterling Highway. A contractor replaced the multiple span timber trestle bridge at Moose River of the Sterling Highway in 1954 with a 160-foot steel through truss bridge salvaged from the Seward-Anchorage Highway (ARC 1954:23, 40; ARC 1955:21, 25). On McKinley Park Road, contractors for the ARC built a steel stringer bridge at the Savage River in 1951 (ARC 1951:21; ARC 1952b:10, 16), steel stringer bridges at the Toklat, Teklanika and Santuary Rivers and at Igloo Creek between 1954 and 1956, a steel stringer continuous bridge at the East Fork of the Toklat River in 1955, and 12 treated timber stringer bridges at various places along the road between 1950 and 1956 (DOH 1972:54-55). Contractors built a steel stringer bridge at Big Boulder Creek on the Haines Cut-off in 1950 and a multi-span steel I-beam bridge at Indian River (Bridge No. 865) on Sawmill Creek Road at Sitka in 1952. ARC crews replaced decking, handrail and curbs on the 480-foot Skagway River bridge and jacked up the Dyea River Bridge to repair the abutments and rocker shoes (ARC 1954:27). The ARC rebuilt a 122-foot footbridge at Mansfield Indian Village in 1952-1953, (ARC 1953a:27). In 1953, the ARC borrowed two Bailey Bridges from the U.S. Army at Fort Richardson for use at water crossing where bridges had been destroyed or damaged by flooding (ARC 1953b). The ARC built two bridges south of Anchorage, a steel stringer span on Campbell Creek Road in 1954 and a treated timber span on Campbell Station Road in 1955. The ARC also built a steel stinger bridge at Horsetail Creek (Bridge No. 945), on Mineral Creek near Valdez in 1955.

By 1955, the six year program for connecting, improving and paving the primary highway system in Alaska was nearing completion (ARC 1955:2-3). Between 1949 and 1955, Congress appropriated $135,395,031 for road and bridge construction in Alaska. In just six years, Congress funded more than three times as much as it had in the previous 43 years put together (Naske 1987:6). In 1955, the ARC reorganized and designated its Engineering Division as the "Design and Construction Division," which included the "Bridge and Building Design Branch" (ARC 1955:4-5). The ARC started its Engineer in Training (EIT) program, which cycled engineering student interns through the different engineering sections, including the Bridge and Building Design Branch.

Donald F. Bolton succeeded DeLaHunt as Chief Bridge Engineer in early 1955. Bolton compiled data and distributed it to design personnel to assure uniform standard bridge design. The Branch also adopted pencil tracing cloth in lieu of tracing paper. During 1955, the Branch designed eleven major bridges, did preliminary design for six bridges, and designed eight structures utilizing trusses and beams salvaged from replaced bridges. The focus of activity was on replacement of old and obsolete bridges on the main roads of the highway system. The chief of the Design Branch and his principal assistant spent considerable time reviewing proposed bridge sites in the field with district personnel to improve the economics of bridge design (ARC 1955:13). The Branch also initiated an inspection program. Personnel assigned to inspect the work conducted on bridge construction contracts were given uniform training on inspection procedures. The ARC also began periodic inspections of existing bridges, but how often bridges were inspected in the 1950s remains unknown. The Branch developed a form for recording information during these inspections. The earliest inspection form found in the bridge files was filled out on the Eklutna River Bridge in August 1956.

BPR Bridge Building in the early 1950s

In the early 1950s, the BPR maintained 298.7 miles of Forest Highways in Alaska, less than a tenth of the 3,466 miles of highways, secondary and local roads, tramways and trails maintained by the ARC (Stoddart 1953; ARC 1953a:1). The BPR continued to design bridges and put them out to bid to private contractors on Forest Highways. Hugh Stoddart was the Engineer for the Alaska region and John Kiely was the Bridge Engineer. A.V. Walker succeeded John Kiely as the regional Bridge Engineer in 1954. During the early 1950s, major BPR bridges built in Alaska were designd at the BPR Western Headquarters in San Francisco (Stoddart 1951a; Stoddart 1951b). BPR engineers in Alaska designed short bridges and gradually assumed design responsibilities over medium and longer bridges by the mid-1950s. BPR contractors in Alaska during the early 1950s built timber trestles, timber box culverts, steel stringer/girder bridges, concrete girder bridges, and rigid form concrete bridges. Most of the major bridges constructed for the BPR during the early 1950s were steel stringer but a few were built with concrete girders. In the states by this time, concrete girder bridges had become the predominate bridge type favored by bridge designers.

The BPR in the early and mid-1950s built several rigid frame concrete bridges and experimented with precast and prestressed concrete girders made of light weight concrete and steel reinforcement. In 1951-1952, contractors working for the BPR on the Seward Highway between Seward and Mile 58.0 built five precast concrete girder bridges (Figure 163) and three rigid frame concrete bridges. BPR contractors also built a rigid frame concrete bridge on the Sterling Highway in 1951 and five more concrete girder bridges on the Seward Highway in 1952-1953. The BPR also widened the Copper River Highway in 1954 to two lanes between Cordova and the Cordova Airport.

Figure 163. Precast concrete stringers for BPR bridges on the Seward Highway, July 1951. U.S. Alaska Road Commission Collection, PCA 61-94-33, Alaska State Library.

Figure 164. The Eyak River Bridge (right), the first prestressed concrete bridge built in Alaska, nearing completion, August 1954. The old CR&NW trestle bridge, which was converted to automobile use in the late 1940s, is at left. BPR photo courtesy of ADOT&PF Bridge Section, Juneau.

The agency designed and had a contractor build a concrete slab bridge at the outlet of Eyak Lake near Cordova. The Eyak River Bridge (Bridge No. 381) was the first prestressed concrete highway bridge built in Alaska (Figure 164). The BPR decided to cast and prestress the Eyak River Bridge, consisting of concrete slabs on pilings, on site near Cordova to obtain design and cost information for this type of construction. BPR officials view the project as a means "to explore the possibilities for developing satisfactory bridge designs of maximum economy in the territory" (Walker 1954).

In 1955, a contractor for the BPR constructed a concrete girder bridge across the Kenai River at Schooner's Bend (Figure 165) using girders composed of light-weight concrete. BPR engineers designed the bridge and the concrete girders were fabricated in Oregon (Figure 166), shipped to and erected in Alaska. At the time, light-weight prestressed concrete girders appeared to be the future in bridge construction, but construction of them in Alaska was limited during the 1950s by the absence of local plants that could pour and prestress the girders (Goodall 1955:2). The cost of freighting concrete girders from plants in Portland and Seattle made steel girder bridges more economical than concrete girder bridges in Alaska. In addition, the ends of concrete girders tended to crack or spall in transit, raising questions about their strength in the critical portion of the girders that rested on abutments and piers. Such cracks developed on the Schooner Bend Bridge shortly after it was constructed. BPR bridge engineers watched the cracks closely in the following years and began to question the wisdom of using girders made of light weight concrete (Halsted 1963:60). While Oregon and other state highway agencies adopted light-weight prestressed concrete bridges

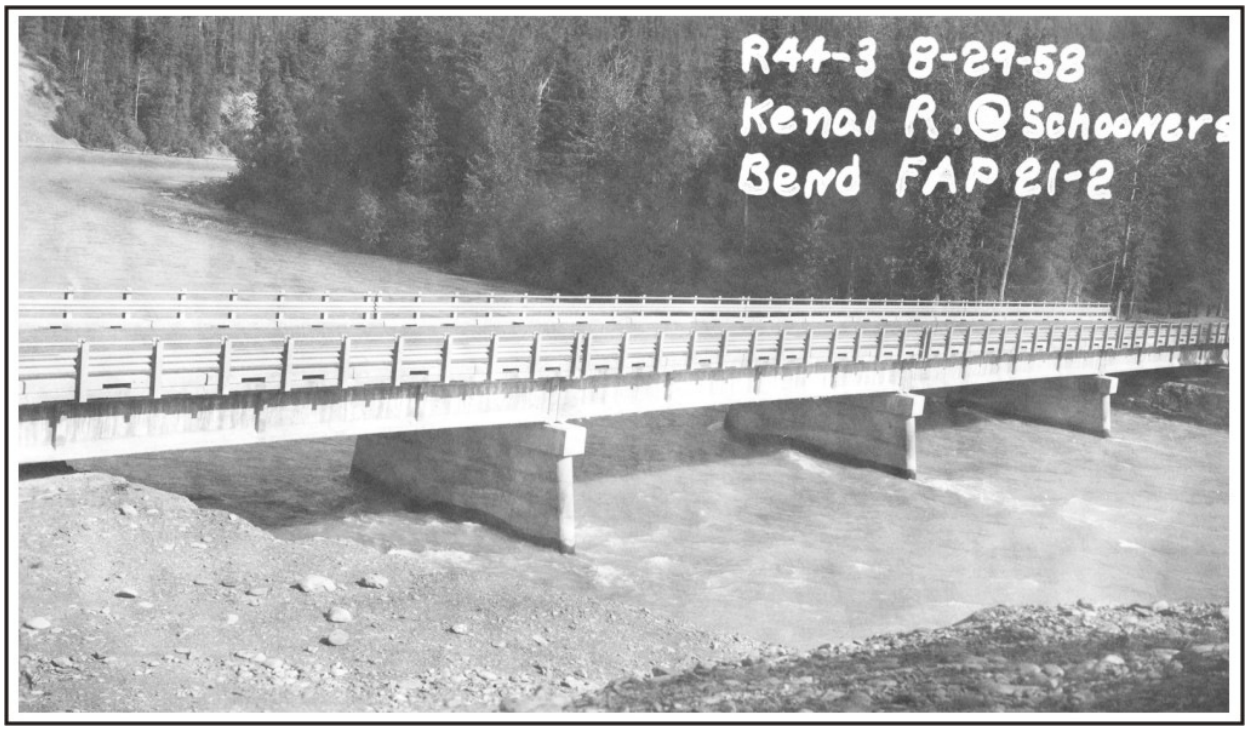

Figure 165. The light-weight concrete girder bridge at Schooners Bend on the Kenai River, August 29, 1958. BPR photograph, ADOT&PF Bridge Section, Juneau.

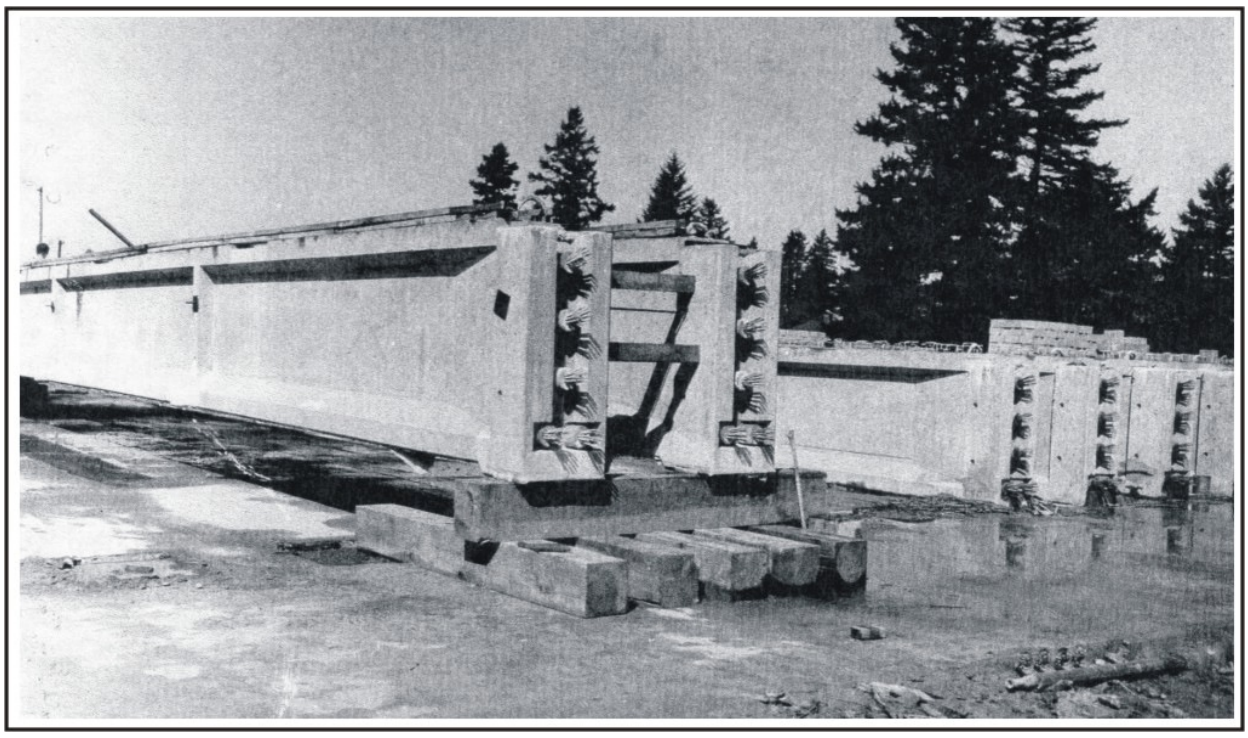

Figure 166. Girders for the Schooners Bend Bridge at the Kenai River at the casting plant in Oregon, 1955. The cables sticking out the ends were used for prestressing during manufacture. Photo courtesy of ADOT&PF Bridge Section, Juneau.

as their primary bridge type in the 1950s, the ARC and the BPR, after a brief interlude from 1948 to 1955, shied away from concrete in the late 1950s in favor of steel stringer/girder bridges.

The largest project undertaken by the BPR in the early 1950s was reconstruction of the Seward Highway from Seward to Mile 58 to bring that portion of the route up to the standards of the recently completed Turnagain Arm Road. The BPR used ARC funds to upgrade the old highway, the first use of Department of Interior funds on a Forest Road. The ARC and BPR entered into a joint agreement on the Seward-Mile 58 construction project, but friction developed between the two agencies over excessive costs for BPR's design and construction work on the project, especially on bridges (ARC 1951:34, 36). The BPR contractors started in Seward and worked their way north. They replaced 13 major bridges in 1952-1953, including steel I-beam bridges at Salmon Creek and Snow River No. 1; a steel stringer continuous bridge at Victory Creek (Bridge No. 607); concrete girder bridges at Bear, Ptarmigan (Bridge No. 608), Falls (Bridge No. 609), Trail (Bridge No. 610) and Moose creeks; treated timber stringer bridges at Grouse Creek No. 1, Snow River No. 2, Snow River No. 3, and a crossing called Snow River Overhead; and rigid frame concrete bridges at Quartz, Summit (Bridge No. 4011, Figure 167) and Colorado creeks. Contractors also built replacement bridges on the Seward Highway between Portage and Anchorage in 1953, including steel stringer bridges at Peterson, Glacier, Bird, Kern and Indian creeks and a 195-foot steel stringer bridge at Twenty-Mile River (ARC 1952b:14; ARC 1953a:20).

Major bridges built by contractors for the BPR in southeast Alaska during the early 1950s included a steel stringer continuous bridge at Fish Creek (Bridge No. 353) on North Douglas High-

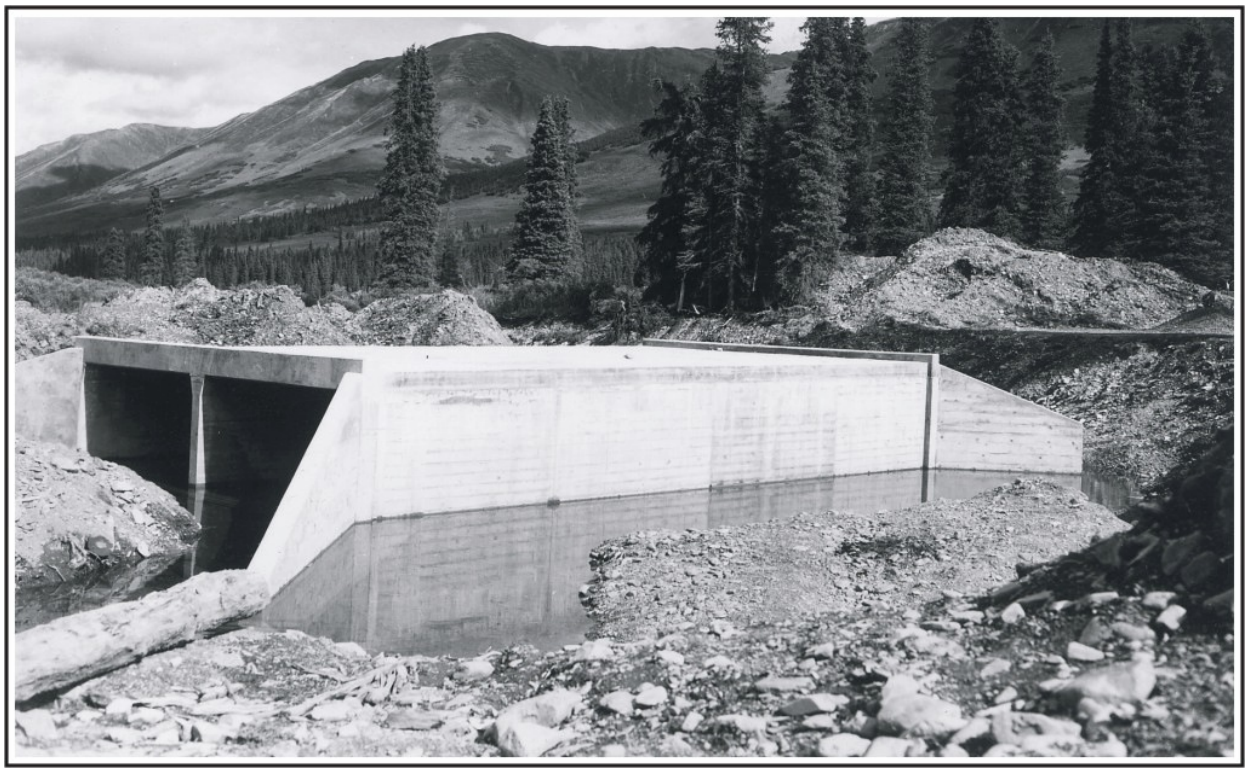

Figure 167. Rigid frame concrete bridge near completion at Summit Creek, Seward Highway, September 1951. U.S. Alaska Road Commission Collection, PCA 61-94-22, Alaska State Library.

way in 1950, a steel stringer bridge at Herring Cove (Bridge No. 253) on the South Tongass Highway in 1952 and a concrete girder bridge at Switzer Creek on the Glacier Highway in 1956. BPR bridges constructed on the North Tongass Highway included a steel plate girder bridge at Cannery Creek in 1950 and a treated timber stringer bridge at Ward Creek in 1951. Contractors built three bridges on the Sterling Highway within Chugach National Forest, including a rigid frame concrete bridge at Dave's Creek (Bridge No. 4002), the concrete girder bridge at Schooner's Bend on the Kenai River and a steel stringer bridge at Cooper Creek (Bridge No. 674) in 1955. The BPR built a treated timber stringer bridge at California Creek (Bridge No. 1027) on Crow Creek Road near Girdwood in 1950. Contractors working on the Copper River Highway for the BPR built six treated timber stringer bridges east of the Cordova Airport in 1953 and a steel stringer bridge at Alaganik Slough in 1956.

Other Bridge Building Agencies in the 1950s

Several other federal agencies built bridges during the 1950s. The U.S. Forest Service continued to build Forest Development Roads and Trails in southeast and southcentral Alaska to promote logging (Metcalf 1951:5; Metcalf 1953:6). Forest Service crews built treated timber bridges in the Cooper Landing area, including one at Shackleford Creek on Snug Harbor Road in 1954 (DOH 1972:41) and two on Quartz Creek Road, at Quartz Creek No. 1 (Bridge No. 1020) in 1958 and Crescent Creek (Bridge No. 1021) in 1959. The U.S. Bureau of Mines financed the reconstruction of several bridges built in the 1940s on the road from Seldovia to the Red Mountain Road Chromium Mine on the south side of Kachemak Bay on the Kenai Peninsula. Untreated timber stringer bridges were built at Miles 5.1 and 5.4 during 1955 to access the chromium mine (DOH 1972:40).

Another source of funding for bridges in the 1950s was the Alaska Public Works Program, authorized by Congress on August 24, 1949 and terminated in 1961. During the course of this program, $69 million dollars was spent in Alaska on public works construction projects in Alaskan cities and towns. This program funded the reconstruction of Tongass Avenue, the main street in Ketchikan that connected neighborhoods scattered along the steep coast line (American Society of Civil Engineers, Alaska Section 1976:59). The Tongass Avenue project replaced a dilapidated wood trestle running along Ketchikan's waterfront with a concrete thoroughfare that included three bridges. The Water Street Viaduct (Bridge No. 797), consisting of concrete "T" and I-beam girders and pre-cast concrete panels, was completed in 1955. It was 1,624 feet long and 60 feet wide (Figure 168). The Tongass Avenue Viaduct (Bridge No. 997), made up of prestressed reinforced concrete I-beam s and cast-in-place reinforced concrete slabs, was completed in 1955. It was 1,727 feet long and 60 feet wide. A prestressed concrete girder bridge at Hoadly Creek (Bridge No. 725) was constructed at the north end of the arterial in 1956. Near the south end, contractors cut a tunnel through the hillside for one-way traffic. All utilities were placed under the Water Street and Tongass Avenue viaducts. Other bridges built by or for the City of Ketchikan during the 1950s included the treated timber Bauer-Hopkins Trestle (Bridge No. 1472) in 1950, a treated timber stringer bridge at Third Avenue in 1953 (DOH 1972:53), and the salvage of a steel pony truss bridge at Carlanna Creek and its re-erection across Ketchikan Creek (Bridge No. 726) at Park and Harris Streets in 1957.

The Territorial Legislature continued to fund road and bridge projects in the 1950s, but its contributions were dwarfed by the massive construction projects of the ARC and BPR. The Territory

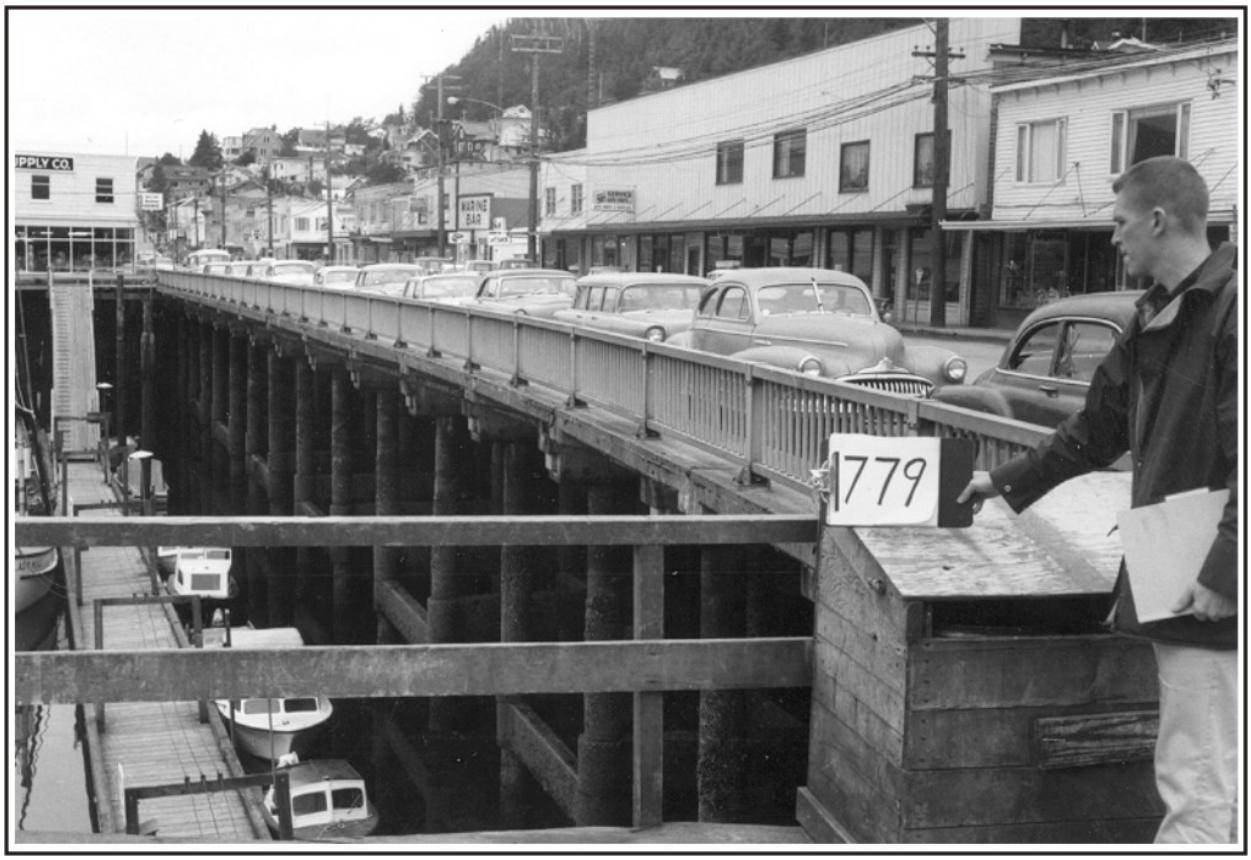

Figure 168. The Water Street Viaduct, mid-1950s, part of the City of Ketchikan's reconstruction of Tongass Avenue. Photo courtesy of ADOT&PF Bridge Section, Juneau.

contributed 11.7 % of the total funds expended for road work from 1920 to 1940, but its contribution fell to 1.2 % of the total in 1950-1952 (Metcalf 1953:5-6). The Alaska Territorial Legislature changed the composition of the Territorial Board of Road Commissioners in 1953. The new board included the highway engineer and a representative from each judicial district chosen by the governor. The new board, the precursor to a territorial highway agency, had no work force, but the Territorial Highway Engineer began hiring professional engineers to investigate highway routes and handle modest projects by contract (Naske 1987:166-167). The board made grants to local communities to build and repair roads and bridges. It provided funds to the City of Seldovia in 1951-1952 to repair a bridge on the road between Point Graham and English Bay (Reed 1955:51). During the following biennium, the board funded repairs to a bridge across the Klawak Lagoon, funded construction of a gridiron (elevated road) at Pelican, paid for repairs on a pile bridge on the Naknek-King Salmon Road, and rebuilt a bridge across the Nulato River between the village and the airfield (Reed 1955:9, 13, 41, 50, 54). The City of Pelican matched the territorial grant and completed the Main Street Boardwalk (Bridge No. 1268) in 1958, using treated timbers. The territory also paid for the rebuilding of a bridge across the Davidson Ditch on a tractor-jeep road branching off from the Steese Highway. A local mining company supplied the timber for the bridge (Reed 1955:53). All

work using territorial funds was done by contract with road building agencies, cities, contractors or miners (Reed 1957:3). A few communities built bridges without territorial support. The City of Hyder built a treated timber Dock Trestle (Bridge No. 1238) on Salmon River Road in 1950.

Consolidation of ARC into the BPR

With passage of the Federal Aid Highway Act (Public Law 672) in 1956, Alaska became eligible to participate for the first time in federal highway aid programs (Reed 1957:4). Beginning in 1958, Alaska became eligible to receive $13.2 million from Congress with a 10% matching requirement. Under provisions of the new law, the ARC was transferred to the Department of Commerce on September 16, 1956 and combined with the BPR to form a single federal agency responsible for building roads and bridges in Alaska (ARC 1955:1; ARC 1956:4). The reorganized agency was designated BPR Region 10, with the regional office in Juneau and district offices in Anchorage, Valdez, Fairbanks, Nome and Juneau. The reorganized BPR, which including the former ARC organization and its employees, consisted of 1,008 employees responsible for 5,152 miles of road, of which 1,959 miles were primary system (hard surfaced), 3,193 miles were secondary or feeder roads. Half of the secondary roads were connected to the primary system and the other half was connected isolated communities by rail, water or air transport (BPR Annual Report 1957:1).

The new Alaska BPR largely retained the administrative organization developed by the ARC. Long-time ARC employee A.F. Ghiglione was appointed acting BPR Regional Engineer, but BPR headquarters in Washington, D.C. replaced him with long-time BPR engineer Edgar H. Swich in March 1957. The ARC had been the only federal agency in the territory with full decision making power in the field. BPR operated differently, with bureaucratic control vested in Washington, D.C. And Swich's appointment insured that Juneau would be under Washington's control (Naske 1987:180-181).

The ARC and BPR bridge design sections were combined into a single unit. Donald F. Bolton (Figure 169), the Chief Bridge Engineer at the ARC, became the Supervising Bridge Engineer for the new BPR. At least eleven engineers from the ARC Bridge Branch transferred along with Bolton to the BPR "Bridge and Facilities Section" during the reorganization. Bridge files and plans from the two bridge design agencies were combined, but not all bridge records ended up in the same place. The Forest Highway system on the Kenai Peninsula became part of the BPR Division in Anchorage, but the BPR Engineer in Anchorage did not receive any drawings, plans, sketches or real estate records for the Forest Highway system, including bridges, on the Kenai Peninsula (Zimmerman 1959).

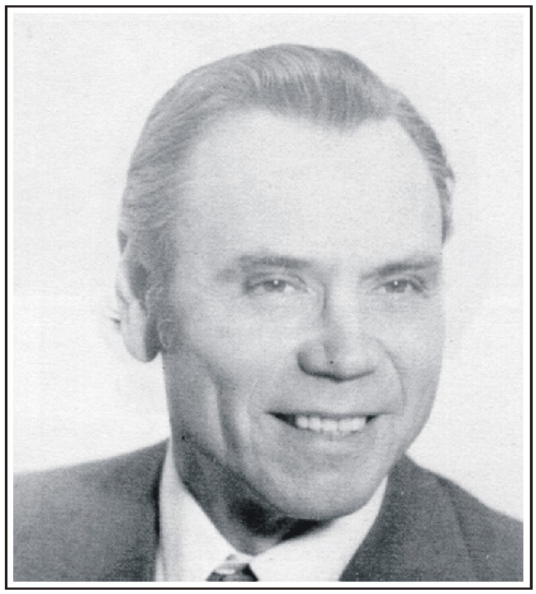

Figure 169. Donald F. Bolton, chief bridge engineer of the ARC from 1955 to 1956 and the BPR from 1956 through 1959. Photo reprinted from American Society of Civil Engineers (1976:111).

During fiscal year 1956, the BPR's Bridge and Building Design Branch designed 17 bridges and five major drainage structures and did preliminary design on seven other bridges (ARC 1956:13). Most of the bridges replaced timber stringer and trestle bridges that had become obsolete. The BPR's preferred bridge type during the late 1950s was the steel stringer (Table 9), which accounted for nearly half of all bridges constructed. The BPR designed two concrete girder bridges that were constructed in southeast Alaska near the coast. BPR or its contractors built seven timber stringer bridges for short stream crossings. The BPR also experimented with laminated timber stringer bridges. Seven steel truss bridges were salvaged from major highways and re-erected on secondary roads.

Table 9. BPR Bridge Types Built 1957-1959

Bridge Material and Type	1957	1958	1959	Total
Timber Stringer	-	2	-	2
Treated Timber Stringer	2	-	3	5
Steel Pony Truss	2	-	-	2
Steel Through Truss	2	1	2	5
Steel Stringer	11	7	4	22
Steel Stringer Continuous	1	4	1	6
Steel Plate Girder	3	1	2	6
Steel Plate Girder Continuous	1	-	1	2
Concrete Girder	1	-	-	1
Prestressed Concrete Girder	1	-	-	1
Subtotals	24	15	13	52

(Sources: DOH 1972 and ADOT&PF Bridge Section Files)

BPR contractors constructed seven steel stringer/girder bridges on the Richardson Highway in the late 1950s. Steel stringer structures were completed at Phelan Creek (Bridge No. 579), Lower Miller Creek (Bridge No. 582) and Munson Slough (Bridge No. 2126) in 1958. Pacific Construction Company completed a steel plate girder continuous bridge (Figure 170) at the Klutina River (Bridge

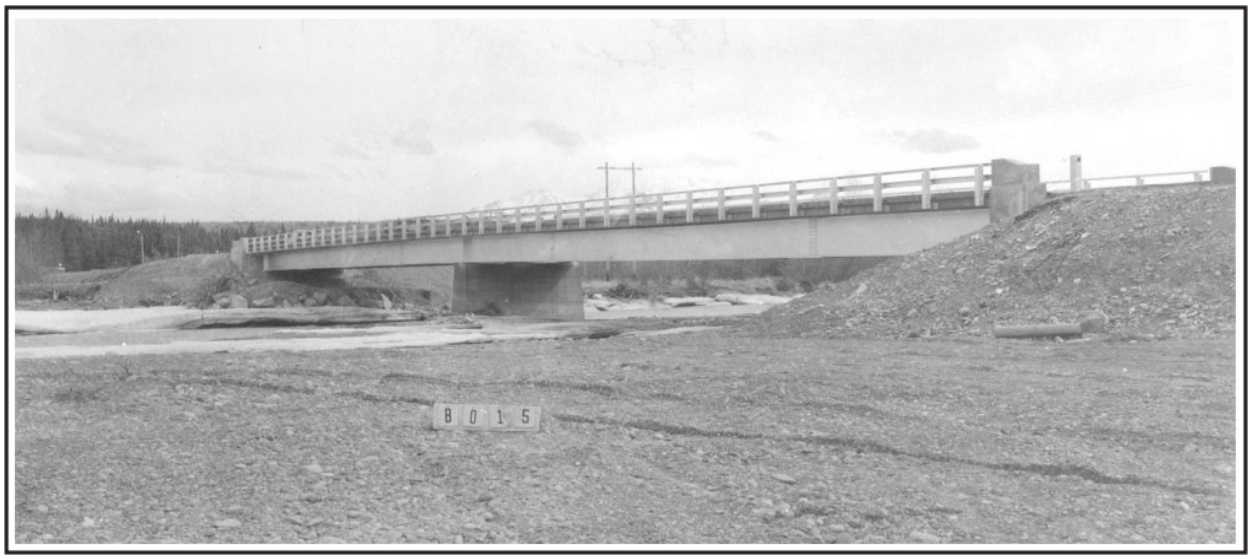

Figure 170. The steel plate girder continuous bridge at the Klutina River on the Richardson Highway, 1959. Photo courtesy of ADOT&PF Bridge Section, Juneau.

No. 572) and a steel stringer continuous at the Tonsina River (Bridge No. 569) in 1957. Nygren Construction Company completed steel stringer continuous bridges at Upper Miller Creek (Bridge No. 581) and Castner Creek (Bridge No. 583) in 1958. Contractors for the BPR replaced eight timber trestle bridges on the Alaska Highway with steel stringer bridges in 1956-1957. The new bridges were completed at Cathedral Rapids creeks No. 1, No. 2 and No. 3; Sheep, Bear and Chief creeks, Dry Creek (Bridge No. 517), and a bridge over an un-named stream near Delta Junction.

On the Glenn Highway, contractors for the BPR built six steel stringer/girder bridges in 1957-1959. They included steel stringer continuous bridges at Moose Creek (Bridge No. 541) and Granite Creek in 1958, and steel stringer bridges at Moose River, Purington Creek (Bridge No. 546) in 1957, Eska Creek in 1958, and Eagle River in 1959. Contractors completed a multi-span steel stringer bridge at Clearwater Creek (Bridge No. 686) on the Denali Highway in 1957 and a multi-span steel stringer bridge at Little Gold Stream Creek (Bridge No. 678) on the Fairbanks-Nenana Highway in 1958. The BPR oversaw construction of steel stringer bridges at Rock, Stony and Gighlione creeks on the McKinley Park Road during 1957-1958. The ARC began construction of the Livengood-Rampart Road (Elliott Highway) in 1952 (ARC 1953:14) and continued throughout the decade. In 1959, the BPR built a treated timber bridge on the road at Livengood Creek (Bridge No. 229). Steel stringer bridges were completed in 1959 at the South Fork of the Anchor River (Bridge No. 666) on the Sterling Highway and at Campbell Creek on the Seward Highway near Anchorage. In the Nome area, contractors working for the BPR built seven new bridges in the late 1950s. Five were steel plate girder structures located at Bonanza Channel and Solomon River on the Nome-Council Road, at Grand Central River and Kruzganepa River on the Nome-Taylor Road, and at Snake River (Bridge No. 324) on the Nome-Teller Road (Figure 171). Contractors also built a steel stringer bridge at Penny River (Bridge No. 323) on the Nome-Teller Road and a timber stringer bridge at No Name

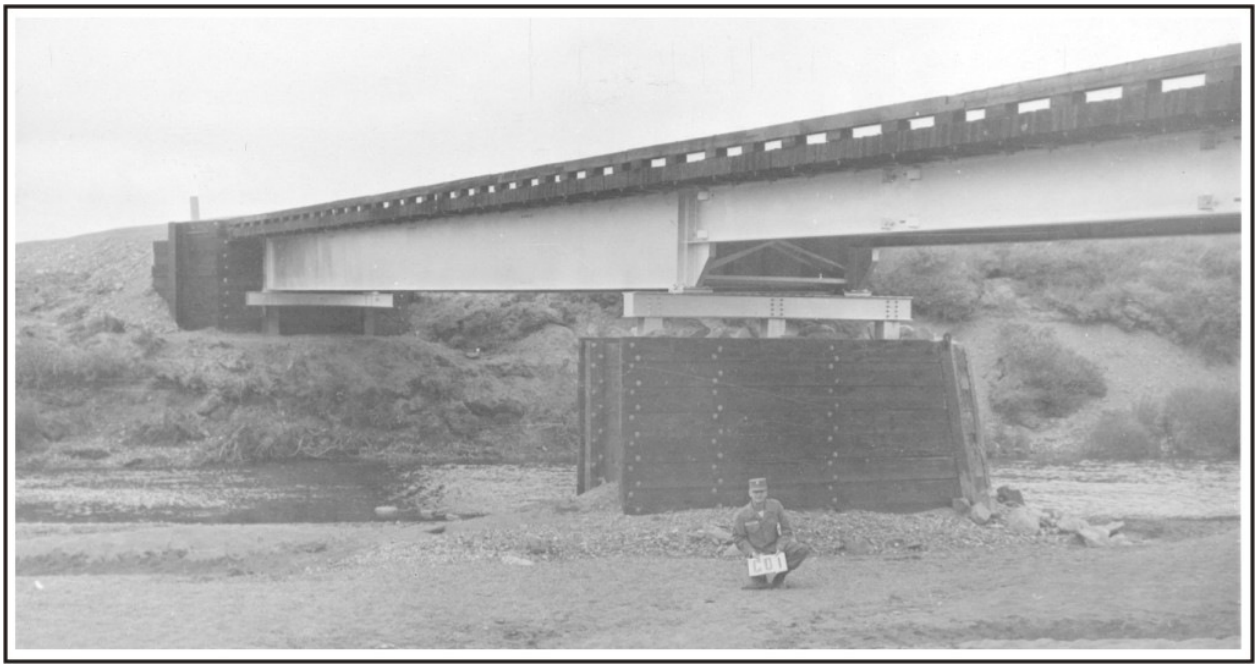

Figure 171. The steel plate girder bridge at Snake River on the Nome-Teller Road, 1957. U.S. Army photograph, courtesy of ADOT&PF Bridge Section, Juneau.

Creek on the Nome-Council Road. The BPR built a small number of steel stringer and treated timber bridges on local roads in central and northern Alaska during the late 1950s.

In southeast Alaska, contractors for the BPR built eight bridges, including four steel stringer/girder bridges, two concrete girder bridges, and two treated timber stringer bridges. A multiple-span steel stringer bridge was constructed at the Chilkat River (Bridge No. 742) on the Haines Highway in 1958 and a steel stringer continuous bridge was erected at Fish Creek (Bridge No. 353) on the North Douglas Highway in 1959. The contractor Cole and Paddock of Juneau built a steel plate girder bridge at the Herbert River (Bridge No. 736) and a steel plate girder continuous bridge at Eagle River (Bridge No. 735), both on the Glacier Highway, in 1959. Other contractors for the BPR completed a concrete girder bridge at Montana Creek on the Mendenhall Loop Road north of Juneau and a prestressed concrete girder bridge at Carlanna Creek on the North Tongass Highway near Ketchikan in 1959. The BPR built two treated timber bridges in 1959, one at the Klawak River on the Craig-Klawak Road and the other at Ohmer Creek (Bridge No. 388) on the Mitkof Highway south of Petersburg.

As BPR contractors replaced narrow, steel truss bridges on main highways with steel stringer/girder bridges, the old truss bridges were salvaged and re-erected on local roads. Contractors erected two salvaged steel truss bridges on the Steese Highway in 1957. The first was a steel pony truss bridge salvaged from Ahtel Creek on the Tok Cutoff that was re-erected at Crooked Creek (Bridge No. 431) on the Steese Highway. The other was a camelback steel truss salvaged from the Chickaloon River on the Glenn Highway and re-erected at Birch Creek (Bridge No. 355, Figure 172). Another contractor salvaged a steel through truss bridge from Phelan Creek on the Richardson Highway and re-erected it at Hutlinana Creek on the Livengood-Rampart Road in

Figure 172. A crew re-erecting the former Chickaloon River Bridge at Birch Creek on the Steese Highway, September 2, 1957. Photo courtesy of ADOT&PF Bridge Section, Juneau.

Road in 1958. During the following year, the Pennsylvania steel truss bridge salvaged from the Chena River at Fairbanks was transported to and re-erected at the Kuzitrin River (Bridge No. 398) on the Nome-Taylor Road. The old Chena River span was the first steel truss bridge built in Alaska for automobiles.

As the Chief Bridge Engineer of BPR's Bridge Design Unit, Donald Bolton was responsible for a number of innovations that would have long term implications for bridge design in Alaska. Starting in 1955, while chief of the ARC Bridge Design Branch, Bolton required contractors to provide completion photos of the bridges that they built. Bolton was one of the few high level Alaska BPR managers who traveled in the late 1950s. His highway odometer log provided the basis for BPR's first territory-wide bridge inventory list. Bolton handed his odometer log to draftsman Rob Mourant and told him to make up a bridge list. The inventory listed the bridges by highway and milepost, similar to the ARC's 1952 inventory, but the new list included bridges on public roads and trails throughout the territory. In the late 1950s, engineers in the BPR Bridge Unit followed specifications in Federal Projects 1957 (FP-57) for design and contracting standards for bridge construction. All bridge design work was done in-house in the four years before statehood. Draftsmen worked with ink on fabric and drafted timber, steel truss and steel stringer/girder bridges (Mourant 2005:1-2, 4-5, 9). Just prior to statehood, engineers in the bridge design unit came up with an idea for insulating pilings in permafrost ground. When water attached to bridge pilings in permanently frozen ground, frost jacking could lift the piles out of the ground or make them sink out of sight. In a few cases, bridge substructures sunk into massive sink holes. Thermo piles helped keep permafrost frozen. In the 1960s, state bridge engineer Dennis Nottingham developed thermo couplings to insulate piling and abutments on bridges anchored in permafrost (Mourant 2005:7).

Unlike other BPR divisions in the United States, the BPR in Alaska functioned in a capacity similar to that of a state or territorial highway department. The Alaska Territorial Legislature sought to change that when it passed an act on April 1, 1957 creating an Alaska Highway and Public Works Department. The new department included a highway division to plan, design, construct, and maintain roads and bridges. It took time for the territorial highway agency to develop (Naske 1987:183-185, 191), however, so the BPR entered into an agreement with the Territorial Division of Highways in 1958 to jointly plan projects in 1959. Congress passed the Alaska Statehood Act on June 30, 1958, President Dwight Eisenhower signed the act into law on July 7, 1958, and Alaska officially became a state on January 1, 1959. The new State Highway Division was unable to assume responsibilities in 1959, So Governor William Egan and the BPR signed a contract on July 1, 1959, authorizing BPR to perform certain functions and services for the state. In the spring of 1959, E.H. Swich was replaced as BPR Regional Engineer in Region 10 by William J. Neimi, who oversaw the transition of road maintenance and construction activities from the BPR to a state highway agency. The State began taking over road maintenance while the BPR negotiated consultant services for design and construction of roads and bridges. The State hoped to take over all highway functions on July 1, 1960, but fell behind schedule. When it became apparent that the State of Alaska would not be able to assume full highway functions by July 1, 1960, the BPR amended its contract with the State to continue overseeing bridge design and construction services (Naske 1987:357-359, 378).

The question of whether or not to build more concrete girder bridges in Alaska came up again in early 1959 when BPR headquarters in Washington, D.C. sent a circular to the each of its regional offices asking for information on the performance of prestressed concrete girder bridges (Williams

1959). The Alaska BPR Bridge Design Unit was doing preliminary planning at the time for a bridge over the Chena River at University Avenue in Fairbanks. Officials in the recently created State Division of Highways were considering whether to design the new Chena River Bridge as a three-span prestressed concrete girder bridge, even though the cost would be more expensive than a three-span steel stringer bridge. BPR Regional Engineer William J. Niemi thought the added expense would encourage concrete companies in Alaska to invest in prestressed concrete technology, which would ultimately same the state money in the future. State officials ultimately decided in favor of the less expensive conventional steel stringer design (Bolton 1959; Neimi 1959; DeLaHunt 1960).

Legacy of the 1950s

The 1950s was a time of change and consolidation in bridge design and construction in Alaska.. The ARC and BPR implemented the changes in bridge design and construction started in 1948 by professionalizing their design staff and contracting out the construction of most bridges. The ARC and BPR expanded the use of steel stringer/girders and treated timbers in bridge construction. The ARC preferred steel stringer/girder bridges for medium length spans and treated timber stringer bridges for short spans. The BPR, drawing initially upon the expertise of its bridge engineers in the states, built a number of concrete girder bridges in the early and mid-1950s, but steered away in the late 1950s from using light-weight concrete girders that had become the predominate bridge type in the states. The often competitive and sometimes contentious relationship in Alaska between the ARC and the smaller BPR was put to rest in 1956 when Congress mandated that the two agencies be combined. Highway bridge design in Alaska was consolidated in a single agency, the BPR, with jurisdiction over roads and bridges throughout the territory. Public works funds from the federal government also fueled bridge construction in Alaska towns and cities. The largest and most ambitious municipal bridge project of the decade was undertaken in Ketchikan. Using federal public works funds, the City of Ketchikan hired contractors to built the first major concrete girder and slab viaducts in Alaska since the City of Juneau constructed the Calhoun Viaduct in the mid-1930s.

X. BRIDGE CONSTRUCTION DURING EARLY STATEHOOD, 1959-1964

The early years of Statehood were a critical time for the development of road and highway bridges in Alaska. The new State Division of Highways started its own bridge design section and recruited experienced personnel to take over the functions of preliminary planning, design and developing bid specifications for construction of new bridges. The State also introduced new bridge types and developed a bridge inspection program. The 1964 Earthquake destroyed and damaged a significant proportion of the State's highway bridges, interrupted the State's bridge building program and prompted the Bridge Section to reassess its choice of bridge types, materials and designs in the aftermath of the Earthquake.

Creating a State Bridge Design Section

After Alaska officially became a state in January 1959, it took more than two years for the new state to create its own Bridge Design Section and recruit qualified personnel to take over the task of designing new bridges for the state's highway construction program. During the interim, before the state Bridge Design Section was fully functioning, the BPR provided design services to the state under a contractual agreement. Don Bolton, the chief bridge engineer for BPR in Alaska, directed the bridge design work until the state hired a bridge chief and established its own bridge design program. The BPR's San Francisco office designed some Alaska bridges, such as at Whitman Creek (Bridge No. 1078) on South Tongass Highway, that BPR put out to bid for construction.

Bolton planned to have consultants design many of Alaska's new bridges, rather than have in-house staff design the bridges, until the state had a functioning bridge design shop. The BPR contracted with private engineering firms to design bridges and BPR administered the construction contracts. As the state Bridge Section acquired staff, its personnel became active in checking the consultants' work to see that it met the latest standards of bridge design. BPR hired consultant Tippetts, Abbett, McCarthy and Stratton Consulting Engineers (TAMS) of New York City to do the preliminary and final design on five Parks Highway bridges. TAMS, with BPR support, wanted to design all of the Parks Highway bridges. These projects did not all work out well because of poor site evaluation and design. TAMS designed the bridges to be built in dry creek beds, then the rivers were re-channeled under the new bridges. The rivers were unpredictable, however, and several changed channels after construction was completed. One of these bridges had to be rebuilt later. The State Bridge Section objected to TAMS designing other Parks Highway bridges and the state bridge engineers, over the objections of the BPR, designed the rest of the bridges along the Anchorage-Fairbanks route (Lium 2005:1, 4).

Contracting for bridge design was one of several issues that strained the relationship at times between the State Bridge Section and the BPR as the two agencies sought to define their roles during the early years of statehood (Halsted 2005:3). By late 1962, consultants were still doing preliminary design for bridges proposed for crossings at the Yukon River near Tanana; the Susitna and Chulitna rivers, Hurricane Gulch and the Tanana River on the Parks Highway; and the Copper River near Chitina for a road between Chitina and McCarthy. The firm of Sverdrup and Parcel studied the Tanana River crossing at Nenana to determine if use of the Alaska Railroad bridge or a ferry were

feasible to carry highway traffic. The State decided to build a separate highway bridge 120 feet downstream from the railroad bridge. The Bridge Design Section did the final design on these projects. Consultants prepared final design, plans and specifications for 14 bridges on the proposed Bering River Highway, but the bridges were never built. State Bridge Section employees completed bridge plans and specifications and checked on another 11 bridges in 1961 (Sherard 1961:8-12).

When the State Division of Highways was formed in 1960, the "Bridge Design Section" was placed administratively under the supervision of the Assistant State Highway Engineer for "Operations" (Sherard 1961:5). Robert Lium (Figure 173) was the first employee in the new Bridge Design Section. Lium was a bridge engineer who worked in BPR's Alaska Bridge Design Branch. In early 1960, BPR loaned him to the State to help set up a bridge design program (Lium 2005:1; Mourant 2005:2). At the same time, recruitment was underway for a chief bridge engineer to head the section. In March 1960, the State hired Raymond Archibald, who had designed Alaskan bridges as a BPR employee, and named him chief of the new bridge section. Prior to accepting the job, Archibald served 12 years as head of the National Bridge Association Board. He set up the bridge design program for the State of Alaska and resisted pressure from BPR to hire consultants to design most of the state's bridges. Archibald preferred a professional staff that did design work in-house. He helped keep Alaska on the leading edge of technology through his professional contacts (Lium 2005:1, 5).

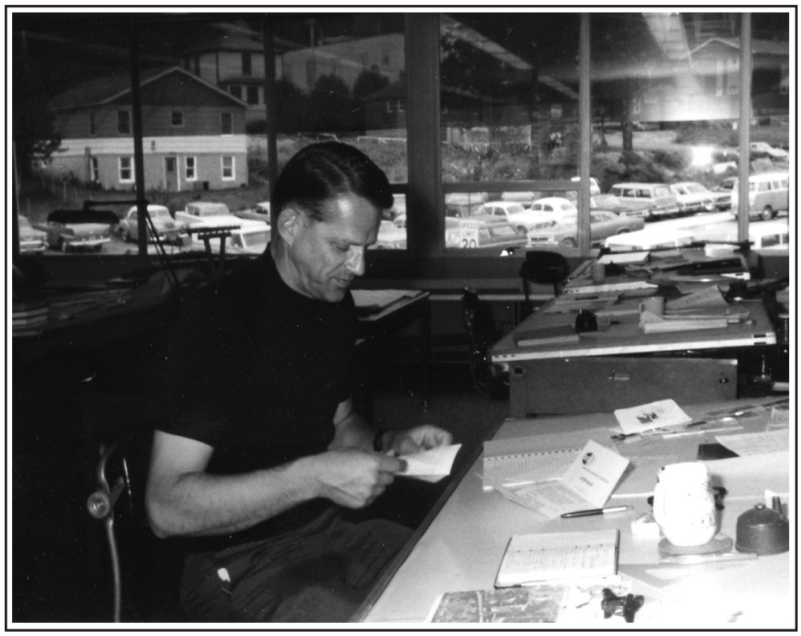

Figure 173. Robert Lium, the first employee hired to work in the State's Bridge Design Section, at his desk in Douglas in the late 1960s. Photo courtesy of Bob Mourant, Juneau.

As the Division of Highways hired staff in 1960 and 1961, the State offered BPR employees various jobs. Many of the people who went to work for the Bridge Design Section transferred from the BPR Bridge Design Branch. Bob Mourant, Don Prow and Bill Gute came over from BPR to the state shortly after Archibald was hired. There were 10-12 employees in the section in 1960. Donald Halsted, a bridge engineer for the State of California, moved to Alaska in June 1960 to work in the Alaska's new Bridge Design Section. Harvey Golub, another professional bridge engineer, moved to Alaska in 1962 and began working for the Bridge Design Section (Lium 2005:1; Mourant 2005:3; Halsted 2005:1). After Archibald retired in February 1962, he selected Charles P. Smith (Figure 174) to succeed him as chief bridge engineer. Smith, who had been a colonel in the U.S. Army, was hired

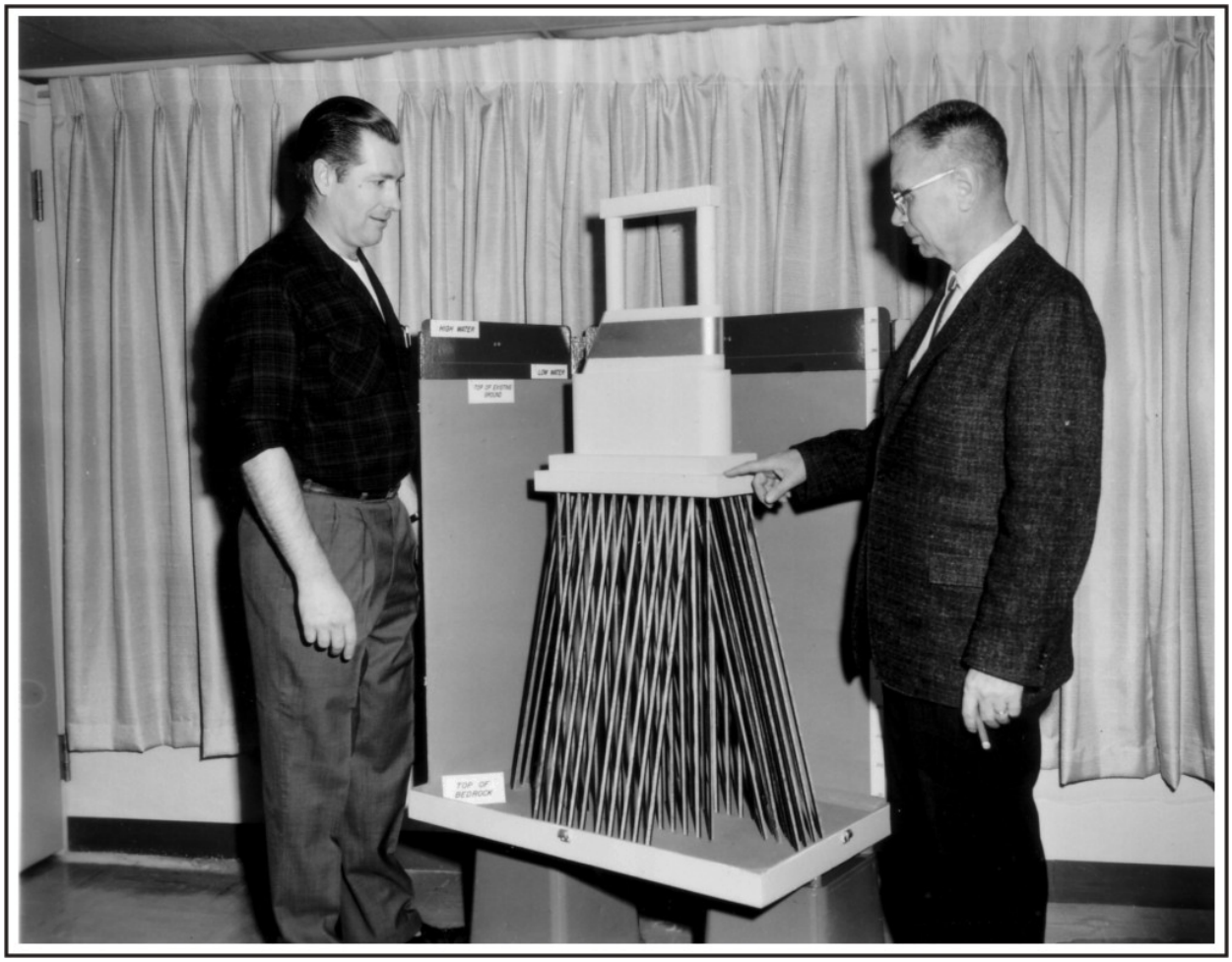

Figure 174. Donald E. Halsted (left) and Charles P. Smith, head of the Bridge Design Section, with a scale model of the main pier of Bridge No. 202, Tanana River at Nenana, about 1965. Photo courtesy of Donald Halsted, Juneau.

from outside. He carried on Archibald's mission of establishing a professional program to design bridges in-house (Halsted 2005:2; Lium 2005:5).

The Bridge Section was responsible for design and review of bridge construction and maintenance on the state highway system. Actual bridge construction was supervised by highway engineers in the district where the bridge was constructed. The design section checked all shop fabrication and construction drawings prepared by contractors, made recommendations for difficult construction problems and inspected completed structures prior to acceptance by the State (Sherard 1961:6). In the first two years, the Bridge Section did preliminary and final design only, and the section's duties did not include bridge inspection, and review of bridge construction and maintenance. The Bridge Section was divided into three or four squads. Each squad, consisting of two to three engineers and a couple of draftspersons, was assigned bridges to design (Halsted 2005:1; Mourant 2005:5). By the end of 1961, staff consisted of five bridge design engineers, six engineer assistants,

two draftsmen, a messenger and a secretary. As the State took over designing bridges in Alaska, BPR assumed the roles of oversight for federal aid funds and review of bridge designs before they went out to bid (Sherard 1961:5, 17).

The BPR transferred its files on bridges on state roads to the Division of Highways in 1960 and 1961 (Jones 1960). All plans, specifications, estimates and each bridge folder were hand delivered to the State. BPR kept the bridge files on McKinley Park Road and on bridges in national forests. The section also adhered to the traditional definition of a bridge: if there was a 20-foot clear span, then it was a bridge. If less than 20 feet, it was considered a culvert (Mourant 2005:3). After the BPR delivered the files on each bridge to the state, Bob Mourant started an organizational system to keep track of bridge plans and data. Each bridge was given a number, ranging from 200 to 1089, because of the repetition of names of streams in Alaska. About 80 were proposed bridges and 800 were existing bridges in 1961. A card file system was also started to provide a summary index of the bridges (Sherard 1961:16; Mourant 2005:4-5).

Bridge Section engineers often used standard field plans, known as Stratton standard plans,[1] to prepare plans for bridge construction contracts. Most bridges were designed using pieces of these standard plans. Each set of bridge plans usually had seven sheets: 1) general layout; 2) topographic layout; 3-6) Stratton standard plans; and 7) plans for railings. The preparation of standards plans developed when there was slack time in the bridge shop. The chief bridge engineer could always justify use of time for putting together standard plans. Don Bolton started using standard plans at BPR in the late 1950s. They included standard steel through truss spans in various lengths. The bridge engineers also did an economic feasibility study for each proposed bridge to determine which material--steel, timber or concrete--would be most cost effective for the bridge. It was also common in the 1960s to salvage and re-use all or portions of the superstructure of steel truss and steel stringers bridges. The State did not reuse piling and decking material because of deterioration (Mourant 2005:2-4).

Bridge Construction by the State in the Early 1960s

The State's Division of Highways, which was reorganized as the Alaska Department of Highways on March 15, 1962, was the primary builder of road and highway bridges in Alaska during the early 1960s.[2] After a slow start in 1960, the State completed 13 bridge projects under contract in 1961 and had nine bridges on primary routes and three bridges on secondary routes under construction by the end of 1961. The Bridge Design Section, which was in the "Pre-construction Division" of the new department, worked on preliminary studies of stream crossings on 12 creeks or rivers during 1961 and prepared final design plans and specifications for five major bridges (Sherard 1961:9, 12-13). The State's bridge design philosophy was to "utilize the latest advances in design

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[1] Stratton standard plans were named for O.A. Stratton who worked for the ARC from 195-1943 creating standard plans for steel pony and truss bridges.

[2] Most of the bridges built in 1960 were designed by the BPR and built under contracts administered by BPR during the interim while the State was organizing a Division of Highways.

criteria, construction methods and materials" that were "adaptable to Alaska and with these advances, provide permanent structures, adequate for future traffic, at the least cost to the State" (Sherard 1961:6). The practical result was a continuation in the early 1960s of the use of materials and bridge types used by the ARC and BPR in the 1950s (Table 10).

Table 10. Bridge Types Built by the State of Alaska, 1960-1964

Bridge Material and Type	1960	1961	1962	1963	1964	Total
Timber stringer	1	4	0	5	50	60
Treated timber stringer	2	1	7	0	1	11
Glu-laminated stringer	0	0	1	0	0	1
Steel pony truss	0	1	0	0	0	1
Steel through truss	0	3	0	1	0	4
Bailey truss bridge	0	1	0	0	3	4
Steel arch	0	0	0	1	0	1
Steel stringer	0	3	4	2	6	15
Steel stringer continuous	0	0	1	0	1	2
Steel plate girder	0	1	0	1	0	2
Concrete girder	0	0	0	0	0	0
Prestressed concrete girder	0	0	1	5	0	6
Subtotals	3	14	14	15	61	107

(Sources: ADOH 1963a, ADOH 1972 and ADOT&PF Bridge Section Files)

For major crossings on main highways, the State designed and built mostly steel stringer and steel stringer continuous bridges. On local roads, the State continued to build timber stringer bridges, using primarily treated timber stringers. The State completed one prestressed concrete bridge in 1962 and five in 1963, but these were designed by BPR engineers and a bridge design contractor before the State put together its own Bridge Design section. Prestressed, pre-cast concrete bridge members were seldom used in interior Alaska due to high transportation costs. Prestressed concrete girders had to be shipped from the Pacific Northwest until a prestressing yard was installed in Anchorage in the early-1960s. Pre-cast prestressed girders were heavy, difficult to move to job sites, and easily damaged from rough handling in transportation. The deterioration of the concrete girders on the 1955 Schooner's Bend Bridge prompted some State bridge engineers to question the wisdom of using girders made of light weight concrete (Halsted 1963:60-61; Halsted 2005:2). The issue of whether to use concrete girders arose in the late 1950s during planning to build a bridge in Fairbanks over the Chena River at University Avenue. Officials at BPR and the State Division of Highways considered designing the proposed University Avenue Bridge as a three-span prestressed concrete girder bridge,

even though the cost of such a bridge was more expensive than a three-span steel stringer bridge. BPR Regional Engineer William Niemi thought the added expense would encourage concrete companies to invest in prestressed concrete technology, which would ultimately save the state money in the future. State officials ultimately decided in favor of the less expensive conventional steel stringer design (Bolton 1959; Niemi 1959; DeLaHunt 1960). The State's bridge engineers also hoped to take every advantage of newly-developed, high-strength, low-alloy steels in designing bridges "as any saving in material weight is reflected in lower freight and transportation costs" (Sherard 1961:6).

The State built nine steel stringer bridges, one steel stringer continuous bridge and two steel plate girder bridges during 1961-1963. Steel stringer bridges were at King River (Bridge No. 544) and Eagle River on the Glenn Highway; at the North Fork of 12-Mile Creek (Bridge No. 295) on the Steese Highway (Figure 175); at Chena River on University Avenue (Bridge No. 263) in Fairbanks; at the Kenai and Kasiloff rivers on the Sterling Highway; at Funny River on Funny River Road near Soldotna; at Muncaster Creek (No. 743) on the Haines Highway; and at Sawmill Creek (Bridge No. 432) near Sitka. The State built steel plate girder bridges at Sheep Creek (Bridge No. 559) on the Richardson Highway and Tok River (Bridge No. 663) on the Tok Cut-off Highway. The Moose River Bridge, located between Sterling and Soldotna on the Sterling Highway, was a 3-span 159-foot steel I-beam continuous bridge completed in 1962. The Moose River Bridge was the first bridge designed by the State's Bridge Section. It replaced a steel through truss bridge that had been severely damaged by an over height truck (Sherard 1961:14).

Figure 175. The steel stringer bridge at the North Fork of 12 Mile Creek on the Steese Highway, 1962. Photo courtesy of the ADOT&PF Bridge Section, Juneau.

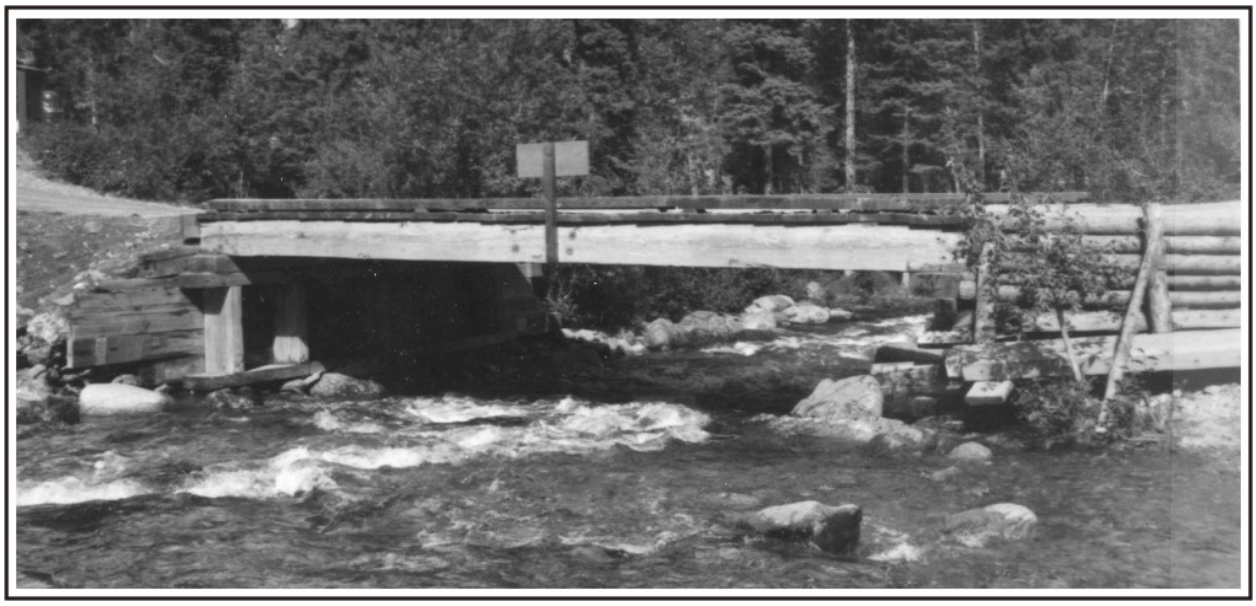

Figure 176. The timber stringer bridge at Liberty Falls, August 24, 1973. Photo by Robert Livan and Mike Murray, courtesy of ADOT&PF Bridge Section, Juneau.

State maintenance crews built both treated timber bridges at Logging Cabin and Taylor creeks on the Taylor Highway and an untreated timber stringer bridge at Dan Creek near McCarthy during 1960 (ADOH 1972). The State replaced three timber stringer bridges on the Nome-Council Road during 1961, including a treated timber bridge at Bear River and untreated timber bridges at the East Fork of Solomon River and at Fox River. Maintenance crews also replaced timber stringer bridges at Goldstream Creek on Goldstream Road near Fairbanks and at Liberty Falls (Bridge No. 285) on the Edgerton Highway (Figure 176) (Sherard 1961:5; Sherard 1961:6). The State built treated timber bridges in 1962 at Dredge Creek on Ruby Road, at Forks Creek No. 1 (Bridge No. 1045) and Forks Creek No. 2 on Roosevelt Road near Ketchikan, at three small creeks on Ward Lake Road, and at Chicken Creek (Bridge No. 1140) on the Taylor Highway. The BPR designed and a contractor built a laminated timber stringer bridge at Cripple Creek (Figure 177) (Bridge No. 266) on the Nome-

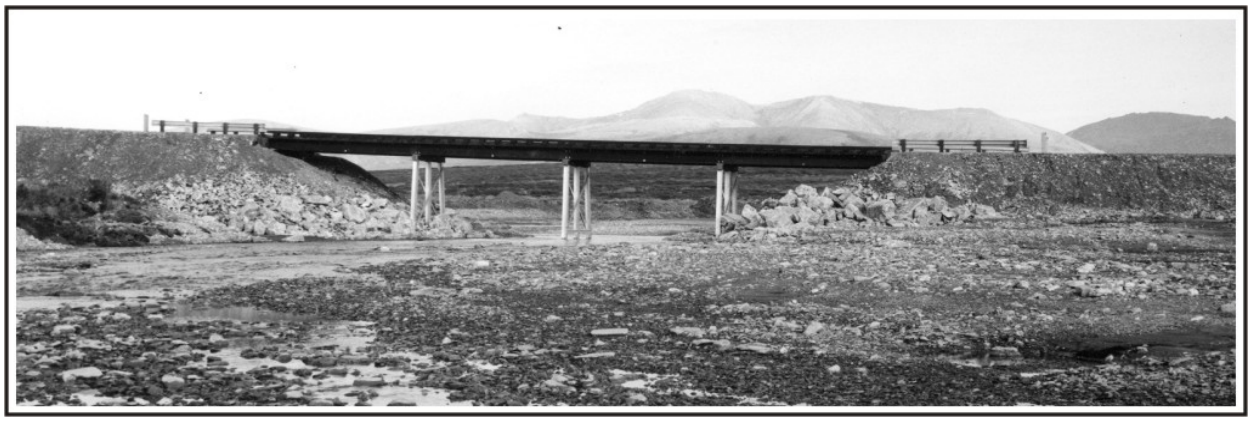

Figure 177. The laminated timber stringer bridge at Cripple Creek, 1963. Photo by the contractor, courtesy of ADOT&PF Bridge Section, Juneau.

Taylor Road in 1962. During the following year, untreated timber bridges were built at Little Boulder Creek just off the Palmer-Cantwell Road, at two crossings of Livengood Creek on the Livengood-Hess Creek Road, at Sullivan Creek on the Manley Hot Springs Road and at Gold Creek on the Takotna Airfield Road (ADOH 1963b:19-20; ADOH 1972).

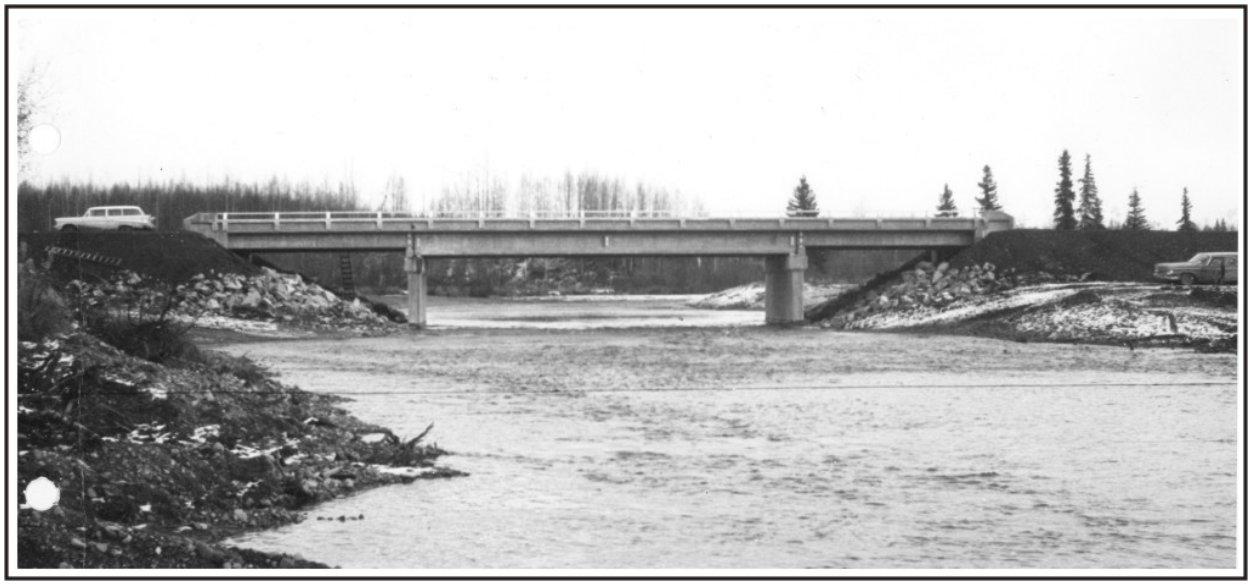

Figure 178. The prestressed concrete girder bridge at Sheep Creek on the Palmer-Cantwell Highway, 1963. Photo by M-B Construction Company, Seattle, courtesy of ADOT&PF Bridge Section, Juneau.

The State oversaw construction of six prestressed concrete girder bridges in 1962-1963. The Sheridan Glacier Stream #3 (Bridge No. 320) at Mile 14.7 of the Copper River Highway, completed in 1962, was the first light-weight concrete girder bridge constructed by the State. It was built with tee-shaped prestressed concrete beams, which compared economically with rolled steel beams for short span bridges (Sherard 1961:14). The State completed five other prestressed concrete girders bridges in 1963 on the Palmer-Cantwell Highway at Willow Creek, Little Willow Creek (Bridge No. 211), Kashwitna River (Bridge No. 212), Sheep Creek (Figure 178) (Bridge No. 213) and Montana Creek (Bridge No. 215) (ADOH 1963:19-20). During the transition to Statehood, the BPR favored prestressed concrete girder bridges and it contracted with TAMS of New York to design the bridges before the State had set up its own Bridge Section. As an experiment, the casting of the beams was done on site (Figure 179) and in pre-

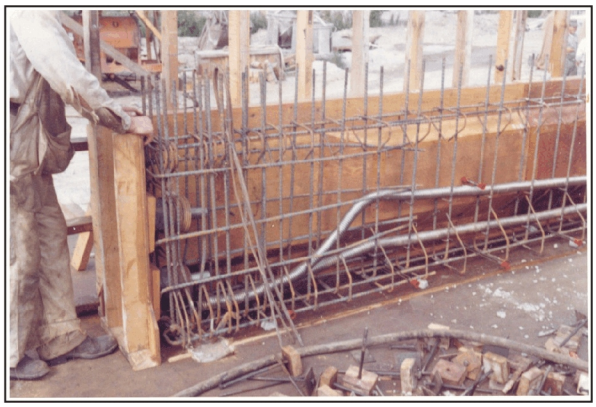

Figure 179. Building the forms for a concrete girder for the Kashwitna River Bridge, July 16, 1962. Photo courtesy of ADOT&PF Bridge Section, Juneau.

stressing yards built for the project in Anchorage. Bid prices, according to the Department of Highways, compared favorably with the estimated costs of steel beams for bridges of the same size (Sherard 1961:11).

The only steel arch bridge built by the State in the early 1960s was the Liberty Falls Bridge (No. 279) on the Edgerton Highway. The bridge, which was completed in 1963, is a graceful steel arch structure (Figure 180), that replaced a timber bridge (Sherard 1961:13).

Figure 180. Erecting the steel arch bridge at Liberty Falls on the Edgerton Highway, 1962. Photo courtesy of ADOT&PF Bridge Section, Juneau.

The Department of Highways erected a number of steel truss bridges in the early 1960s. It carried on the ARC tradition of salvaging steel truss and steel stringer bridges from main roads and re-erecting them on secondary roads. The Nenana River Bridge at Rex (Bridge No. 216) on the Parks Highway was the only new steel through truss built by the State in the early 1960s. Don Halsted designed the 400-foot long, single span K-truss bridge (Figure 181) which was erected in 1963. The Nenana River Bridge was the longest single span constructed in the early Statehood years (Sherard 1961:12).

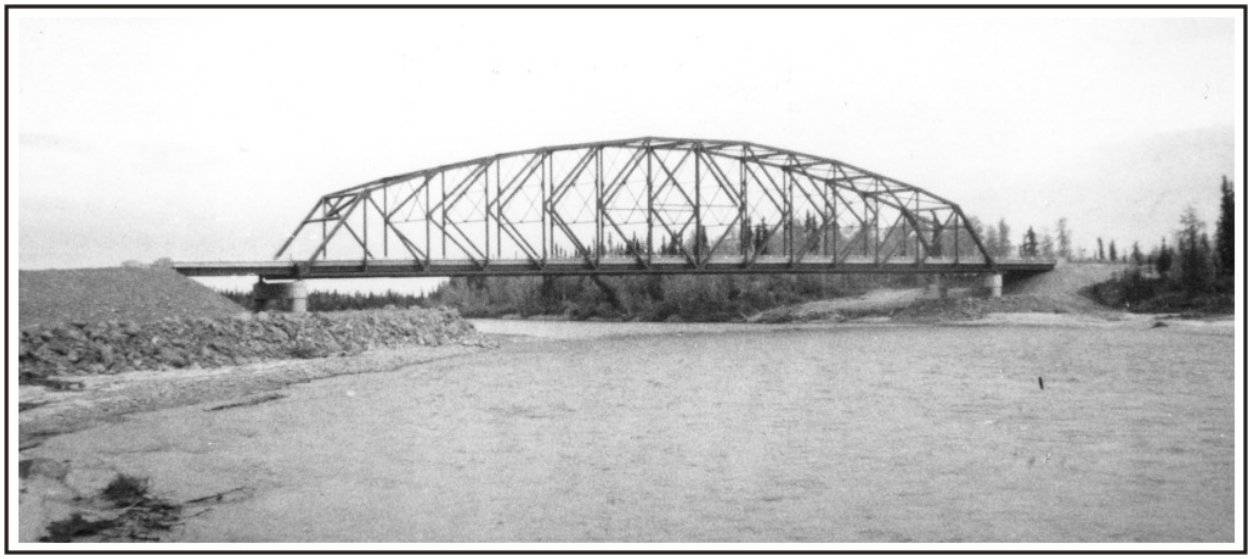

Figure 181. The steel K-truss bridge at Nenana River at Rex on the Parks Highway, 1963. Photograph by Industrial and Commercial Construction of Fairbanks, courtesy of ADOT&PF Bridge Section, Juneau.

During 1961, a crew from the Division of Highways disassembled Alaska's oldest steel through truss bridge, the 1917 Chena River Bridge at Cushman Street in Fairbanks. The Division shipped it to Seattle, then to Nome and re-erected it at the Kuzitrin River (Bridge No. 398) on the Nome-Kougarok Road (Figure 182). The Pennsylvania truss bridge was re-erected at the terminus of the old Seward Peninsula tramway, where there had been no previous bridge (Mourant 2005:2, 9).

Figure 182. A crew re-erecting the old Cushman Street Bridge at the Kuzitrin River, September 1960. Photo courtesy of ADOT&PF Bridge Section, Juneau.

Contractors working for the state installed three steel truss bridges on the Elliott Highway in 1961. The first was a pony truss bridge salvaged from Phelan Creek on the Richardson Highway that was re-erected at the Hutlinana River (Figure 183) on the Elliott Highway. The other two were salvaged through truss bridges, a Pratt truss bridge re-erected at Baker Creek and the Camelback truss bridge from Miller Creek on the Richardson Highway re-erected at Hot Springs Slough (Bridge No. 272). State maintenance crews replaced the Moose Creek Bridge on the Petersville Road near Talkeetna with

Figure 183. The old Phelan Creek steel pony truss bridge after it was re-erected at Hutlinana Creek on the Elliott Highway, October 1961. Photo courtesy of ADOT&PF Bridge Section, Juneau.

a Bailey Bridge in 1961 (Sherard 1961:4, 6, 75). Some of the old through truss bridges were not adequate for traffic. For example, the old Eagle River steel through truss bridge, which had been moved to Pile Bay Road in 1946 (Bridge No. 487), did not have adequate overhead clearance for fishing boats being transported from Cook Inlet to Bristol Bay by truck and trailer. One freight carrier, Carl Williams, sometimes had to cut the flying bridge off the boats with a chain saw to get them through the Illiamna River Bridge.

In the early 1960s, the majority of bridges built in Alaska were constructed on pile foundations. The State contracted with the consulting engineering firm of Claire Hill and Associates to conduct foundation investigations at bridge sites in the Fairbanks-Nenana area using a portable "drill rig." The State Materials Section acquired the drill rig and used it to obtain soils information at many bridges sites. Better subsurface testing enabled the bridge engineers to make a closer approximation of the length of piles required on a job and to make more efficient use of the piles without compromising bridge safety (Sherard1961:8). Bridge engineers also conducted preliminary hydrological and hydraulic studies of proposed bridge sites. The Bridge Section substituted large corrugated metal pipe culverts (CMPs) for bridges in areas of high roadway fill such as at the Ninilchik River and Starsiski Creek on the Sterling Highway, Rock Creek on the Denali Highway, Goose Creek on the Palmer-Cantwell Road, and at Yakutat Lagoon, Browns Slough (near Bethel) and Seldovia Airport Road. Problems with fish migration and heavy ice flows restricted the use of culverts on some streams. Bridges appeared to be the only solution to heavy ice flow or glaciating on small streams (Sherard 1961:6-7).

Bridges Built by the BPR and Other Agencies

The BPR, the U.S. Navy and several cities constructed bridges during the early 1960s. The BPR designed and oversaw construction of eleven bridges in Alaska in the early 1960s (Table 11), most during the interim while the State was organizing a Division of Highways. BPR engineers designed two concrete girder bridges in the late 1950s and a contractor constructed them at Station 355 Creek (Bridge No. 327) and Granite Creek (Figure 184) (Bridge No. 328) on Halibut Point Road near Sitka in 1960. These bridges were erected during the period of transition when the State

Table 11. Bridge Types Built by the BPR, 1960-1962

Bridge Material and Type	1960	1961	1962	Total
Timber stringer	0	0	0	0
Treated timber stringer	0	0	0	0
Glu-laminated stringer	0	2	0	2
Steel stringer	6	0	0	6
Steel stringer continuous	0	0	1	1
Concrete girder	2	0	0	2
Prestressed concrete girder	0	0	0	0
Subtotals	8	2	1	13

(Sources: ADOH 1963a, ADOH 1972 and ADOT&PF Bridge Section Files)

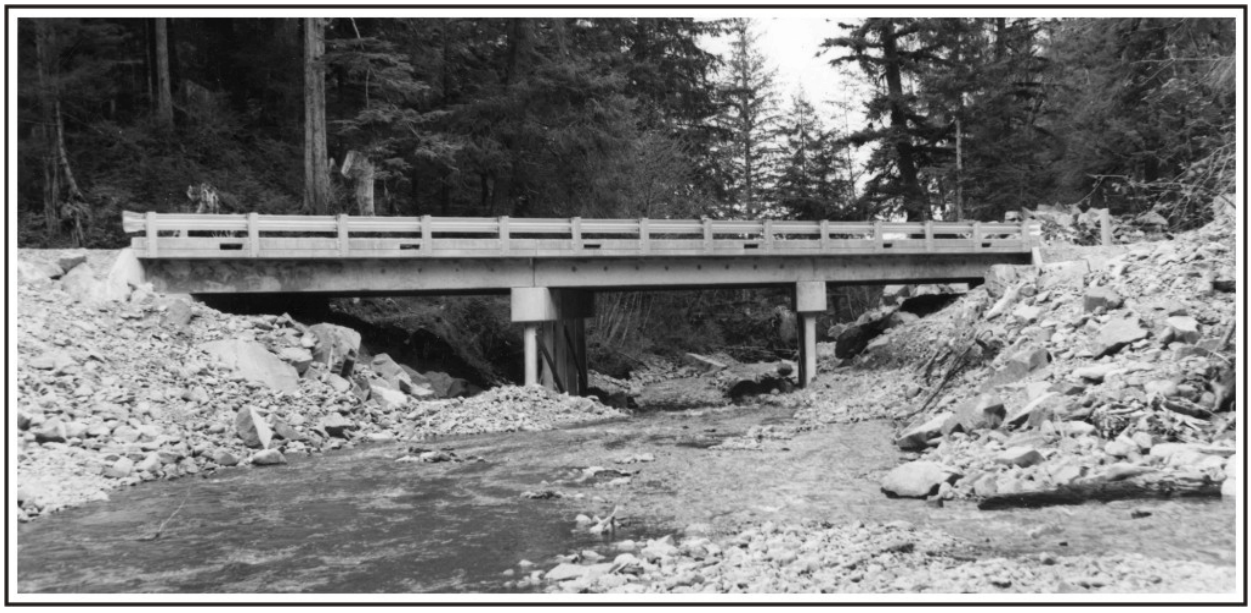

Figure 184. The BPR concrete girder bridge at Granite Creek near Sitka, May 1960. Photo by C&R Builders, courtesy of ADOT&PF Bridge Section, Juneau.

Department of Highways was just getting organized. The BPR designed and hired a contractor to build a steel stringer bridge at Gighlione Creek in Denali National Park in the early 1960. A contractor built three steel stringer bridges in 1960 on the Naknek-King Salmon Road in the Bristol Bay area. Designed by the BPR, the bridges were constructed at King Salmon Creek (Bridge No. 399), Paul's Creek (Figure 185) (Bridge No. 402) and Leader Creek (Bridge No. 400). Contractors

Figure 185. The Paul's Creek Bridge on the Naknek-King Salmon Road, August 4, 1962. Photograph by George Whiteley, ADOT&PF Bridge Section, Juneau.

Figure 186. The steel stringer bridge on Cushman Street in Fairbanks, August 3, 1965. Photograph by Tom Snodgrass of TMS, courtesy of ADOT&PF Bridge Section, Juneau.

built steel stringer bridges for the BPR in Fairbanks at Noyes Slough/Aurora Road (Bridge No. 209) and the Chena River at Cushman Street (Figure 186) (Bridge No. 390) in 1960.

In southeast Alaska, the BPR designed and oversaw construction of a steel stringer continuous bridge at Whitman Creek (Bridge No. 1078), on the South Tongass Highway in 1962. The BPR also designed and hired a contractor to build two glu-laminated timber stringer bridges on the North Tongass Highway outside Ketchikan in 1961. The two bridges, at First Waterfall Creek (Bridge No. 414) and Second Waterfall Creek (Figure 187) (Bridge No. 415) were the first laminated

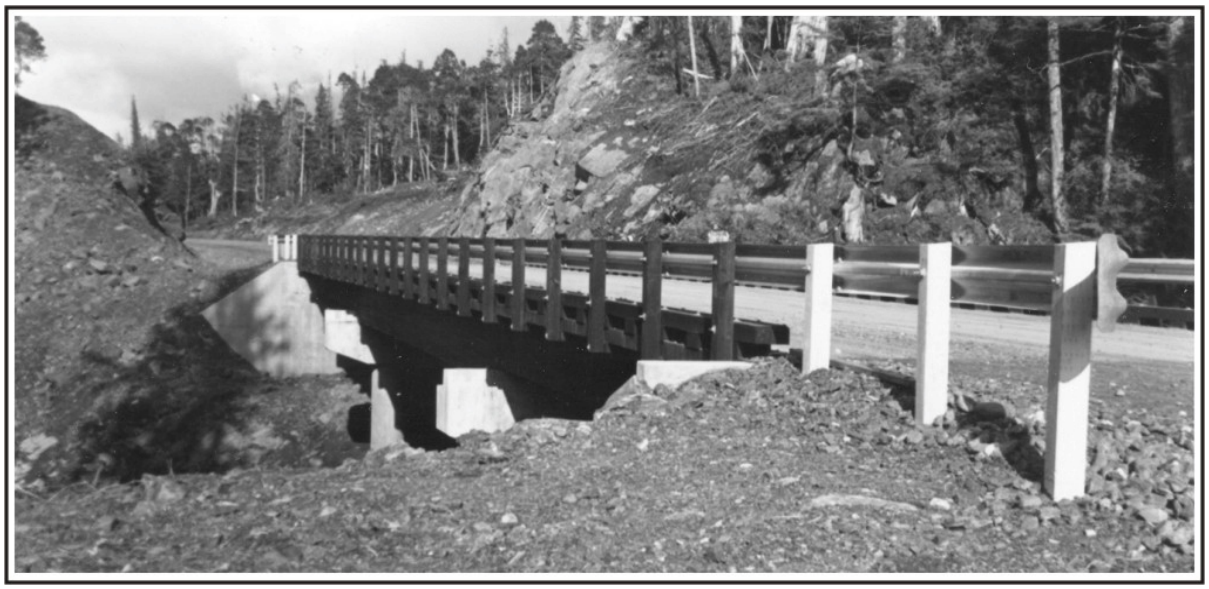

Figure 187. The Second Waterfall Creek Bridge, a laminated timber stringer bridge, September 11, 1962. Photo by Ed Gubler, ADOT&PF Bridge Section, Juneau.

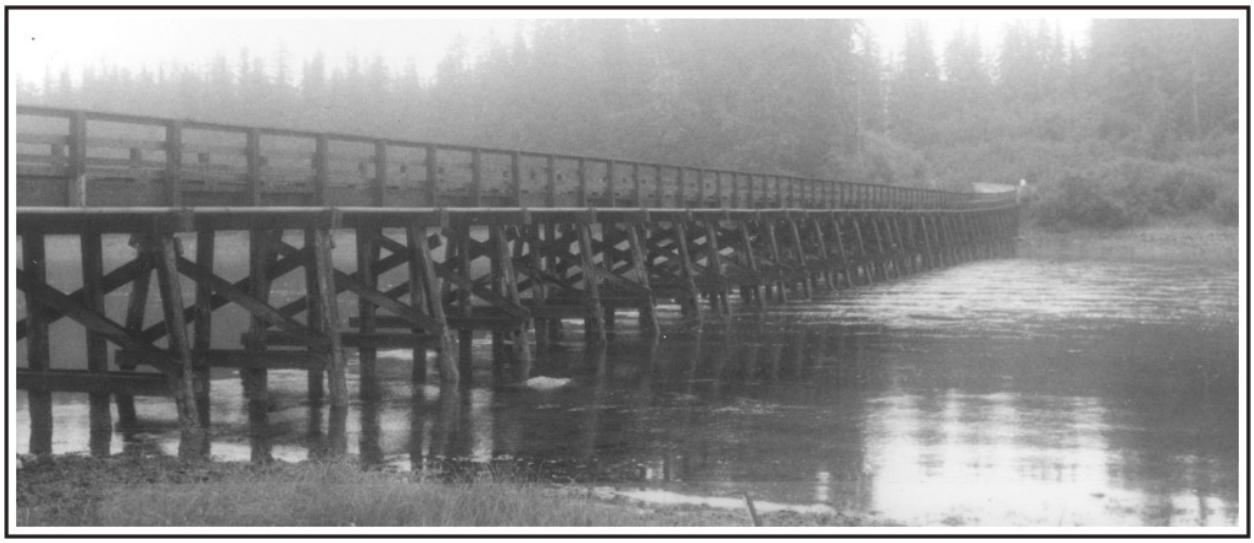

Figure 188. The treated timber trestle bridge built by the U.S. Coast Guard at Ankau Slough, July 28, 1971. Photo by Michael Murray and Robert Lium, ADOT&PF Bridge Section, Juneau.

timber beam bridges built in Alaska that had timber decks. The manufacturer of the beams left the stringers in a pressure treating process too long, lessening their strength (Mourant 2005:9).

In 1961, the U.S. Coast Guard built a 493-foot trestle bridge of treated timbers (Figure 188) at Ankau Slough (Bridge No. 1112) on Ocean Cape Road to access a lighthouse in the Yakutat area. The U.S. Navy built two concrete bridges on Cape Chiniak Road area near its Naval Base in Kodiak in 1960. One was a concrete slab continuous bridge (Figure 189) at Buskin River No. 7 (Bridge No. 993). The other was a rigid frame concrete bridge at Devil's Creek. The Navy also built three treated timber stringer bridges and two laminated timber stringer bridges on the same road (ADOH 1972:24).

Figure 189. The U.S. Navy concrete slab continuous bridge at Bushkin River No. 7, July 6, 1996. Photo by Frank Muchmore and Jerry Mastin, ADOT&PF Bridge Section, Juneau.

Figure 190. The Bayview Street Viaduct in Ketchikan, August 23, 1995. Photo by Mike Higgs and Mark Lukshin, courtesy of ADOT&PF Bridge Section, Juneau.

The City of Ketchikan built four timber trestle bridges in 1960 that were located in neighborhoods. The four bridges were the Sayles-Gorge Viaduct (Bridge No. 1841), which was built with treated timber stringers, the Thomas Street Trestle (Bridge No. 1473), the Bayview Viaduct (Figure 190) (Bridge No. 1181) and the Millar Street Viaduct (Bridge No. 1781). The last three bridges were constructed with un-treated timber stringers. Two log stringer bridges were built at Gustavus in 1960, one at Good River and the other over the FAA Ditch on Gustavus Range Road. The identity of the party who built these two bridges is unknown. A timber stringer bridge was built in 1961, probably by the U.S. Forest Service over the South Channel of the Yakatoga River north of Yakutat. A timber stringer bridge was built on the West Fork of the McLaren River in 1961, probably by local miners.

The Bridge Inspection Program

During the formative years of the state's Bridge Section, inspection of bridges was not a high priority. Before statehood, the ARC and BPR had done bridge inspections on an infrequent basis when area maintenance crews brought structural problems to the attention of the chief bridge

engineer in Juneau. U.S. Army personnel photographed bridges on Alaska's main highways in the late 1950s as part of its Cold War readiness program. It is not known, however, if the Army collected information on the structural condition of the bridges. After Alaska created its own Bridge Section in 1960, section staff conducted occasional bridge inspections starting in 1962. George Whiteley or another engineer from the Bridge Section conducted the inspections with a regional maintenance foreman. The data collected during these inspections was recorded on an inspection form and filed in a folder for each bridge. Inspections were never done without a Bridge Section engineer in attendance. Between inspections, local Division of Highways maintenance staff reported problems that they observed to the Bridge Section in Juneau (Halsted 1963:61; Mourant 2005:5).

During 1963, the Bridge Section initiated and completed a state-wide inventory of existing bridges (ADOH 1963b:34). Larry Carlson was placed in charge of the bridge inspection program. Carlson and Bob Mourant (Figure 191) devised the bridge number system in the early 1960s that is in use today. Private as well as publicly owned bridges were given numbers and Bridge Section staff assured cities and private owners of bridges that being on the list and allowing a bridge to be inspected did not designate state ownership. Numbers were put on the first rail of the bridge; eventually the state required new bridges to have a brass plate installed on the bridge (Mourant 2005:2). The purpose of the inspections was to identify critical and dangerous bridges that would qualify for more frequent inspections, load limits and ultimately for possible replacement. The Bridge Section calculated load limits for bridges, processed overweight vehicle permits, and posted vehicular weight limits on substandard bridges. Overweight permit provisions sometimes imposed speed limits on trucks, required extra planking to strengthen a deck and specified where on the bridge deck the trucks could travel. The Bridge Section kept files on ferries, but did not assign file numbers to aerial cables (ADOH 1962:9; Mourant 2005:7-8, 10).

Figure 191. Bridge Section employees Larry Carlson, Bob Mourant, Harvey Golub and Jack Swanson at their graduation from an engineering management program, University of Alaska Southeast, Spring 1969. Photo courtesy of Bob Mourant, Juneau.

The Bridge Section also provide technical oversight for bridge maintenance. The Bridge Section kept tabs on the condition of bridges through its inspection program and provided technical advice to the maintenance crews in each region that made repairs to the bridges. Steel bridges rusted and required painting at regular intervals. Truss bridges that were narrow or had low overhead clearance were sometimes damaged by heavy equipment or oversized trucks. Bridge decks, particularly those made of timber, wore out and needed to be replaced or repaired. During 1961, for

example, two bridges required cleaning and painting, and two other bridges needed extensive repairs. The Division of Highways made extensive repairs to the 1910 Million Dollar Bridge (Bridge No. 206) in 1961 and converted it from a railroad bridge to automobile use by installing a concrete deck. The Division also made repairs to and painted the Gastineau Channel Bridge and repainted the upper Mendenhall River, Steadman Street and Herring Bay bridges. Work began in 1961 to replace the timber deck and reconstruct the abutments on the Taiya River Bridge near Skagway (Sherard1961:4, 6, 91). During 1963, State maintenance crews repaired 59 bridges in Alaska (ADOH 1963b:14).

The practice of occasional bridge inspections changed after 46 people died on December 15, 1967, in the collapse of the Silver Bridge, a major highway crossing of the Ohio River at Point Pleasant, West Virginia. The disaster in West Virginia prompted Congress to add a section to the Federal-Aid Highway Act of 1970 (P.L. 91-605) that established a systematic nation-wide inspection of bridges. The act required states receiving federal funds to conduct regular inspections on bridges on the Federal-Aid Highway System under Bureau of Public Roads guidelines. In Alaska that meant bridges on main and feeder roads. Congress later passed the Surface Transportation Assistance Act of 1978 (P.L. 95-599) expanding bridge inspection requirements to all public bridges over 20 feet (Plowden 2002:243; FHWA 2004:1-3).

Under the 1970 law requiring states to conduct regular bridge inspections, federal officials wanted Alaska to conduct inspections annually. The Alaska Bridge Section did not have the staff to inspect all bridges every year. Ultimately the federal authorities agreed that an inspection once every two years was reasonable. A bridge inspection team consisted of at least two people for safety reasons. Every-one in the Bridge Design Section in the 1970s spent at least several weeks to a month inspecting bridges each year. Staff participated on a rotating basis, so they could obtain both design and inspection experience (Figure 192). Donald Halsted, even when chief bridge engineer, went along on inspections. Mourant later replaced Carlson as the staff member in charge of inspections. Mourant made sure that old bridges that

Figure 192. Bridge inspector Frank Muchmore examining Pier No. 2 of the Nenana River Bridge at Rex, August 4, 1998. Photo by Gary Scarborough, ADOT&PF Bridge Section, Juneau.

were no longer in use were inventoried because the State might have to reuse them in the future (Mourant 2005:2, 4; Halsted 2005:1, 2, 4).

In the late 1960s and early 1970s, chief bridge engineer Harvey Golub would not allow the use of color film during inspections due to the greater expense. The State purchased several giraffe trucks to inspect bridges about 1979 or 1980. The boom on each truck could extend under as well as above the deck, making inspections of large bridges easier (Mourant 2005:2-3, 6). The Bridge Section had trouble in the 1970s inspecting bridges in Denali National Park, because the park superintendent resisted having the park's bridges inspected by the State. During those years, Bridge Section staff inspected National Park bridges from time to time, but not consistently as with other bridges in the Alaska (Halsted 2005:4). After the Congress amended the national inspection program in 1978 to cover all public bridges, the Bridge Section in Alaska began inspecting bridges built by cities and other public entities. In many of those bridges, the Bridge Section was unable to locate original plans or other information such as when or by whom the structures were built. In 1998, Bridge Section inspection crews switched from using 35-mm single lense reflex camera to digital cameras during bridge inspections.

The State had 35 bridges that were under construction during1963, the largest bridge construction program in Alaska's history. Thirteen bridges were completed on the Federal-Aid system and 22 bridges were scheduled to be under contract in 1964. The Bridge Section completed plans in 1963 for 31 bridge structures with a value of $11 million and was working on designs for 23 additional bridges with a value of $7.25 million. It assessed damage to bridges from several vehicular accidents, did preliminary feasibility studies of Knik Arm, Sitka Harbor, and Taiya River crossings, gave technical direction on bridge foundation and hydrologic investigations, and assisted construction and other divisions (ADOH 1963b:1, 32-35). The future looked bright as the State geared up for the 1964 construction season.

The 1964 Earthquake

The Good Friday Earthquake occurred on March 27th 1964, disrupting the State's bridge construction program and dramatically impacting bridge construction in Alaska. The earthquake registered 9.2 on the Richter Scale and was the strongest seismic event recorded on the North American continent. It shook southcentral Alaska, created a tidal wave that destroyed or damaged a dozen communities, killed 115 people, left thousands homeless and cause more than a hundred million dollars in damage. Of the 77,300 feet of aggregate length of bridges in early 1964 on Alaska's primary and secondary road system, 21,165 feet (27.4%) were destroyed or severely damaged by the earthquake and tidal wave, requiring complete replacement. The earthquake caused an estimated $75 million in highway damage, of which $30 million was the cost of temporary and permanent bridge repair and replacement. The Bridge Section moved quickly to form several teams, composed of a bridge engineer and a construction or maintenance engineer, to conduct a thorough inspection of all damaged bridges (ADOH 1964:1, 2, 9-11).

Engineers found the damage to highway bridges both "enlightening and frightening." Many bridges were completely destroyed (Figure 193) and many others were seriously damaged. In some areas of great disturbance, bridges were essentially unharmed. The basic damage was to sub-struct-

ural elements, and superstructure failures followed substructure failures. Damage was the direct consequence of severe, repetitive horizontal earth movements, not violent uplifting forces. The seismic forces caused severe accelerations in a horizontal direction which resulted, in almost every case, in the shearing of connections between the superstructure and substructure. The inspectors found "literally bushels of sheared anchor bolts."

The most spectacular bridge failures occurred on the Turnagain Arm stretch of the Anchorage-Seward Highway (Figure 194), where the BPR in the late 1940s and early 1950s

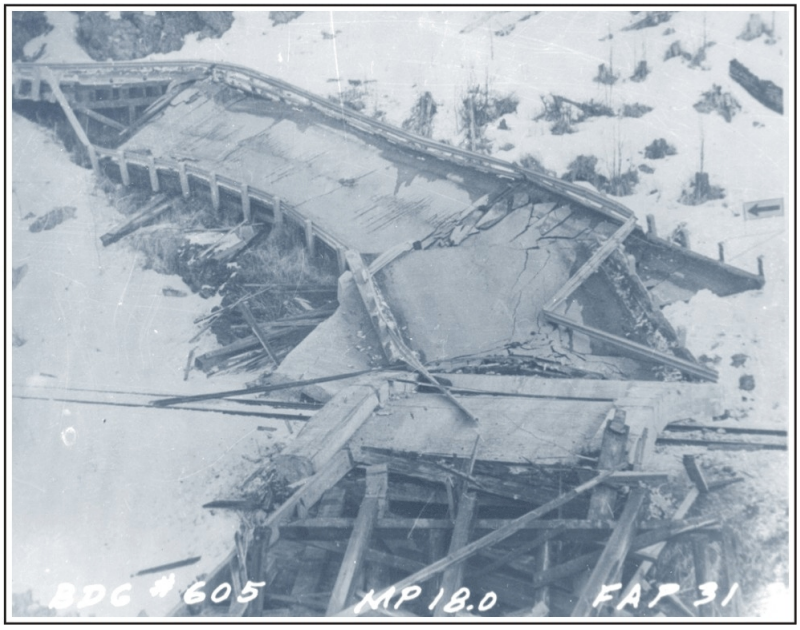

Figure 193. Earthquake damage to Snow River Bridge No. 2 at Mile 18 of the Seward Highway, April 1964. Photo courtesy of the ADOT&PF Bridge Section, Juneau.

Figure 194. Damage to the 20 Mile River Bridge on the Seward Highway, April 1964. The Alaska Railroad Bridge is in the background. Photo courtesy of Bob Mourant, Juneau.

had built primarily bridges comprised of simple concrete T-beam spans that rested on timber bent substructures. Massive concrete piers broke at the ground line, roadway slabs were torn loose from stringers, welds fastening stringers to sole plates were broken, piers settled erratically, abutment back walls broke off under pounding from bridge roadway slabs, and fill disappeared beneath and behind abutments. All bridges suffered a shortening in length, closure of expansion devices, "crowding" of abutments, and settlement of approach fills of as much as three feet. The earthquake displaced heavy, rigid, concrete spans horizontally, usually parallel to roadway centerline. The concrete spans either parted at the joints over the pile caps and dropped to the ground or the timber piles punctured the slabs as the latter fell (Figure 195). Steel stringer bridges with concrete slab decks did not experience this type of failure. The earthquake sheared anchors, tilted rockers, and tore lose sole plates on steel stringer bridges, but most of those bridges remained in service (ADOH 1964:9-10).

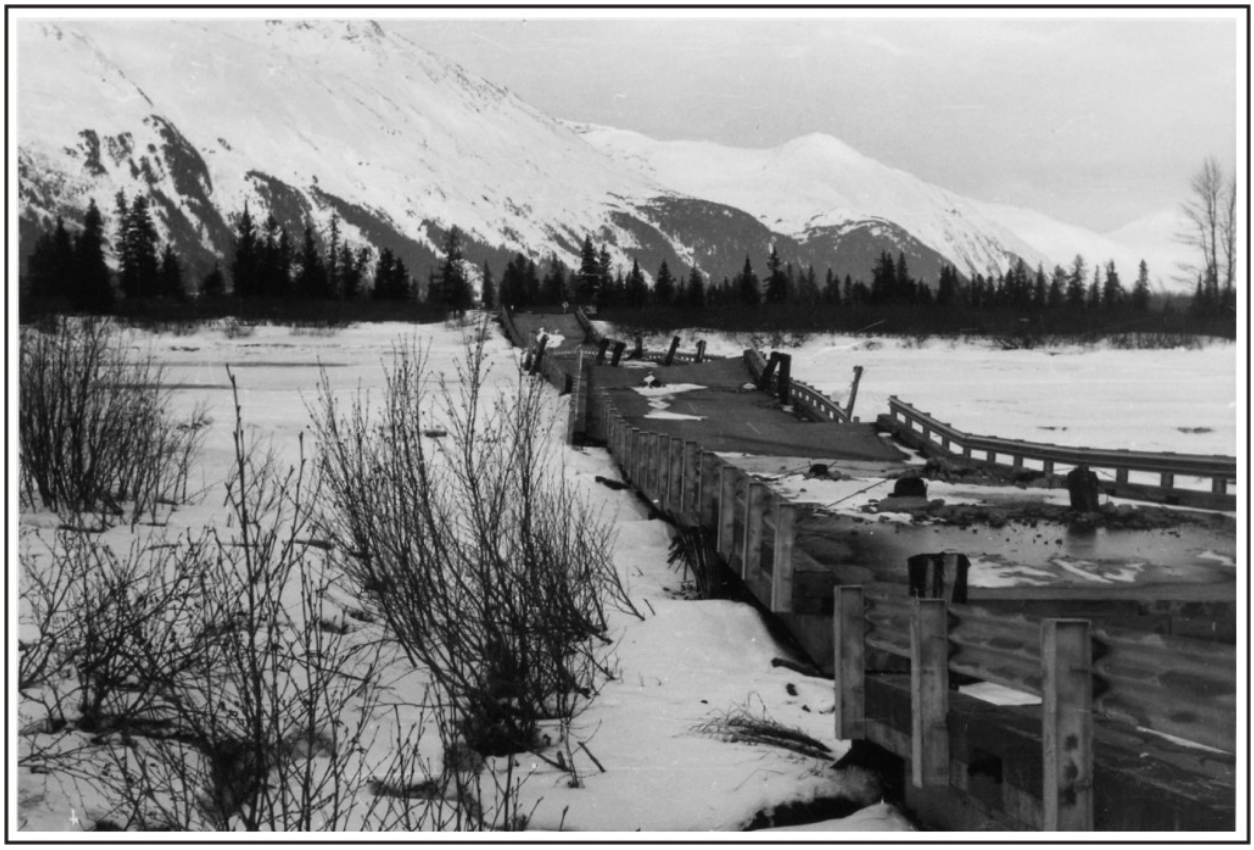

Figure 195. Earthquake damage to a concrete slab bridge, showing timber pilings punched through the concrete deck, April 1964. Photo courtesy of Bob Mourant, Juneau.

North of Anchorage, the earthquake effects on bridges diminished markedly. There were minor displacements of decks and more sheared anchor bolts. At the moment the earthquake struck, major bridge construction projects were underway at crossings of the Knik and Matanuska Rivers near Palmer. The earthquake motion broke the massive masonry piers of the old bridges over both

rivers and longitudinally and laterally displaced the piers and abutments of the new bridges under construction. The substructure of both new bridges remained essentially plumb, so engineers established a new center line for each bridge and the steel girders, which had already been fabricated, were modified to fit the piers and abutments. The length of one span had to be shortened by two feet and two other spans had to be lengthened by a foot. The contractor was able to complete the bridges without appreciable increase in cost. On Kodiak Island, a wall of water estimated at 30 feet high obliterated nine of 14 timber bridges on Cape Chiniak Road. The Department of Highways had to build twelve new bridges to replace the nine due to changes in drainage and topography caused by the earthquake and tsunami.

Damage to bridges was also significant in the Copper River Valley, where the BPR and State had converted the first 70 miles of the CR&NW railbed into a road. The 1964 Earthquake destroyed 34 of the 52 bridges along the Copper River Highway, including the piling bridges from the railroad era along the Copper River Road between Cordova and the Airport. The 34 crippled bridges suffered substructure failures due to massive inertial movements of the superstructures and gross displacement of the substructures. All of these bridges, except for three through truss spans, were composed of short spans on pile bent supports. Twenty-four of the failed bridges were supported by piles built from salvaged railroad rails. At the crossing of the Copper River Delta, the piers supporting the 300-foot and 260-foot through truss spans built by the CR&NW in 1909 completely disappeared from sight, dumping the trusses into the river. Eleven other bridges, consisting of timber trestles, required extensive repairs. One end of the north span of the Million Dollar Bridge fell in the river (Figure 196) and the pier that had supported it shattered and nearly collapsed. The remaining spans of the bridge were seriously displaced and distorted (ADOH 1964:10-11).

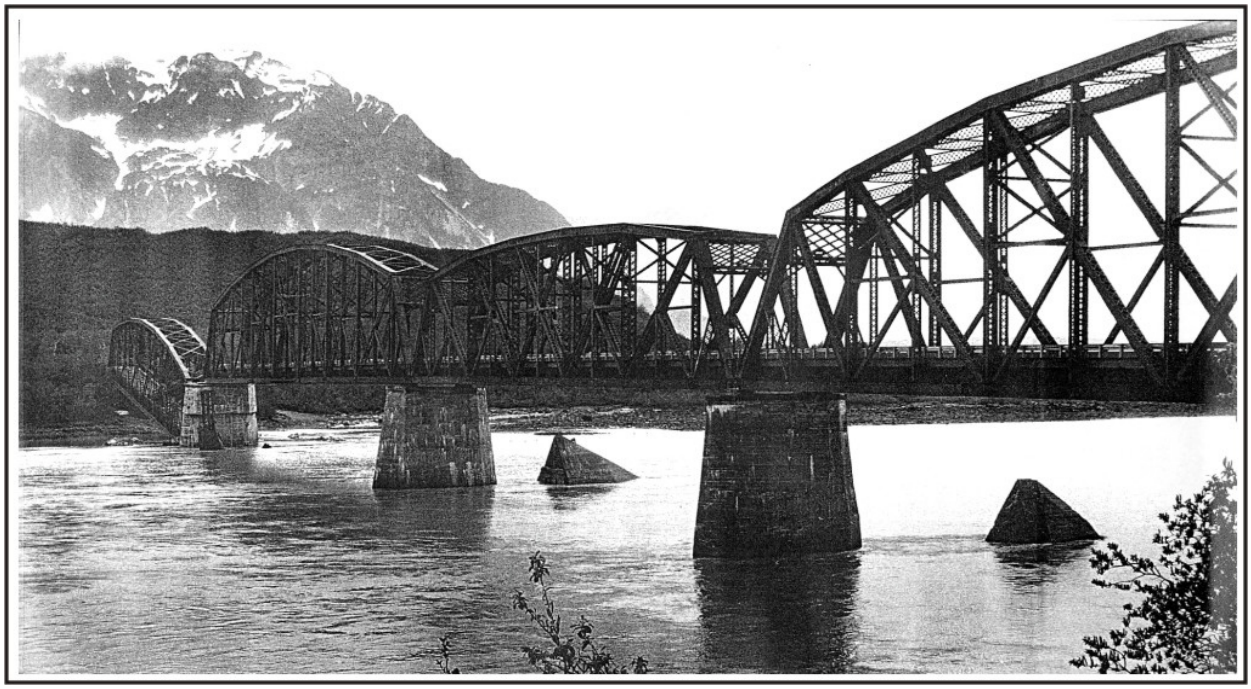

Figure 196. The south end of the north span of the Million Dollar Bridge dropped into the Copper River during the 1964 Earthquake. Photo courtesy of ADOT&PF Bridge Section, Juneau.

Bridge Construction After the Earthquake

The 1964 Earthquake totally involved the Bridge Section. Repair and reconstruction of damaged bridges and restoration of traffic on the most important roads became the critically urgent tasks for the Department of Highways in 1964. The Bridge Section sent out inspections teams to perform thorough inspections of damaged bridges, assisted Department of Highways maintenance workers in making temporary repairs where practicable, scrambled to design temporary bridges to get traffic moving again and designed permanent bridges to replace those that were damaged beyond repair. Plans to restore minimum traffic service at destroyed or crippled bridges began soon after the earthquake.

Initial bridge repairs were made on a "make do" basis. Bridges that had been destroyed were replaced with temporary timber trestles that were built "fast and dirty" with untreated timber piles. The collapse of the bridges at Snow and Kenai rivers (Figure 197) on the Seward and Sterling highways isolated Seward and Homer from one another and the Port of Anchorage. The contractor who had been working on a new bridge at Snow River when the Earthquake occurred built a temporary detour. The U.S. Army flew 17 cargo plane loads of Bailey bridging to Soldotna. State maintenance forces, Army combat engineers and a contractor completed construction of a six-span 320-foot Bailey bridge at the Cooper Landing crossing of the Kenai River by April 11. The temporary bridges at the Snow and Kenai rivers allowed trucks to transport fuel and materials from

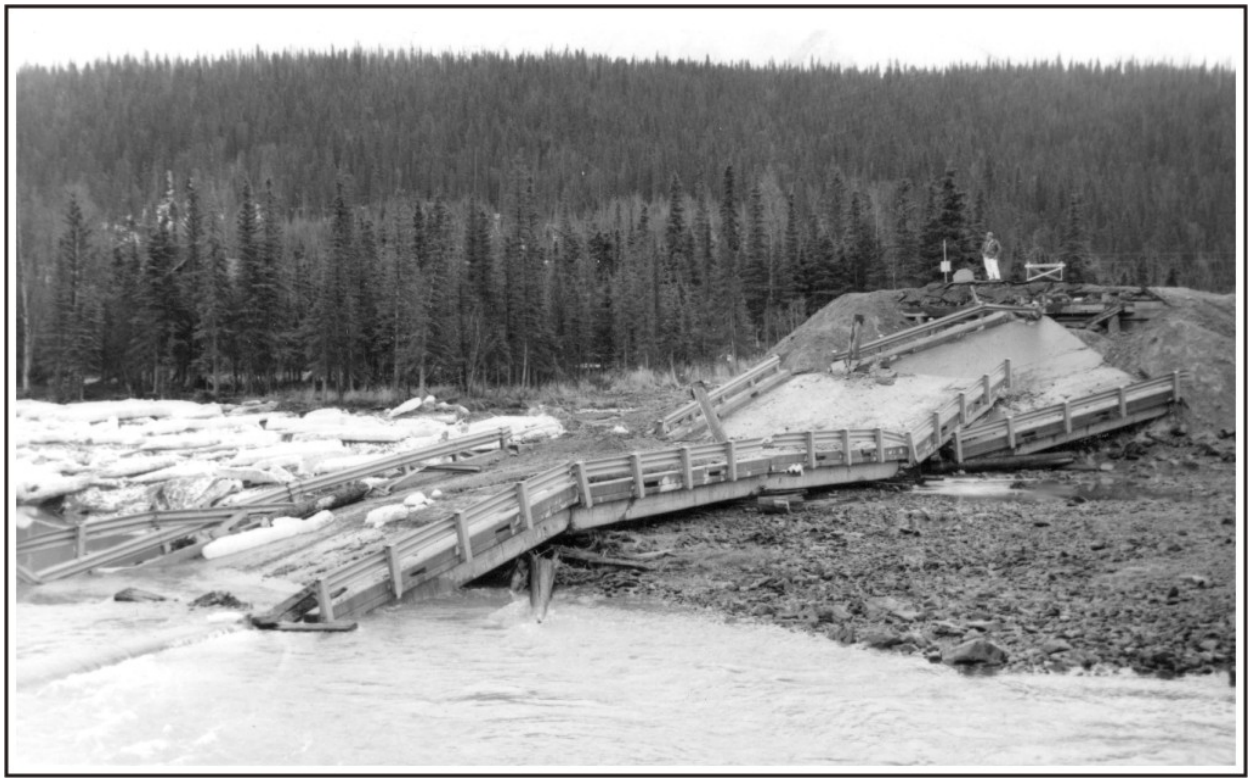

Figure 197. The Sterling Highway bridge at the outlet of Kenai Lake at Cooper Landing that was destroyed by the Earthquake, April 1964. Photo Courtesy of ADOT&PF Bridge Section, Juneau.

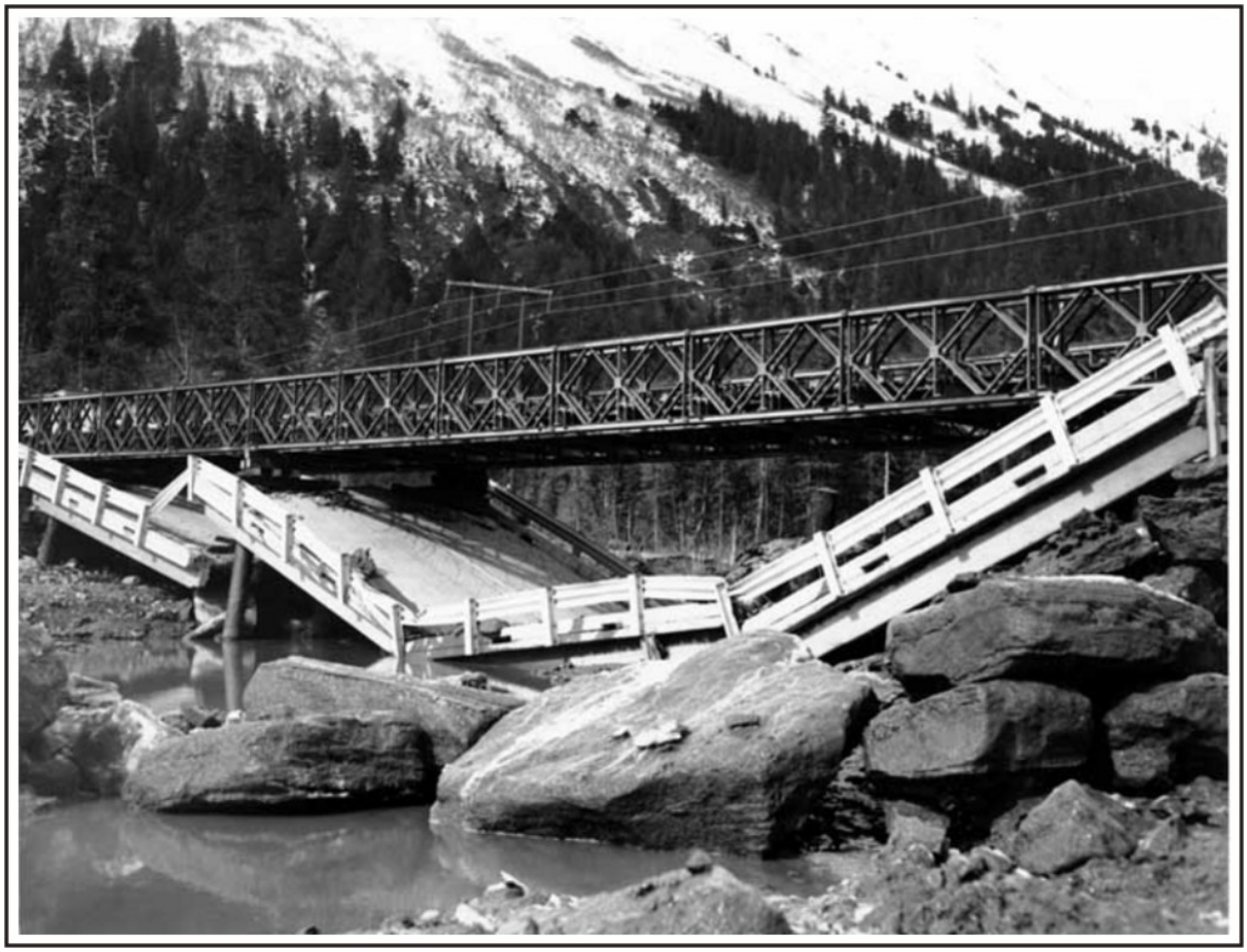

Figure 198. Collapsed Seward Highway Bridge near Girdwood, 1964. A Bailey bridge has been installed over the ruins as a temporary bridge. General Photo File, B79-38-15, Anchorage Museum of History and Art.

the refinery and dock facilities at Kenai to Seward, whose docks had been destroyed. The Army Corps of Engineers also installed two Bailey bridges near Girdwood (Figure 198).

Ten days after the Earthquake, the Bridge Section had completed specifications for the construction of 22 temporary timber bridges on the Seward-Anchorage Highway with a total length of 4,500 feet. These two-lane structures were designed to be made up of 20-foot spans using native timber and other available materials. Competitive bids were solicited in early April and awards were made by the end of May. The State opened bids on April 20 to construct five temporary timber bridges totaling 900 feet in length on the Copper River Road between Cordova and its airport and on June 1 for 12 bridges totaling 860 feet on Chiniak Road near Kodiak. A total of 44 emergency timber trestle structures were built. Maintenance crews and contractors working on force account repaired many other damaged bridges until permanent replacements were built (ADOH 1964:11-12).

While the temporary bridges were being planned and put out to bid, the Bridge Section

undertook a crash program of site surveys, foundation investigation, and design work to construct permanent bridges to replace those destroyed or damaged by the earthquake. The designs for permanent replacement bridges consisted of a series of simple composite steel I-beam structures with concrete slab decks on pile bent piers and abutments. The bridges were designed to insure simplicity of detail and modular application to various sites. Twenty-five standard drawings were developed covering 50, 60 and 80-foot spans for 28, 30 and 41-foot roadway widths. The drawings used either H-pile or cast-in-place concrete pile bents, elastomeric bearings, standard rolled beams and bolted field connections. The modular standard drawings were completed by mid-May and foundation investigations were performed during the same month. Contract documents for reconstruction of 18 bridges with a total length of 3,160 feet were ready to be advertised on June 17, less than 80 days after the earthquake. The ten professional and eight assistants of the Bridge Section then returned to work on the regular design program and to the task of preparing final designs for the remainder of the quake damaged bridges (ADOH 1964:12-13).

The 1964 Earthquake had a significant impact on the Bridge Section's choice of materials and bridge types in the following years. Highway bridges built in the fifteen years prior to the earthquake were characterized by heavy concrete decks supported by light piles. Superstructures impacted by the earthquake moved once, then back into place after the initial movement. The pilings moved in the earthquake, but did not go back into place. Some pilings went right through the decks. After the Earthquake, Bob Lium and several other state bridge engineers advocated building continuous and cantilevered steel bridges (Figure 199) to better withstand earthquakes. Construction of steel stringer

and girder continuous and cantilevered bridges saved on steel compared to conventional multi-span steel stringer and girder bridges, but the connections were more expensive. Continuous spans were better suited to withstand seismic events. Simple, multiple spans could drop off their piers if an earthquake shook the spans apart from each other. After the 1964 earthquake, the state did build more continuous span bridges than in earlier years. Bob Lium designed many of the steel continuous bridges after 1964, although the State continued to build a variety of different bridges styles. Harvey Golub and Don Halsted designed a number of bridges that were multiple span, simple steel stringers (Lium 2005:1-2). After the earthquake, the BPR came up with a requirement to fasten the superstructure to the substructure. A bridge "tether" was used to tie the two together, but few engineers in Alaska's Bridge Section thought they did much good (Mourant 2005:8-9).

The Bridge Section completed plans, specifications and estimates for 40 permanent structures in 1964 and at the end of the year was working on designs for 30 other bridges. In addition, the section provided technical direction for bridge foundation testing done by the Materials Section and hydrological, hydraulic and stream scour studies being done by the U.S. Geological Survey. The section also engaged in a joint research project on piling driven into permafrost with the Cold Regions Research and Engineering laboratory of the U.S. Corps of Engineers, and assisted the Construction Division in checking shop drawings on bridges under construction (ADPOH 1964:13-15). The state built 44 emergency timber bridges in 1964 after the earthquake. During 1964, contracts were in effect for construction of 31 permanent bridges, but most were still under contract at the end of the

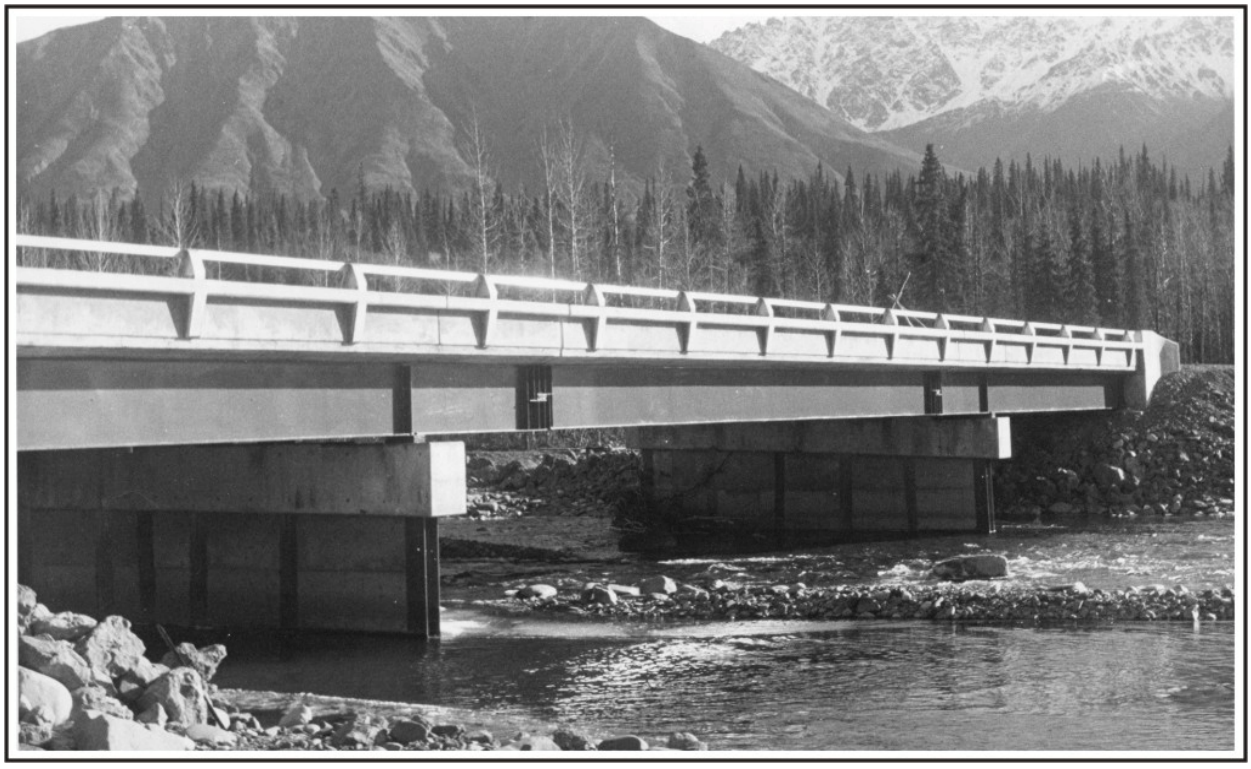

Figure 199. The steel stringer cantilevered bridge at East Fork of the Chulitna River on the Parks Highway, built in 1965 after the earthquake, was typical of bridges built in the mid- and late 1960s to better withstand seismic events. Construction completion photo taken in 1967 by Morrison Knudson Company, courtesy of ADOT&PF Bridge Section, Juneau.

year (ADOH 1964:31). The three permanent bridges completed on primary roads in 1964 were a steel stringer bridge at Schooner's Bend on the Kenai River (Bridge No. 673) (Figure 200), a steel stringer continuous bridge at the Little Susitna River on the Parks Highway and a timber stringer bridge at Carlson Creek on the Tok Cut-off Highway. Bridges completed on secondary roads during 1964 included a steel stringer bridge on Willow-Fishhook Road, timber stringer bridges at Spruce Creek (Bridge No. 485) and Ophir Creek on the Sterling-Ophir Road, timber stringer bridges at Long, Ptarmigan and Small Creek on the Steese Highway, and a treated timber stringer bridge at Lost Chicken Creek on the Taylor Highway. More than twenty other permanent bridges were in the process of being constructed in 1964, but were not completed until 1965 and 1966.

The task of rebuilding roads and bridges damaged by the 1964 Earthquake continued for another two years beyond 1964. The Department of Highways replaced 15 damaged bridges from the 1964 Earthquake with temporary or permanent structures during 1965 (ADOH 1965:31). By the end of 1966, earthquake repair work was nearing completion with 24 bridges and 23 miles of roadway remaining to be done on the Seward Highway (ADOH 1966:34). The State Department of Highways rebuilt and widened the Copper River Highway between Cordova and its airport, replacing ten old railroad bridges with steel stringer bridges. The bridges between Mile 16 and the Mile 49 were gradually replaced in the late 1960s and early 1970s. In 1971, a temporary ramp was placed between spans 3 and 4 on the Million Dollar Bridge (Figure 201). Permanent repairs to the bridge, including lifting and restoring the south end of span 4 that dropped, were not completed until 2005. The bridges between Miles 50 and 70 that were destroyed by the earthquake have not been replaced.

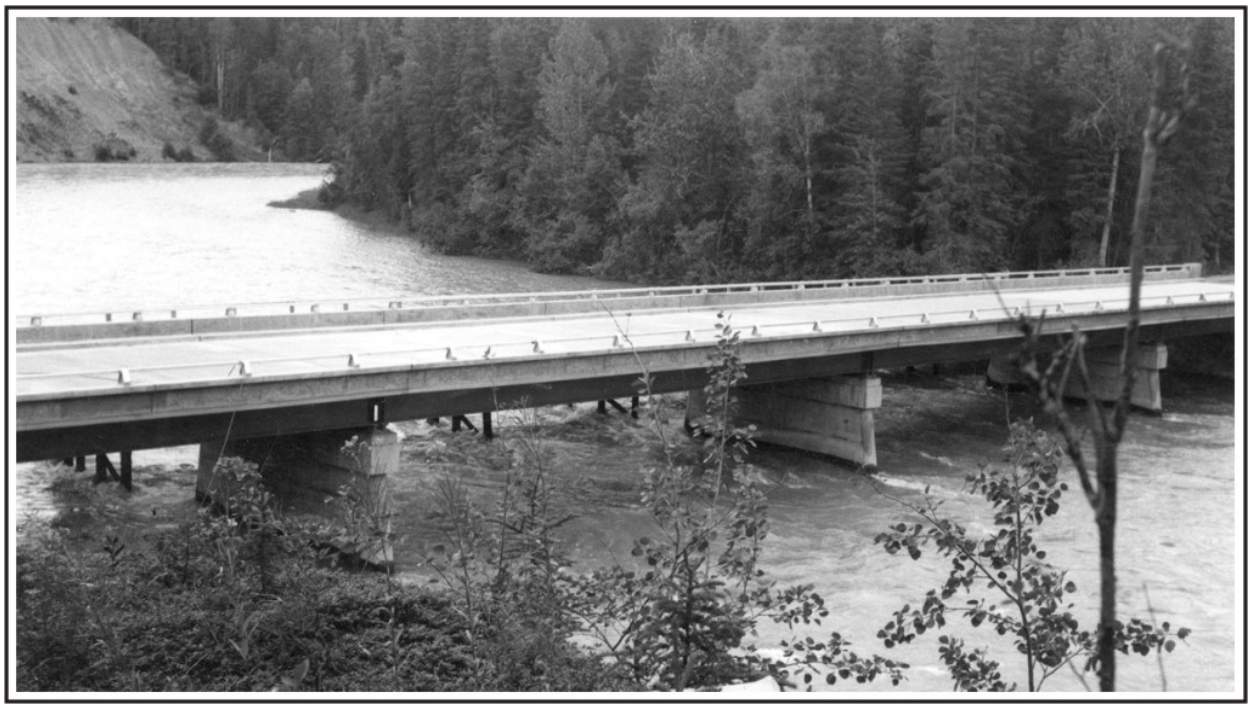

Figure 200. The new steel stringer bridge at Schooner's Bend on the Kenai River, August 1964. The new steel superstructure was place on the substructure of the 1955 concrete girder bridge. Construction completion photo, courtesy of ADOT&PF Bridge Section, Juneau.

Figure 201. The temporary ramp to Pier 3 on the Million Dollar Bridge, August 13, 1992. Photo by Rolfe G. Buzzell, Office of History and Archaeology, Anchorage.

Summary of the Early 1960s

In terms of bridges, the biggest accomplishment of the State in the early 1960s was the creation of a fully functioning Bridge Section by 1963. The predominate bridge type built during the early Statehood years was the steel stringer bridge. A few concrete girder bridges were built, but the questions that BPR and State bridge engineers pondered about light-weight concrete girder bridges in the late 1950s and early 1960s turned out to be very important. The deterioration of the concrete girders on the 1955 Schooner's Bend Bridge to the verge of failure in the early 1960s prompted bridge engineers to cast a skeptical eye on concrete girder bridges (Halsted 1963:60-61). Skepticism about the reliability of concrete girders together with cost factors associated with transporting heavy concrete girders, led Alaskan bridge engineers to prefer open-steel painted girders in the early 1960s, even though steel girders required maintenance such as painting the steel (Halsted 1963:60-61; Halsted 2005:2). The 1964 Earthquake also prompted bridge engineers to question the use of bridges with heavy concrete decks on timber piles. While the rest of the country was embracing light-weight concrete girder bridges, the State of Alaska chose to rely for another decade on steel stringer/girder bridges, which were more economical given the constraints imposed by the topography and remoteness of the last frontier.

PART III :

BRIDGE MATERIALS, DESIGN TYPES AND CHARACTER DEFINING FEATURES

XIV. REFERENCES

Alaska Department of Highways (ADOH)

1962 *First Annual Report of the Department of Highways*. State of Alaska, Juneau.

1963a *Alaska Highway Bridge Inventory Rating Report*. State of Alaska, Department of Highways, Planning and Research Section in cooperation with the U.S. Department of Commerce, Bureau of Public Roads. Juneau.

1963b *Annual Report of Department of Highways, 1963*. State of Alaska, Juneau.

1964 *State of Alaska Department of Highways Annual Report, 1964*. State of Alaska, Juneau.

1965 *Department of Highways Annual Report, 1965*. Alaska Department of Highways, Juneau.

1966 *Department of Highways Annual Report, 1966*. Alaska Department of Highways, Juneau.

1969 *1969 Annual Report*. Juneau.

1972 *Alaska Highway Bridge Loading Report, 1972*. Prepared by the State of Alaska, Department of Highways, Bridge Design Section, Juneau.

Alaska Division of the Federal Highway Administration (ADFHWA)

2005 Evaluation of Eligibility, Richardson Highway MP 228, One Mile Creek Bridge Replacement, Project No. BR-071-4(18)/61870, June 27, 2005.

Alaska Mining Record, *The* (Juneau newspaper)

1895 "The Gem of the Pacific Coast [Sitka]," January 7, 1895, p. 1.

1896 "Juneau Bridge to be Replaced by Mine and Citizen Subscription," July 22, 1986, p. 10.

Alaska Search Light (Juneau newspaper)

1895 December 28, 1895, page 6.

American Society of Civil Engineers, Alaska Section

1976 *Alaska's Engineering Heritage, Building from Past to Future* (Anchorage).

Antonson, Joan and William Hanable
1985 *Alaska's Heritage*. Alaska Historical Commission Studies in History No. 133. The Alaska Historical Society for the Alaska Historical Commission of the Department of Education, Anchorage.

Arvidson, Rose C.
1984 *Cordova, The First 75 Years: A Photographic History*. Fathom Publishing Company, Cordova, Alaska.

Associated General Contractors of Alaska
1998 *Alaska's Builders, 57 Years of Construction in the 49th State*. Publication Consultants, Anchorage.

Bauer, Mary Cracraft
1987 *The Glenn Highway: The Story of its Past and a Guide to Its Present*. Bentwood Press, Sutton, Alaska.

Bolton, Donald F.
1959 Memorandum from Donald F. Bolton, Chief, Bridge Design Unit, to William J. Niemi, BPR Regional Engineer, Bureau of Public Roads, Juneau, December 22, 1959, Bridge File No.163, Chena River at University Avenue, ADOT&PF Bridge Section, Juneau;

Board of Road Commissioners for Alaska (ARC)
1905 "Report of Operations for the Season of 1905 (of the Board of Road Commissioners for Alaska)," November 1, 1905, in *War Department Annual Report, 1905*, Vol. 1, pp. 291-314.

1906 "Report of the Board of Road Commissioners for Alaska, Season of 1906," January 18, 1906, in U.S. House of Representatives Document No. 523, 59th Congress, 2nd Session.

1907 "Report of Operations for the Season of 1907 (of the Board of Road Commissioners for Alaska)," in *War Department Annual Report, 1907*, Vol. 1, pp. 114-144.

1908 "Report of Operations for the Season of 1908 (of the Board of Road Commissioners for Alaska)," in *War Department Annual Report, 1908*, Vol. 1, Appendix D, 1908, pp. 94-116.

1910a *Report of Operations for the Season of 1909 (of the Board of Road Commissioners for Alaska*, U.S. House of Representatives Document 864, 61st Congress, 2nd Session, Volume 131, April 18, 1910.

1910b *Report of the Board of Road Commissioners for Alaska, 1910,* Government Printing

Office, Washington, D.C.

1912a *Report of the Board of Road Commissioners for Alaska, 1911*. Government Printing Office, Washington, D.C.

1912b *Report of the Board of Road Commissioners for Alaska, 1912*. Government Printing Office, Washington, D.C.

1913 *Report of the Board of Road Commissioners for Alaska, 1913* (Government Printing Office, Washington, D.C.

1914 *Report of Operations for the Season of 1914 (of the Board of Road Commission-ers for Alaska)*. U.S. Government Printing Office, Washington, D.C.

1915 *Report of the Board of Road Commissioners for Alaska, 1915*. Government Printing Office, Washington, D.C.

1916 Report of the Board of Road Commissioners for Alaska, 1916. Government Printing Office, Washington, D.C.

1917 *Report of the Board of Road Commissioners for Alaska, 1917.* Government Printing Office, Washington, D.C.

1919a Report upon Construction and Maintenance of Military and Post Roads, Bridges and Trails, Alaska. Board of Road Commissioners for Alaska in Charge, Fiscal Year 1919." (Part I). In *U.S. Army Chiefs of Engineers Annual Report, 1919*, Extract KKK, pages 2095-2102 (U.S. Serials, No. 7693, Fiche 22).

1919b Report upon Construction and Maintenance of Military and Post Roads, Bridges and Trails, Alaska. Board of Road Commissioners for Alaska in Charge, Fiscal Year 1919." (Part II). In *U.S. Army Chiefs of Engineers Annual Report, 1919*, Extract KKK, pages 3871-3887 (U.S. Serials, No. 7695, Fiche 7).

1920 *Report upon the Construction and Maintenance of Military and Post Roads, Bridges, and Trails, Alaska*. Annual Report of the Chief of Engineers, 1920, Government Printing Office, Washington, D.C., pp. 55-67.

1921 *Annual Report of the Alaska Road Commission, Fiscal Year 1921. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. 1921, Part II. Juneau, Alaska.

1922 *Annual Report of the Alaska Road Commission, Fiscal Year 1922. Report upon the*

Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska. 1922, Part II. Juneau, Alaska.

1923b *Annual Report of the Alaska Road Commission, Fiscal Year 1923. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. 1923, Part II. Juneau, Alaska.

1924 *Annual Report of the Alaska Road Commission, Fiscal Year 1924. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. 1924, Part II. Juneau, Alaska.

1925a Report Upon the Construction and Maintenance of Roads, Bridges and Trails, Alaska, Annual Report of the Chief of Engineers, 1925, Extract. Government Printing Office, Washington, 1925, pp. 1987-1999.

1925b *Annual Report of the Alaska Road Commission, Fiscal Year 1925. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-First Annual Report, 1925, Part II, Operations. Juneau, Alaska.

1925c Report Upon the Construction and Maintenance of Roads, Bridges and Trails, Alaska, Annual Report of the Chief of Engineers, 1924, Extract. Government Printing Office, Washington, D.C., 1925, pp. 2069-2085.

1926 *Annual Report of the Alaska Road Commission, Fiscal Year 1926. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-Second Annual Report, 1926, Part II, Operations. Juneau, Alaska.

1927 *Annual Report of the Alaska Road Commission, Fiscal Year 1927. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-third Annual Report, 1927, Part II, Operations. Juneau, Alaska.

1928b *Annual Report of the Alaska Road Commission, Fiscal Year 1928. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the*

Territory of Alaska. Twenty-fourth Annual Report, 1928, Part II, Operations. Juneau, Alaska.

1929 *Annual Report of the Alaska Road Commission, Fiscal Year 1929. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-fifth Annual Report, 1928, Part II, Operations. Juneau, Alaska.

1930 *Annual Report of the Alaska Road Commission, Fiscal Year 1930. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-sixth Annual Report, 1930, Part II, Operations. Juneau, Alaska.

1931 *Annual Report of the Alaska Road Commission, Fiscal Year 1931. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-Seventh Annual Report, 1931, Part II, Operations. Juneau, Alaska.

1932 *Twenty-eight Annual Report of the Alaska Road Commission, Fiscal Year 1932. Upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and Related Works in the Territory of Alaska*. U.S. Government Printing Office, Washington, D.C.

1933 *Annual Report of the Alaska Road Commission For the Year Ending June 30, 1933*, U.S. Department of the Interior, Juneau.

1934 *Annual Report of the Alaska Road Commission For the Year Ending June 30, 1934*. U.S. Department of the Interior, Juneau.

1935 *Annual Report, Alaska Road Commission, 1935*. Juneau.

1936 *Annual Report, Alaska Road Commission, 1936*. Juneau.

1937 *Annual Report, Alaska Road Commission, 1937*. Juneau.

1938 *Annual Report, Alaska Road Commission, 1938*. Juneau.

1939 *Annual Report, Alaska Road Commission*, *1939*. Juneau.

1940 *Annual Report, Alaska Road Commission*, *1940.* Juneau.

1941 *Annual Report of the Alaska Road Commission, 1940* (Juneau).

1942 *Annual Report Alaska Road Commission, 1942*. Juneau.

1944 *Annual Report Alaska Road Commission, 1944*. Juneau.

1945 *Annual Report Alaska Road Commission, 1945*. Juneau.

1946 *Annual Report Alaska Road Commission, 1946*. Juneau.

1947 *Annual Report Alaska Road Commission, 1947*. Juneau.

1948 *Annual Report Alaska Road Commission, 1948.* Juneau.

1949 "A Plan for Alaska Roads, August 1, 1949," Appendix 1, in *Report of Operations of the Alaska Road Commission for the Fiscal Years 1949, 1950 & 1951* (Juneau: Department of the Interior, 1951).

1951 *Report of Operations of the Alaska Road Commission for the Fiscal Years 1949, 1950 & 1951,* (Juneau: 1951),

1952a "A List of All Bridges Under Alaska Road Commission Jurisdiction," prepared by the Bridge Design Section, Engineering Division, Alaska Road Commission, as of November 1, 1952, Juneau.

1952b *Alaska Road Commission Annual Report for the Fiscal Year 1952.* Condensed Report of Funds, Expenditures, Mileages and Work Status as of June 30, 1952. U.S. Department of the Interior, Juneau.

1953a *Alaska Road Commission Annual Report for the Fiscal Year 1953.* U.S. Department of the Interior, Juneau.

1953b Bridge Design Branch Memorandum, 1953, Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

1954 *Alaska Road Commission Annual Report, Fiscal Year 1954.* U.S. Department of the Interior, Juneau.

1955 *Alaska Road Commission Annual Report, For the Fiscal Year Ended June 30, 1955.* U.S. Department of the Interior, Office of Territories, Juneau.

1956 *Alaska Road Commission Annual Report, For the Fiscal Year Ended June 30, 1956.* U.S. Department of the Interior, Office of Territories, Juneau.

Boily, Sean M.

2004 *Perseverance Trail: Last Chance Basin to Silver Bow Basin, Historic Inventory and Report*. Completed for the City and Borough of Juneau, Parks and Recreation Department, Juneau, Alaska.

Brooks, Alfred Hulse

1953 *Blazing Alaska's Trails*. University of Alaska Press, Fairbanks.

Bureau of Public Roads (BPR)

1927 "Biennial Report of Forest Road Projects, Chugach And Tongass National Forests, Alaska, Calendar Years 1925 and 1926," in *Biennial Report of the Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1925 to March 31, 1927*, Juneau, Alaska, pp. 70-100.

1929 "Biennial Report of Forest Road Projects, Chugach And Tongass National Forests, Alaska, 1927 and 1928," in *Biennial Report, Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1927 to March 31, 1929*, Alaska Daily Empire, Juneau, pp. 70-84.

1931 "Biennial Report of Forest Highways [in Alaska], 1929-1930," in *Biennial Report, Territorial Highway Engineer, Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1929 to March 31, 1931*, Juneau, Alaska, pp. 92-127.

1953 "Report on the Development of the Alaska Forest Highway System in the Tongass and Chugach Forests," PCA 61-136, Alaska Road Commission Collection, Album 136, Alaska State Library, Juneau.

1957 "Annual Report – Bureau of Public Roads: Fiscal Year, 1957, Federal Aid to Alaska," reprinted in Grace Edna, Alice Hudson and Sam Johnson *Fifty Years of Highways*. Alaska Department of Public Works, Division of Highways, Nome, 1960.

Buzzell, Rolfe G.

1986 "Settlement Patterns of the Upper Kenai River Area Since the American Purchase of Alaska," in Charles E. Holmes, editor, *Supplemental Report: Sterling Highway Archaeology, 1985-1986*, Public Data File 86-35, Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, Anchorage,, pp. II-1 - II-69.

2002 *Cordova Historic Building Survey for the First Street Sidewalk Improvement Project and the Copper River Highway Bicycle and Pedestrian Path, Mile 0-10.7.* Office of History and Archaeology Report No 85, Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

2003a *Willow Fishhook Road Cultural Resource Survey Mile 25-Mile 39, Hatcher Pass, Project No. 55500.* Office of History and Archaeology Report No 97, Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

2003b Cultural Resource Evaluation of the Tanana River Bridge (No. 505), Mile 1303.3, Alaska Highway (Project No. 61637). Office of History and Archaeology Report No 93, Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

2004 *A History of the Skagway River*. Office of History and Archaeology Report Number 99, Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

2005 *Cultural Resources Survey Report for the Relocation of McCarthy Road (Project No. L66008*), Office of History and Archaeology Report Number 107, Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

Buzzell, Rolfe G. and Douglas Gibson

1986 *Nome-Council Road: Cultural Resources Survey Along Mile 32 to Mile 42, Seward Peninsula, Alaska*. Public Data File 86-4. Division of Geological and Geophysical Surveys, Alaska Department of Natural Resources, Anchorage.

Buzzell, Rolfe G., Steven R. Posgate, J. David McMahan, and Mark E. Pipkin.

1993 *Copper River Highway Cultural Resources Reconnaissance Survey, 1992*. Office of History and Archaeology Report Number 35. Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

Campbell, Chris Rabich

1996 "A History of the Steadman Street Bridge, Ketchikan, Alaska." Report produced for the Alaska Department of Transportation and Public Facilities.

Clifford, Howard

1981 *Rails North: The Railroads of Alaska and the Yukon*. Superior Publishing, Seattle.

Coates, Ken and William R. Morrison

1992 *The Alaska Highway in World War II: The U.S. Army of Occupation in Canada's Northwest.* University of Oklahoma Press, Norman, Oklahoma.

Cohen, Stan
1980 *The White Pass and Yukon Route: A Pictorial History*. Pictorial Histories Publishing Company, Missoula, Montana.

Condit, Carl W.
1968 *American Building: Materials and Techniques from the First Colonial Settlements to the Present.* University of Chicago, Chicago.

Connecticut River Valley Covered Bridge Society
1980 "Special Issue Covered Bridges From Alaska's Past," *Bulletin*, Volume XXVI, No. 4, Spring 1980, pp. 1-8.

Cheatham, C.W. (Assistant District Engineer)
1925 "Biennial Report on Forest Road Project Activities by Bureau of Public Roads, U.S. Department of Agriculture, Period 1923 and 1924," in *Biennial Report, Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1923 to March 31, 1925*, Alaska Daily Empire, Juneau, pp. 68-81.

Cole, Cash
1931 *Biennial Report, Territorial Highway Engineer, Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1929 to March 31, 1931*, Juneau, Alaska, pp. 1-91.

Daily Alaskan (Skagway newspaper)
1900a "Railroad Starts A Fine Steel Bridge: Alaska's First Cantilever Structure is Begun," July 17, 1900, p.1, column 3.

1900b "The Bridge at Switchback," September 27, 1900, p. 4, column 5.

1900c "Bridge Done: Great Steel Bridge Near the Summit Completed Yesterday," December 20, 1900, p. 1, column 6.

1901 "Railroad Improvements," August 13, 1901, p. 4, column 1.

1903a "Council Abandons Plan To Rebuild City Bridge: Will Take Over Sixteenth Avenue Span Which Will Be Repaired And Maintained At Municipal Expense," May 2, 1903, p. 1.

1903b "16th Street Bridge Repaired," August 25, 1903, p. 1, column 1.

1903c "About Over: Work of Repair on Railroad Nearly Completed," September 16, 1903, p. 4, column 6.

Daily Alaska Empire (Juneau newspaper)

1932 "A. Dishaw and Son Win Bid to Build Lawson Creek Bridge," July 25, 1932, p. 8.

1932 "Calhoun Ave. Viaduct Now Ready For Use," December 13, 1932.

1934 "Leveling Starts on Calhoun Street," December 11, 1934, p. 2.

1934 "Bid Call Made on Pair of PWA Constructions: Gastineau, Calhoun Avenue Concrete Structures Grouped," December 28, 1934.

1934 "J.G. Shepard is Appointed to PWA Staff Here," December 31, 1934.

1935 "Bridge over Gold Creek is Ready for Use: First PWA Loan Project in Juneau is Opened to Traffic Yesterday," May 10, 1935, p. 2.

1935 "Final Steel in Place Today," June 7, 1935.

1938 "Basin Road Will Be Closed Tuesday," August 5, 1938, p. 3.

DeLaHunt, Roland .J.

1960 Letter from Roland J. DeLaHunt, BPR Design Engineer, to Richard A. Downing, Commissioner, Alaska Department of Public Works, January 25, 1960, correspondence in Bridge File No.163, Chena River at University Avenue, ADOT&PF Bridge Section, Juneau.

Edna, Grace, Alice Hudson and Sam Johnson

1960 *Fifty Years of Highways*. Alaska Department of Public Works, Division of Highways. Nome.

Ermold, Sharon

2007 E-mail from Sharon Ermold, Cordova Museum, to Rolfe G. Buzzell, April 10, 2007.

Federal Highway Administration (FHWA)

2004 "Bridges" [Chapter 15], *Status of the Nation's Highways, Bridges and Transit: 2004 Conditions and Performance*, U.S. Department of Transportation, Federal Highway Administration, http://www.fhwa.dot.gov/policy/2004cpr.

Ghiglione, A.F.

1953 Letter from A.F. Ghiglione to August Altrery, consulting engineer, New York, New York, February 11, 1953, Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

Goodall, David M.
1955 Special Report on Precasting and Prestressing the Lightweight Concrete Superstructure Elements for Kenai River Bridge, Alaska Forest Highway project 5-A5, May 15, 1955, copy in Kenai River Bridge at Schooner Bend (Bridge No. 673), ADOT&PF Bridge Design Section, Juneau.

Halsted, Donald E.
1963 "Precast and prestressed–But Not Permanent," *Civil Engineering* (August 1963), pp. 60-61.

1979 Letter from Donald E. Halsted, Chief Bridge Engineer, to Joseph Conwill of Wyckoff, New Jersey, September 4, 1979. ADOT&PF Bridge Design Files, Juneau.

2005 Interview with Donald E. Halsted, retired ADOT&PF Bridge Engineer, at his residence in Douglas, by Rolfe G. Buzzell, March 28, 2005.

Hayes, Glenn D.
1979 Letter from Glenn D. Hayes of Colonia, New Jersey, to Don E. Halsted, Chief Bridge Engineer, November 23, 1979. ADOT&PF Bridge Design Files, Juneau.

Hesse, William A.
1933 *Biennial Report of the Territorial Highway Engineer, April 1, 1931 to March 31, 1933*. Juneau.

1935 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1933-1934*. Juneau.

1937 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1935-1936*. Juneau.

1939 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1937-1938*. Juneau.

1941 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1939-1940*. Juneau.

Hewitt, L.H.
1949 "Report on Survey for Flood Control of Gold Creek and Tributaries," Alaska. Report of the District Engineer, U.S. Army Corps of Engineers, Seattle District, March 1, 1949, House of Representatives, 82d Congress, 1st Session, Document 54, Washington, D.C., pp 7-22.

Huntley, Theodore A. and R.E. Royall
1945 *Construction of the Alaska Highway*. Public Roads Administration, Washington,

D.C.

Johnson, Julie
2003 A *Wild Discouraging Mess: The History of the White Pass Unit of the Klondike Gold Rush National Historical Park*. Alaska Support Office, National Park Service, U.S. Department of the Interior, Anchorage and Klondike Gold Rush National Historical Park, Sitka.

Jones, Clinton C.
1960 Assistant Bridge Engineer, BPR to T.D. Sherrard, Director of Highways and Chief Engineer, Alaska Department of Public Works, July 20, 1960, Bridge File 206, ADOT&PF/Bridge Section.

Lium, Robert (Bob)
2005 Interview with retired state bridge engineer Robert Lium at his residence in West Douglas, by Rolfe G. Buzzell, March 28, 2005.

McClanahan, Alexandra J.
2006 "Alaska Scrapbook," *Anchorage Daily News*, September 3, 2006, p. J-4.

Metcalf, Frank A.
1949 *Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1947-1948*. Territory of Alaska, Juneau.

1951 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1949-1950*. Juneau.

1953 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1951-1952*. Juneau.

Mourant, Robert (Rob)
2005 Interview with Robert Mourant at his home in West Juneau, February 18, 2005, by Rolfe G. Buzzell.

Morgan, Murray
1967 *One Man's Gold Rush: A Klondike Album*. University of Washington Press, Seattle.

Naske, Claus-M.
1976 The Alcan: Its Impact on Alaska. *The Northern Engineer*, Volume 8, No.1 (Spring 1976), pp. 12-18.

1983 *Alaska Road Commission Historical Narrative, Final Report*. Prepared for the Research Section of the Division of Planning and Programming, Alaska Department of Transportation and Public Facilities, Fairbanks.

1986 *Paving Alaska's Trails: The Work of the Alaska Road Commission*. University Press of America, New York.

1987 *Alaska's Inclusion in the Federal-Aid Highway Act of 1956, the Work of the Bureau Public Roads and the Transition to Statehood*. Prepared for the Alaska Department of Transportation and Public Facilities, Division of Planning and Research, Fairbanks.

Niemi, William J.
1959 Letter from William J. Niemi, BPR Regional Engineer, to Richard A. Downing, Commissioner, Alaska Department of Public Works, December 28, 1959, correspondence in Bridge File No.163, Chena River at University Avenue, ADOT&PF Bridge Section, Juneau.

Otis, Alison T., William D. Honey, Thomas C. Hogg, and Kimberly K. Lakin.
1986 *The Forest Service and the Civilian Conservation Corps*. Pacific Crest Research and Services Corporation, Corvallis, Oregon.

Parsons, Brinckerhoff and Engineering and Industrial Heritage
2005 *A Context for Common Historic Bridge Types*, NCHRP Project 25-25, Task 15, prepared for the National Cooperative Highway Research Program, Transportation Research Council, National Research Council.

Pivar, John J.
2005 Interview with John J. Pivar, Senior Bridge Engineer, at ADOT&PF Bridge Section, Juneau, by Rolfe G. Buzzell, April 1, 2005.

Plowden, David
2002 *Bridges: The Spans of North America* . W.W. Norton and Company, New York.

Potter, James E. and L. Robert Puschendof, editors
1999 *Spans in Time: A History of Nebraska Bridges*. Nebraska State Historical Society and the Nebraska Department of Roads, Omaha.

Reed, Irving Mck
1955 *Biennial Report of the Alaska Territorial Highway Engineer and the Superintendent of Public Works, 1953-1954*. Territory of Alaska, Juneau.

Ross, H.R. (Chairman)
1917 Annual Report of Office of Fourth Division, Territorial Road Commission, Fair-

banks.

Samuelson, Laura

2007 Telephone interview with Laura Samuelson, Director of the Carrie M. McLain Memorial Museum in Nome, January 11, 2007, by Rolfe G. Buzzell.

Schultz, Harold B.

1951a "Reconstruction Existing Bridges, 1952-54, List in order of Priority," April 11, 1951, pp. 1-2, Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956, [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

1951b "Alaska Road Commission Proposed Bridge Improvements, August 2, 1951," Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

1951c Memo by Harold B. Schultz, Bridge Design Chief, to G. M. Tapley, Chief of the Engineering Division, September 11, 1951, Record Group 30, ARC & BPR Files, Directives Files, Juneau 19301-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

1952a "Recommended Bridge Replacement Program, 1952," Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

1952b Memo from H.B. Schultz to E.J. White, January 9, 1952, Record Group 30, ARC & BPR Files, Directives Files, Juneau 19301-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

Shepard, R. J.

1933 R.J. Shepard to Ike P. Taylor, Chief Engineer, Alaska Road Commission, Juneau, July 12, 1933, in Record Group 30, ARC Records, Project Correspondence, Juneau, 1916-1959, Box 4, National Archives and Records Center, Anchorage.

Sherard, T.D. (Director of Highways)

1961 *Annual Report, Division of Highways, 1961.* Alaska Department of Public Works, Division of Highways, Juneau.

Shipp, Frank

1933 Frank Shipp to Alaska Road Commission, Juneau, May 10, 1933, in Record Group 30, ARC Records, Project Correspondence, Juneau, 1916-1959, Box 4, National Archives and Records Center, Anchorage.

Simpson, Sherry

1995 Alaska's Ferry Fleet: History of the Marine Highway System, in Sherry Simpson and Mark Kelley, *Alaska's Ocean Highways: A Travel Adventure Aboard Northern*

Ferries. Epicenter Press, Seattle.

Smith, W. Leonard
1947 *Biennial Report of the Alaska Territorial Highway Engineer and the Superintendent of Public Works, 1945-1946*. Territory of Alaska, Juneau.

Soberg, Ralph.
1991 *Bridging Alaska: From the Big Delta to the Kenai: A Personal Account of 30 Years of Pioneer Bridge and Road Construction Throughout the 49th State*. Hardscratch Press, Walnut Creek, California.

Stoddart, Hugh A.
n.d. "Discussion of [BPR] Accomplishments, FY 1949," n.d., Record Group 30, ARC & BPR Files, Project Correspondence, Juneau, 1916, 1959, Box 53, National Archives and Records Center, Anchorage.

1949 "Confidential Monthly Report for June 1949 for Division No. 10," July 6, 1949, ARC Photo Collection, PCA-61 Album 76, Alaska State Library, Juneau.

1951a Hugh A. Stoddart to G.W. May, San Francisco, "Monthly [Alaska] BPR Report," April 7, 1951, Juneau, in Album 76, ARC Photo Collection, PCA-61-76, Alaska State Library, Juneau.

1951b Hugh A. Stoddart to G.W. May, San Francisco, "April Monthly [Alaska] BPR Report," May 8, 1951, ARC Photo Collection, PCA-61-76, in Album 76, Alaska State Library, Juneau.

1953 Memo by Hugh A. Stoddart, BPR Division Engineer, Juneau, to A.C. Clark, Deputy Commissioner BPR in Washington, D.C., July 31, 1953, Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

Stone, David and Brenda
1980 *Hard Rock Gold: The Story of the Great Mines that were the Heartbeat of Juneau*. Juneau Centennial Committee, City and Borough of Juneau.

Talbot, C.B.
1897 "Sketch of the Dyea and Skagua Trails, Sept-1897, by C.B. Talbot, Sitka, Alaska," in Report of the Governor of the District of Alaska to the Secretary of the Interior, 1897. Government Printing Office, Washington, D.C.

Theile, Karl
1923 *Biennial Report of the Territorial Board of Road Commissioners for the Territory of Alaska, April 1,1921, to March 32, 1923*, Juneau.

1925 *Biennial Report of the Territorial Board of Road Commissioners, 1923-1925*, Alaska Daily Empire Print, Juneau.

1927 *Biennial Report of the Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1925 to March 31, 1927*, Juneau, Alaska.

1929 *Biennial Report, Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1927 to March 31, 1929*, Alaska Daily Empire, Juneau.

Twitchell, Heath

1992 *Northwest Epic: The Building of the Alaska Highway*. St. Martin's Press, New York.

U.S. House Committee on Roads

1946 *The Alaska Highway*, House Report 1704, 79th Congress, 2nd Session (March 31, 1946).

U.S. Department of the Interior/National Park Service (USDI/NPS)

1991 *How to Apply the National Register Criteria of Evaluation*, National Register Bulletin 16A , Interagency Resources Division, National Park Service, Washington, D.C.

Walker, A.V.

1954 Report on Design and Construction of Eyak River Bridge," Copper River Highway, Alaska Forest Highway Project 31-2, September 30, 1954, Bureau of Public Roads, copy located in Eyak River Bridge File (Bridge No. 381), ADOT&PF Bridge Design Section, Juneau.

Williams, G. W.

1959 Circular from G.W. Williams at BPR headquarters in Washington, D.C. to Regional and Division Engineers, January 5, 1959, Schooner Bend Bridge file, Bridge No. 673, ADOT&PF Bridge Section files, Juneau.

Woodman, Lyman L.

1997 *Duty Station Northwest: The U.S. Army in Alaska and Western Canada, 1867-1987. Volume Two, 1918-1945*. Alaska Historical Society, Anchorage, Alaska.

Yost. Harry

1995 "A Soldier's Scrapbook," in Fern Chandonnet, editor, *Alaska at War: The Forgotten War Remembered: Papers from the Alaska at War Symposium Anchorage, Alaska, November 11-13, 1993*. Alaska at War Committee, Anchorage, Alaska, pp. 185-187.

Zimmerman, M.C.

1959 Memorandum from M.C. Zimmerman, BPR in Anchorage, to R.J. DeLaHunt, BPR Design Engineer in Juneau, March 10, 1959, Schooner Bay Bridge file, Bridge No. 673, ADOT&PF Bridge files.

XIV. REFERENCES

Alaska Department of Highways

1963 *Alaska Highway Bridge Inventory Rating Report*. State of Alaska, Department of Highways, Planning and Research Section in cooperation with the U.S. Department of Commerce, Bureau of Public Roads. Juneau.

1964 *1964 Annual Report*. Juneau.

1969 *1969 Annual Report*. Juneau.

1972 *Alaska Highway Bridge Loading Report, 1972*. Prepared by the State of Alaska, Department of Highways, Bridge Design Section, Juneau.

Alaska Division of the Federal Highway Administration (ADFHWA)

2005 Evaluation of Eligibility, Richardson Highway MP 228, One Mile Creek Bridge Replacement, Project No. BR-071-4(18)/61870, June 27, 2005.

Alaska Mining Record, *The* (Juneau newspaper)

1895 "The Gem of the Pacific Coast [Sitka]," January 7, 1895, p. 1.

1896 "Juneau Bridge to be Replaced by Mine and Citizen Subscription," July 22, 1986, p. 10.

Alaska Search Light (Juneau newspaper)

1895 December 28, 1895, page 6.

American Society of Civil Engineers, Alaska Section

1976 *Alaska's Engineering Heritage, Building from Past to Future* (Anchorage).

Antonson, Joan and William Hanable

1985 *Alaska's Heritage*. Alaska Historical Commission Studies in History No. 133. The Alaska Historical Society for the Alaska Historical Commission of the Department of Education, Anchorage.

Arvidson, Rose C.

1984 *Cordova, The First 75 Years: A Photographic History*. Fathom Publishing Company, Cordova, Alaska.

Associated General Contractors of Alaska

1998 *Alaska's Builders, 57 Years of Construction in the 49th State*. Publication Consultants, Anchorage.

Bauer, Mary Cracraft
1987 *The Glenn Highway: The Story of its Past and a Guide to Its Present.* Bentwood Press, Sutton, Alaska.

Bolton, Donald F.
1959 Memorandum from Donald F. Bolton, Chief, Bridge Design Unit, to William J. Niemi, BPR Regional Engineer, Bureau of Public Roads, Juneau, December 22, 1959, Bridge File No.163, Chena River at University Avenue, ADOT&PF Bridge Section, Juneau;

Board of Road Commissioners for Alaska (ARC)
1905 "Report of Operations for the Season of 1905 (of the Board of Road Commissioners for Alaska)," November 1, 1905, in *War Department Annual Report, 1905*, Vol. 1, pp. 291-314.

1906 "Report of the Board of Road Commissioners for Alaska, Season of 1906," January 18, 1906, in U.S. House of Representatives Document No. 523, 59th Congress, 2nd Session.

1907 "Report of Operations for the Season of 1907 (of the Board of Road Commissioners for Alaska)," in *War Department Annual Report, 1907*, Vol. 1, pp. 114-144.

1908 "Report of Operations for the Season of 1908 (of the Board of Road Commissioners for Alaska)," in *War Department Annual Report, 1908*, Vol. 1, Appendix D, 1908, pp. 94-116.

1910a *Report of Operations for the Season of 1909 (of the Board of Road Commissioners for Alaska*, U.S. House of Representatives Document 864, 61st Congress, 2nd Session, Volume 131, April 18, 1910.

1910b *Report of the Board of Road Commissioners for Alaska, 1910,* Government Printing Office, Washington, D.C.

1912a *Report of the Board of Road Commissioners for Alaska, 1911*. Government Printing Office, Washington, D.C.

1912b *Report of the Board of Road Commissioners for Alaska, 1912*. Government Printing Office, Washington, D.C.

1913 *Report of the Board of Road Commissioners for Alaska, 1913* (Government Printing Office, Washington, D.C.

1914 *Report of Operations for the Season of 1914 (of the Board of Road Commission-ers for Alaska)*. U.S. Government Printing Office, Washington, D.C.

1915 *Report of the Board of Road Commissioners for Alaska, 1915*. Government Printing Office, Washington, D.C.

1916 Report of the Board of Road Commissioners for Alaska, 1916. Government Printing Office, Washington, D.C.

1917 *Report of the Board of Road Commissioners for Alaska, 1917*. Government Printing Office, Washington, D.C.

1919a Report upon Construction and Maintenance of Military and Post Roads, Bridges and Trails, Alaska. Board of Road Commissioners for Alaska in Charge, Fiscal Year 1919." (Part I). In *U.S. Army Chiefs of Engineers Annual Report, 1919*, Extract KKK, pages 2095-2102 (U.S. Serials, No. 7693, Fiche 22).

1919b Report upon Construction and Maintenance of Military and Post Roads, Bridges and Trails, Alaska. Board of Road Commissioners for Alaska in Charge, Fiscal Year 1919." (Part II). In *U.S. Army Chiefs of Engineers Annual Report, 1919*, Extract KKK, pages 3871-3887 (U.S. Serials, No. 7695, Fiche 7).

1920 *Report upon the Construction and Maintenance of Military and Post Roads, Bridges, and Trails, Alaska*. Annual Report of the Chief of Engineers, 1920, Government Printing Office, Washington, D.C., pp. 55-67.

1921 *Annual Report of the Alaska Road Commission, Fiscal Year 1921. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. 1921, Part II. Juneau, Alaska.

1922 *Annual Report of the Alaska Road Commission, Fiscal Year 1922. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. 1922, Part II. Juneau, Alaska.

1923b *Annual Report of the Alaska Road Commission, Fiscal Year 1923. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. 1923, Part II. Juneau, Alaska.

1924 *Annual Report of the Alaska Road Commission, Fiscal Year 1924. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. 1924, Part II. Juneau, Alaska.

1925a Report Upon the Construction and Maintenance of Roads, Bridges and Trails, Alaska, Annual Report of the Chief of Engineers, 1925, Extract. Government Printing Office, Washington, 1925, pp. 1987-1999.

1925b *Annual Report of the Alaska Road Commission, Fiscal Year 1925. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-First Annual Report, 1925, Part II, Operations. Juneau, Alaska.

1925c Report Upon the Construction and Maintenance of Roads, Bridges and Trails, Alaska, Annual Report of the Chief of Engineers, 1924, Extract. Government Printing Office, Washington, D.C., 1925, pp. 2069-2085.

1926 *Annual Report of the Alaska Road Commission, Fiscal Year 1926. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-Second Annual Report, 1926, Part II, Operations. Juneau, Alaska.

1927 *Annual Report of the Alaska Road Commission, Fiscal Year 1927. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-third Annual Report, 1927, Part II, Operations. Juneau, Alaska.

1928b *Annual Report of the Alaska Road Commission, Fiscal Year 1928. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-fourth Annual Report, 1928, Part II, Operations. Juneau, Alaska.

1929 *Annual Report of the Alaska Road Commission, Fiscal Year 1929. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-fifth Annual Report, 1928, Part II, Operations. Juneau, Alaska.

1930 *Annual Report of the Alaska Road Commission, Fiscal Year 1930. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-sixth Annual Report, 1930, Part II, Operations. Juneau, Alaska.

1931 *Annual Report of the Alaska Road Commission, Fiscal Year 1931. Report upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and related works in the Territory of Alaska*. Twenty-Seventh Annual Report, 1931, Part II, Operations. Juneau, Alaska.

1932 *Twenty-eight Annual Report of the Alaska Road Commission, Fiscal Year 1932. Upon the Construction and Maintenance of Military and Post Roads, Bridges and Trails; and of other Roads, Tramways, Ferries, Bridges, Trails, and Related Works in the Territory of Alaska*. U.S. Government Printing Office, Washington, D.C.

1933 *Annual Report of the Alaska Road Commission For the Year Ending June 30, 1933*, U.S. Department of the Interior, Juneau.

1934 *Annual Report of the Alaska Road Commission For the Year Ending June 30, 1934*. U.S. Department of the Interior, Juneau.

1935 *Annual Report, Alaska Road Commission, 1935*. Juneau.

1936 *Annual Report, Alaska Road Commission, 1936*. Juneau.

1937 *Annual Report, Alaska Road Commission, 1937.* Juneau.

1938 *Annual Report, Alaska Road Commission, 1938*. Juneau.

1939 *Annual Report, Alaska Road Commission*, *1939.* Juneau.

1940 *Annual Report, Alaska Road Commission*, *1940.* Juneau.

1941 *Annual Report of the Alaska Road Commission, 1940* (Juneau).

1942 *Annual Report Alaska Road Commission, 1942*. Juneau.

1944 *Annual Report Alaska Road Commission, 1944*. Juneau.

1945 *Annual Report Alaska Road Commission, 1945*. Juneau.

1946 *Annual Report Alaska Road Commission, 1946*. Juneau.

1947 *Annual Report Alaska Road Commission, 1947*. Juneau.

1948 *Annual Report Alaska Road Commission, 1948*. Juneau.

1949 "A Plan for Alaska Roads, August 1, 1949," Appendix 1, in *Report of Operations of the Alaska Road Commission for the Fiscal Years 1949, 1950 & 1951* (Juneau: Department of the Interior, 1951).

1951 *Report of Operations of the Alaska Road Commission for the Fiscal Years 1949, 1950 & 1951,* (Juneau: 1951),

1952a "A List of All Bridges Under Alaska Road Commission Jurisdiction," prepared by the Bridge Design Section, Engineering Division, Alaska Road Commission, as of November 1, 1952, Juneau.

1952b *Alaska Road Commission Annual Report for the Fiscal Year 1952*. Condensed Report of Funds, Expenditures, Mileages and Work Status as of June 30, 1952. U.S. Department of the Interior, Juneau.

1953a *Alaska Road Commission Annual Report for the Fiscal Year 1953*. U.S. Department of the Interior, Juneau.

1953b Bridge Design Branch Memorandum, 1953, Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

1954 *Alaska Road Commission Annual Report, Fiscal Year 1954*. U.S. Department of the Interior, Juneau.

1955 *Alaska Road Commission Annual Report, For the Fiscal Year Ended June 30, 1955*. U.S. Department of the Interior, Office of Territories, Juneau.

1956 *Alaska Road Commission Annual Report, For the Fiscal Year Ended June 30, 1956*. U.S. Department of the Interior, Office of Territories, Juneau.

Boily, Sean M.

2004 *Perseverance Trail: Last Chance Basin to Silver Bow Basin, Historic Inventory and Report*. Completed for the City and Borough of Juneau, Parks and Recreation Department, Juneau, Alaska.

Brooks, Alfred Hulse

1953 *Blazing Alaska's Trails*. University of Alaska Press, Fairbanks.

Bureau of Public Roads (BPR)

1927 "Biennial Report of Forest Road Projects, Chugach And Tongass National Forests, Alaska, Calendar Years 1925 and 1926," in *Biennial Report of the Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1925 to March 31, 1927*, Juneau, Alaska, pp. 70-100.

1929 "Biennial Report of Forest Road Projects, Chugach And Tongass National Forests, Alaska, 1927 and 1928," in *Biennial Report, Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1927 to March 31, 1929*, Alaska Daily Empire, Juneau, pp. 70-84.

1931 "Biennial Report of Forest Highways [in Alaska], 1929-1930," in *Biennial Report, Territorial Highway Engineer, Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1929 to March 31, 1931*, Juneau, Alaska, pp. 92-127.

1953 "Report on the Development of the Alaska Forest Highway System in the Tongass and Chugach Forests," PCA 61-136, Alaska Road Commission Collection, Album 136, Alaska State Library, Juneau.

1957 "Annual Report – Bureau of Public Roads: Fiscal Year, 1957, Federal Aid to Alaska," reprinted in Grace Edna, Alice Hudson and Sam Johnson *Fifty Years of Highways*. Alaska Department of Public Works, Division of Highways, Nome, 1960.

Buzzell, Rolfe G.

1986 "Settlement Patterns of the Upper Kenai River Area Since the American Purchase of Alaska," in Charles E. Holmes, editor, *Supplemental Report: Sterling Highway Archaeology, 1985-1986*, Public Data File 86-35, Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, Anchorage,, pp. II-1 - II-69.

2002 *Cordova Historic Building Survey for the First Street Sidewalk Improvement Project and the Copper River Highway Bicycle and Pedestrian Path, Mile 0-10.7*. Office of History and Archaeology Report No 85, Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

2003a *Willow Fishhook Road Cultural Resource Survey Mile 25-Mile 39, Hatcher Pass, Project No. 55500*. Office of History and Archaeology Report No 97, Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

2003b Cultural Resource Evaluation of the Tanana River Bridge (No. 505), Mile 1303.3, Alaska Highway (Project No. 61637). Office of History and Archaeology Report No 93, Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

2004 *A History of the Skagway River*. Office of History and Archaeology Report Number 99, Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

2005 *Cultural Resources Survey Report for the Relocation of McCarthy Road (Project No. L66008*), Office of History and Archaeology Report Number 107, Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

Buzzell, Rolfe G. and Douglas Gibson

1986 *Nome-Council Road: Cultural Resources Survey Along Mile 32 to Mile 42, Seward Peninsula, Alaska*. Public Data File 86-4. Division of Geological and Geophysical Surveys, Alaska Department of Natural Resources, Anchorage.

Buzzell, Rolfe G., Steven R. Posgate, J. David McMahan, and Mark E. Pipkin.

1993 *Copper River Highway Cultural Resources Reconnaissance Survey, 1992*. Office of History and Archaeology Report Number 35. Division of Parks and Outdoor Recreation, Alaska Department of Natural Resources, Anchorage.

Campbell, Chris Rabich

1996 "A History of the Steadman Street Bridge, Ketchikan, Alaska." Report produced for the Alaska Department of Transportation and Public Facilities.

Clifford, Howard

1981 *Rails North: The Railroads of Alaska and the Yukon*. Superior Publishing, Seattle.

Coates, Ken and William R. Morrison

1992 *The Alaska Highway in World War II: The U.S. Army of Occupation in Canada's Northwest*. University of Oklahoma Press, Norman, Oklahoma.

Cohen, Stan

1980 *The White Pass and Yukon Route: A Pictorial History*. Pictorial Histories Publishing Company, Missoula, Montana.

Condit, Carl W.

1968 *American Building: Materials and Techniques from the First Colonial Settlements to the Present*. University of Chicago, Chicago.

Connecticut River Valley Covered Bridge Society
1980 "Special Issue Covered Bridges From Alaska's Past," *Bulletin*, Volume XXVI, No. 4, Spring 1980, pp. 1-8.

Cheatham, C.W. (Assistant District Engineer)
1925 "Biennial Report on Forest Road Project Activities by Bureau of Public Roads, U.S. Department of Agriculture, Period 1923 and 1924," in *Biennial Report, Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1923 to March 31, 1925*, Alaska Daily Empire, Juneau, pp. 68-81.

Cole, Cash
1931 *Biennial Report, Territorial Highway Engineer, Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1929 to March 31, 1931*, Juneau, Alaska, pp. 1-91.

Daily Alaskan (Skagway newspaper)
1900a "Railroad Starts A Fine Steel Bridge: Alaska's First Cantilever Structure is Begun," July 17, 1900, p.1, column 3.

1900b "The Bridge at Switchback," September 27, 1900, p. 4, column 5.

1900c "Bridge Done: Great Steel Bridge Near the Summit Completed Yesterday," December 20, 1900, p. 1, column 6.

1901 "Railroad Improvements," August 13, 1901, p. 4, column 1.

1903a "Council Abandons Plan To Rebuild City Bridge: Will Take Over Sixteenth Avenue Span Which Will Be Repaired And Maintained At Municipal Expense," May 2, 1903, p. 1.

1903b "16th Street Bridge Repaired," August 25, 1903, p. 1, column 1.

1903c "About Over: Work of Repair on Railroad Nearly Completed," September 16, 1903, p. 4, column 6.

Daily Alaska Empire (Juneau newspaper)
1932 "A. Dishaw and Son Win Bid to Build Lawson Creek Bridge," July 25, 1932, p. 8.

1932 "Calhoun Ave. Viaduct Now Ready For Use," December 13, 1932.

1934 "Leveling Starts on Calhoun Street," December 11, 1934, p. 2.

1934 "Bid Call Made on Pair of PWA Constructions: Gastineau, Calhoun Avenue Concrete Structures Grouped," December 28, 1934.

1934 "J.G. Shepard is Appointed to PWA Staff Here," December 31, 1934.

1935 "Bridge over Gold Creek is Ready for Use: First PWA Loan Project in Juneau is Opened to Traffic Yesterday," May 10, 1935, p. 2.

1935 "Final Steel in Place Today," June 7, 1935.

1938 "Basin Road Will Be Closed Tuesday," August 5, 1938, p. 3.

DeLaHunt, Roland .J.

1960 Letter from Roland J. DeLaHunt, BPR Design Engineer, to Richard A. Downing, Commissioner, Alaska Department of Public Works, January 25, 1960, Bridge File No.163, Chena River at University Avenue, ADOT&PF Bridge Section, Juneau.

Edna, Grace, Alice Hudson and Sam Johnson

1960 *Fifty Years of Highways*. Alaska Department of Public Works, Division of Highways. Nome.

Ermold, Sharon

2007 E-mail from Sharon Ermold, Cordova Museum, to Rolfe G. Buzzell, April 10, 2007.

Ghiglione, A.F.

1953 Letter from A.F. Ghiglione to August Altrery, consulting engineer, New York, New York, February 11, 1953, Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

Goodall, David M.

1955 Special Report on Precasting and Prestressing the Lightweight Concrete Superstructure Elements for Kenai River Bridge, Alaska Forest Highway project 5-A5, May 15, 1955, copy in Kenai River Bridge at Schooner Bend (Bridge No. 673), ADOT&PF Bridge Design Section, Juneau.

Halsted, Donald E.

1963 "Precast and prestressed–But Not Permanent," *Civil Engineering* (August 1963), pp. 60-61.

1979 Letter from Donald E. Halsted, Chief Bridge Engineer, to Joseph Conwill of Wyckoff, New Jersey, September 4, 1979. ADOT&PF Bridge Design Files, Juneau.

2005 Interview with Donald E. Halsted, retired ADOT&PF Bridge Engineer, at his residence in Douglas, by Rolfe G. Buzzell, March 28, 2005.

Hayes, Glenn D.
1979 Letter from Glenn D. Hayes of Colonia, New Jersey, to Don E. Halsted, Chief Bridge Engineer, November 23, 1979. ADOT&PF Bridge Design Files, Juneau.

Hesse, William A.
1933 *Biennial Report of the Territorial Highway Engineer, April 1, 1931 to March 31, 1933*. Juneau.

1935 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1933-1934*. Juneau.

1937 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1935-1936*. Juneau.

1939 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1937-1938*. Juneau.

1941 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1939-1940*. Juneau.

Hewitt, L.H.
1949 "Report on Survey for Flood Control of Gold Creek and Tributaries," Alaska. Report of the District Engineer, U.S. Army Corps of Engineers, Seattle District, March 1, 1949, House of Representatives, 82d Congress, 1st Session, Document 54, Washington, D.C., pp 7-22.

Huntley, Theodore A. and R.E. Royall
1945 *Construction of the Alaska Highway*. Public Roads Administration, Washington, D.C.

Johnson, Julie
2003 A *Wild Discouraging Mess: The History of the White Pass Unit of the Klondike Gold Rush National Historical Park*. Alaska Support Office, National Park Service, U.S. Department of the Interior, Anchorage and Klondike Gold Rush National Historical Park, Sitka.

Lium, Robert (Bob)
2005 Interview with retired state bridge engineer Robert Lium at his residence in West Douglas, by Rolfe G. Buzzell, March 28, 2005.

McClanahan, Alexandra J.
2006 "Alaska Scrapbook," *Anchorage Daily News*, September 3, 2006, p. J-4.

Metcalf, Frank A.
1949 *Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1947-1948*. Territory of Alaska, Juneau.

1951 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1949-1950*. Juneau.

1953 *Biennial Report of the Alaska Territorial Highway Engineer and Superintendent of Public Works, 1951-1952*. Juneau.

Mourant, Robert (Rob)
2005 Interview with Robert Mourant at his home in West Juneau, February 18, 2005, by Rolfe G. Buzzell.

Morgan, Murray
1967 *One Man's Gold Rush: A Klondike Album*. University of Washington Press, Seattle.

Naske, Claus-M.
1976 The Alcan: Its Impact on Alaska. *The Northern Engineer*, Volume 8, No.1 (Spring 1976), pp. 12-18.

1983 *Alaska Road Commission Historical Narrative, Final Report*. Prepared for the Research Section of the Division of Planning and Programming, Alaska Department of Transportation and Public Facilities, Fairbanks.

1986 *Paving Alaska's Trails: The Work of the Alaska Road Commission*. University Press of America, New York.

1987 *Alaska's Inclusion in the Federal-Aid Highway Act of 1956, the Work of the Bureau Public Roads and the Transition to Statehood*. Prepared for the Alaska Department of Transportation and Public Facilities, Division of Planning and Research, Fairbanks.

Niemi, William J.
1959 Letter from William J. Niemi, BPR Regional Engineer, to Richard A. Downing, Commissioner, Alaska Department of Public Works, December 28, 1959, Bridge File No.163, Chena River at University Avenue, ADOT&PF Bridge Section, Juneau.

Otis, Alison T., William D. Honey, Thomas C. Hogg, and Kimberly K. Lakin.
1986 *The Forest Service and the Civilian Conservation Corps*. Pacific Crest Research and Services Corporation, Corvallis, Oregon.

Parsons, Brinckerhoff and Engineering and Industrial Heritage
2005 *A Context for Common Historic Bridge Types*, NCHRP Project 25-25, Task 15, prepared for the National Cooperative Highway Research Program, Transportation Research Council, National Research Council.

Pivar, John J.
2005 Interview with John J. Pivar, Senior Bridge Engineer, at ADOT&PF Bridge Section, Juneau, by Rolfe G. Buzzell, April 1, 2005.

Plowden, David
2002 *Bridges: The Spans of North America* . W.W. Norton and Company, New York.

Potter, James E. and L. Robert Puschendof, editors
1999 *Spans in Time: A History of Nebraska Bridges*. Nebraska State Historical Society and the Nebraska Department of Roads, Omaha.

Reed, Irving Mck
1955 *Biennial Report of the Alaska Territorial Highway Engineer and the Superintendent of Public Works, 1953-1954*. Territory of Alaska, Juneau.

Ross, H.R. (Chairman)
1917 Annual Report of Office of Fourth Division, Territorial Road Commission, Fairbanks.

Samuelson, Laura
2007 Telephone interview with Laura Samuelson, Director of the Carrie M. McLain Memorial Museum in Nome, January 11, 2007, by Rolfe G. Buzzell.

Schultz, Harold B.
1951a "Reconstruction Existing Bridges, 1952-54, List in order of Priority," April 11, 1951, pp. 1-2, Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956, [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

1951b "Alaska Road Commission Proposed Bridge Improvements, August 2, 1951," Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

1951c Memo by Harold B. Schultz, Bridge Design Chief, to G. M. Tapley, Chief of the Engineering Division, September 11, 1951, Record Group 30, ARC & BPR Files, Directives Files, Juneau 19301-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

1952a "Recommended Bridge Replacement Program, 1952," Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

1952b Memo from H.B. Schultz to E.J. White, January 9, 1952, Record Group 30, ARC & BPR Files, Directives Files, Juneau 19301-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

Shepard, R. J.

1933 R.J. Shepard to Ike P. Taylor, Chief Engineer, Alaska Road Commission, Juneau, July 12, 1933, in Record Group 30, ARC Records, Project Correspondence, Juneau, 1916-1959, Box 4, National Archives and Records Center, Anchorage.

Shipp, Frank

1933 Frank Shipp to Alaska Road Commission, Juneau, May 10, 1933, in Record Group 30, ARC Records, Project Correspondence, Juneau, 1916-1959, Box 4, National Archives and Records Center, Anchorage.

Simpson, Sherry

1995 Alaska's Ferry Fleet: History of the Marine Highway System, in Sherry Simpson and Mark Kelley, *Alaska's Ocean Highways: A Travel Adventure Aboard Northern Ferries*. Epicenter Press, Seattle.

Smith, W. Leonard

1947 *Biennial Report of the Alaska Territorial Highway Engineer and the Superintendent of Public Works, 1945-1946*. Territory of Alaska, Juneau.

Soberg, Ralph.

1991 *Bridging Alaska: From the Big Delta to the Kenai: A Personal Account of 30 Years of Pioneer Bridge and Road Construction Throughout the 49th State*. Hardscratch Press, Walnut Creek, California.

Stoddart, Hugh A.

n.d. "Discussion of [BPR] Accomplishments, FY 1949," n.d., Record Group 30, ARC & BPR Files, Project Correspondence, Juneau, 1916, 1959, Box 53, National Archives and Records Center, Anchorage.

1949 "Confidential Monthly Report for June 1949 for Division No. 10," July 6, 1949, ARC Photo Collection, PCA-61 Album 76, Alaska State Library, Juneau.

1951a Hugh A. Stoddart to G.W. May, San Francisco, "Monthly [Alaska] BPR Report," April 7, 1951, Juneau, in Album 76, ARC Photo Collection, PCA-61-76, Alaska State Library, Juneau.

1951b Hugh A. Stoddart to G.W. May, San Francisco, "April Monthly [Alaska] BPR Report," May 8, 1951, ARC Photo Collection, PCA-61-76, in Album 76, Alaska State Library, Juneau.

1953 Memo by Hugh A. Stoddart, BPR Division Engineer, Juneau, to A.C. Clark, Deputy Commissioner BPR in Washington, D.C., July 31, 1953, Record Group 30, ARC & BPR Files, Directives Files, Juneau 1931-1956 [Bridge] Design, Box 9, National Archives and Records Center, Anchorage.

Stone, David and Brenda

1980 *Hard Rock Gold: The Story of the Great Mines that were the Heartbeat of Juneau.* Juneau Centennial Committee, City and Borough of Juneau.

Talbot, C.B.

1897 "Sketch of the Dyea and Skagua Trails, Sept-1897, by C.B. Talbot, Sitka, Alaska," in Report of the Governor of the District of Alaska to the Secretary of the Interior, 1897. Government Printing Office, Washington, D.C.

Theile, Karl

1923 *Biennial Report of the Territorial Board of Road Commissioners for the Territory of Alaska, April 1,1921, to March 32, 1923*, Juneau.

1925 *Biennial Report of the Territorial Board of Road Commissioners, 1923-1925*, Alaska Daily Empire Print, Juneau.

1927 *Biennial Report of the Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1925 to March 31, 1927*, Juneau, Alaska.

1929 *Biennial Report, Territorial Board of Road Commissioners for the Territory of Alaska, April 1, 1927 to March 31, 1929*, Alaska Daily Empire, Juneau.

Twitchell, Heath

1992 *Northwest Epic: The Building of the Alaska Highway*. St. Martin's Press, New York.

U.S. House Committee on Roads

1946 *The Alaska Highway*, House Report 1704, 79th Congress, 2nd Session (March 31, 1946).

U.S. Department of the Interior/National Park Service (USDI/NPS)

1991 *How to Apply the National Register Criteria of Evaluation*, National Register Bulletin 16A , Interagency Resources Division, National Park Service, Washington, D.C.

Walker, A.V.
1954 Report on Design and Construction of Eyak River Bridge," Copper River Highway, Alaska Forest Highway Project 31-2, September 30, 1954, Bureau of Public Roads, copy located in Eyak River Bridge File (Bridge No. 381), ADOT&PF Bridge Design Section, Juneau.

Williams, G. W.
1959 Circular from G.W. Williams at BPR headquarters in Washington, D.C. to Regional and Division Engineers, January 5, 1959, Schooner Bend Bridge file, Bridge No. 673, ADOT&PF Bridge Section files, Juneau.

Woodman, Lyman L.
1997 *Duty Station Northwest: The U.S. Army in Alaska and Western Canada, 1867-1987. Volume Two, 1918-1945*. Alaska Historical Society, Anchorage, Alaska.

Yost. Harry
1995 "A Soldier's Scrapbook," in Fern Chandonnet, editor, *Alaska at War: The Forgotten War Remembered: Papers from the Alaska at War Symposium Anchorage, Alaska, November 11-13, 1993*. Alaska at War Committee, Anchorage, Alaska, pp. 185-187.

Zimmerman, M.C.
1959 Memorandum from M.C. Zimmerman, BPR in Anchorage, to R.J. DeLaHunt, BPR Design Engineer in Juneau, March 10, 1959, Schooner Bay Bridge file, Bridge No. 673, ADOT&PF Bridge files.