MC-1167

NPS Form 10-900-b (Rev. 01/2009) OMB No. 1024-0018 (Expires 5/31/2012)

United States Department of the Interior
National Park Service

National Register of Historic Places Multiple Property Documentation Form

This form is used for documenting property groups relating to one or several historic contexts. See instructions in National Register Bulletin *How to Complete the Multiple Property Documentation Form* (formerly 16B). Complete each item by entering the requested information. For additional space, use continuation sheets (Form 10-900-a). Use a typewriter, word processor, or computer to complete all items

X New Submission ______ Amended Submission

A. Name of Multiple Property Listing

Florida's Historic Highway Bridges

B. Associated Historic Contexts

(Name each associated historic context, identifying theme, geographical area, and chronological period for each.)

Early Twentieth Century (1900-1941)
World War II and the Modern Age (1941-1956)
The Modern Era (1956-1970)

C. Form Prepared by

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D. Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this documentation form meets the National Register documentation standards and sets forth requirements for the listing of related properties consistent with the National Register criteria. This submission meets the procedural and professional requirements set forth in 36 CFR 60 and the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation.
(______ See continuation sheet for additional comments.)

Alissa Lotane, Deputy SHPO 8/3/17
Signature and title of certifying official | Date

Florida State Historic Preservation Office
State or Federal Agency or Tribal government

I hereby certify that this multiple property documentation form has been approved by the National Register as a basis for evaluating related properties for listing in the National Register.

[signature] 9-25-2017
Signature of the Keeper For Date of Action

Table of Contents for Written Narrative

Provide the following information on continuation sheets. Cite the letter and title before each section of the narrative. Assign page numbers according to the instructions for continuation sheets in National Register Bulletin *How to Complete the Multiple Property Documentation Form* (formerly 16B). Fill in page numbers for each section in the space below.

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HISTORIC CONTEXT

FIRST EUROPEAN CONTACT: THE SPANISH (1513-1762 AND 1784-1819)

Florida was controlled by Spain for nearly two and a half centuries, excepting a brief twenty-one year British rule. During the Spanish occupation, little effort was focused on building roadways because of Spain's greater interest in their rich and vast empire of gold and silver mines in South America. Early Spanish explorers such as Pánfilo de Narváez in 1528 and Hernando de Soto in 1539 used pathways created by Native Americans to travel from the Tampa Bay region to the Tallahassee area.[1]

The few wagon roads constructed by the Spanish linked a growing number of military outposts to missions and villages established among the Native Americans in North Florida.[2] St. Augustine, founded by Pedro Menéndez de Avilés in 1565, became the first permanent European settlement in Florida and thus the oldest city in the continental United States. It began as a fort, selected because of its strategic location on the Mantanzas Inlet.[3] While shipments of men and material entered at the port of St. Augustine, Native American pathways and trails continued to be used overland. The Spanish constructed military roads to connect the fort with the St. Johns River.

The end of the American Revolution saw Florida being returned to the control of Spain because of the Treaty of Paris of 1783. As with the earlier period, Florida was divided into East and West with St. Augustine and Pensacola being the respective capitols. Although Spain was now in control, they retained the British policy of trade with the Indians. However, with the change of flags, the British occupants of Florida left, resulting in a serious depopulation of the state, and many plantations and other developments, especially in East Florida were abandoned. In order to attract more settlers to the area, very lax immigration policies were established. The only requirement for land ownership was an oath of loyalty to the Spanish Crown, and unlike other Spanish colonies, there was no requirement to be Catholic. Each head of household would be granted 100 acres, and each additional family member or slave qualified for an additional 50 acres. Title to the lands would be passed on to the homesteaders after 10 years of occupancy, farming, erecting appropriate buildings, and maintaining livestock.[4]

The population at this time was very diverse, and included a mixture of Spanish, Minorcan, Indian, British loyalists, British Isles immigrants, U.S. immigrants, and black, both free and slave.[5] Most of the population was centered on the two capitols and Fernandina. The rural population was small, scattered, and relied on subsistence farming. There were also plantations established as well as timbering, citrus

[1] Michael Gannon, "First European Contacts," In *The New History of Florida,* edited by Michael Gannon (Gainesville, FL: University Press of Florida, 1996), 22-31.
[2] Ibid., 67.
[3] Charlton W. Tebeau, *A History of Florida* (Coral Gables, FL: University of Miami Press, 1971), 34-35.
[4] William S. Coker and Susan R. Parker, "The Second Spanish Period in the Two Floridas," In *The New History of Florida,* edited by Michael Gannon (Gainesville, FL: University Press of Florida, 1996), 150-166.
[5] Paul George, "Historical/Architectural Contexts," *Draft: State of Florida Comprehensive Historic Preservation Plan* (Tallahassee, FL: Florida Division of Historical Resources, 1990).

cultivation, and cattle ranching. The number of farms and plantations greatly increased throughout this period, especially along the northeastern waterways. The importance of the timber industry can be noted by the number of large sawmill grants that were awarded by the Spanish governors.

Indian trade was also an important economic activity. The Panton, Leslie Company, which later became the John Forbes and Company were British firms that were licensed by the Spanish, and controlled all of the trade.[6] Their centers of operation were in St. Augustine and Pensacola and they had their stores on the St. Johns River and on the St. Marks River. Prior to the American colonial settlement of Florida, remnants of the Creek Nation and other Indian groups from Alabama, Georgia, and South Carolina moved into Florida and began to repopulate the vacuum created by the decimation of the aboriginal inhabitants. The Seminoles, as these migrating groups of Indians became known, formed at various times, loose confederacies for mutual protection against the new American Nation to the north.[7] The Seminoles crossed back and forth into Georgia and Alabama conducting raids and welcoming escaped slaves. This resulted in General Andrew Jackson's invasion of Spanish Florida in 1818, which became known as the First Seminole War. Florida became a U.S. territory in 1821 as a result of the Adams-Onis Treaty of 1819.

Although its origins and actual route remain somewhat unclear, the most significant road built (measured by its long-term impact) during the Spanish occupation began in St. Augustine and ended in Pensacola. The Spanish used the Camino Real or "royal road," which was more of a pathway than a built road, during the seventeenth century as an overland route to supply forts and missions[8], as well as to avoid the perilous journey of sailing around the Florida Keys. Streams along the trail were crossed at fords or by means of log rafts or simple pine-pole bridges. In time, the Camino Real became a major transportation corridor and future railroad and road builders followed its course in the building of old State Road No. 1, U.S. 90, and Interstate 10.

FLORIDA UNDER THE ENGLISH (1763-1818)

During the brief English occupation of Florida between the end of the French and Indian War (1763) and the close of the American Revolution (1783), the British Crown supported the construction of roads to and from St. Augustine. These efforts resulted in the "King's Road" that extended north through Cowford (now Jacksonville) to the St. Mary's River and south to New Smyrna, a colony of indentured servants on the North Indian River. An attempt to bridge the San Sebastian River at St. Augustine during the 1760s failed when, according to one witness, "the great depth of the river joined to the instability of the bottom, did not suffer it [the bridge] to remain long." The crossing could only be made by ferry.

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[6] William S. Coker and Thomas D. Watson, *Indian Traders of the Southeastern Spanish Borderlands* (Pensacola, FL: University of West Florida Press, 1986).
[7] Tebeau, 72.
[8] John E. Worth, *Timucuan Chiefdoms of Spanish Florida,* Volume 1 Assimilation (Gainesville, FL: University Press of Florida, 1998), 154.

FLORIDA, AN AMERICAN TERRITORY (1819-1845)

According to C. B. Treadway, Chairman of the State Road Department (SRD) in the 1930s, Florida's highway system actually began during the Territorial period when the U.S. government appropriated funds to build important roadways. In 1824, Congress provided:

> *...that the President of the United States be, and is hereby, authorized to cause to be opened, in the Territory of Florida, a public road from Pensacola to St. Augustine, commencing at Deer Point, on the Bay of Pensacola, and pursuing the old Indian Trail to Cow Ford, on the Choctawhatchy River; thence, to the Ochesee Bluff, on the Apalachicola river; thence in the most direct practicable route, to the site of Fort St. Lewis; thence as nearly as practicable on the old Spanish road to St. Augustine, crossing the St. Johns River at Picolata; which road shall be plainly and distinctly marked and of the width of twenty-five feet*.[9]

The advertisement for the contract states that it is required that the road, causeways, and bridges must be made in substantial manner; and the stumps cut down as even to the ground as possible.[10] Captain Daniel Burch of the Army's Quartermaster Corps was assigned this daunting project. He contracted with planter John Bellamy for the slave labor used to build the road from St. Augustine to Tallahassee. The "Bellamy Road" was completed in 1826, with portions of it "corduroyed" by logs sunk crossways into the roadway, and ferries provided crossings of all major streams.[11] This road greatly aided the expansion of cotton and cattle production in northern Florida. Captain Burch also laid out another road between Tallahassee and Pensacola that also proved a boon to trade and communications. Unfortunately, it deteriorated from a lack of maintenance.

A by-product of the Army campaigns that waged war against the Seminole Indians was the expansion of Florida's road system. Federal troops that penetrated Florida's interior opened new trails and erected makeshift bridges in order to move supplies between forts. Among the temporary bridges built by Colonel Zachary Taylor, who operated in the area north of Lake Okeechobee, was an inflated pontoon made of cotton fabric and rubber used to cross the Kissimmee River. Later reports credited Taylor with constructing 848 miles of wagon roads and 3,643 feet of causeways and bridges during the late 1830s.[12]

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[9] Mark F. Boyd, "The First American Road in Florida: Papers Relating to the Survey and Construction of the Pensacola-St. Augustine Highway (Part I),"*Florida Historical Quarterly* 14: 2 (1935), 74.
[10] Mark F. Boyd, "The First American Road in Florida: Papers Relating to the Survey and Construction of the Pensacola-St. Augustine Highway (Part II),"*Florida Historical Quarterly* 14: 3 (1936), 166.
[11] Tebeau, 141.
[12] John K. Mahon, *History of the Second Seminole War 1835-1842* (Gainesville, FL: University of Florida Press, 1985), 261.

EARLY STATEHOOD THROUGH THE CIVIL WAR AND RECONSTRUCTION (1845-1899)

Toll Roads, Ferries, Steamboats and Private Enterprise

Even taking into account the Army's accomplishments, there would be no adequate road and bridge system in Florida before the Civil War. In fact, there were few improvements made as Florida approached the end of the nineteenth century. Roads remained strictly local matters falling under the jurisdiction of county commissioners. The commissioners divided their counties into districts and appointed road overseers, an honorary position until 1895. In addition, there were no requirements for road overseers to have specific knowledge or experience in road or bridge building. In fact, counties required all adult males (exempting only disabled persons, those of unsound mind, and ministers) to labor several days each year as road workers, or pay a tax in lieu of service. Under this "system" commonly practiced throughout the U.S., roads were built to serve the needs of the local property owners and rarely became anything more than rudimentary, scratched-out paths that were unconnected with other roads. When it was necessary to cross water, simple log rafts or crude timber bridges were built. Still in operation today, the Fort Gates Ferry across the St. Johns River in Putnam County was constructed in 1853 at a federal encampment established during the Second Seminole War. The original ferrymen pushed the simple barge across the river with long poles. A steam-powered tugboat was used to move the ferry following the Civil War, and it was replaced with a tugboat powered by an internal combustion engine in the early part of the twentieth century.[13]

Before the establishment of a Florida road building authority, some enterprising individuals built their own roads and bridges and operated ferry services. Users of "toll roads" paid a fee established by the road owner. During the 1850s, Florida shared in the national enthusiasm for building plank roads made from sawed timbers spiked to wooden stringers and embedded in the roadway.[14] Florida's abundant timberlands prompted the rise of many plank road companies, although few succeeded before the onset of the Civil War. The Newport plank road, running from Newport on the St. Marks River to the Georgia state line with a branch to Tallahassee, was perhaps the most successful.[15] Another, the Alligator plank road, though only partially completed, extended from Jacksonville towards the village of Alligator, now known as Lake City.[16]

The privately owned toll ferries over Florida rivers were frequently the subjects of complaints by travelers, who called them slow, undependable, and dangerous. Today, some ferries are remembered by the river crossings that still bear the name of old ferry operators, among them Kolar's Ferry on the St. Mary's River and Charles Ferry on the Suwannee. Like the roads they served, ferry service varied widely in kind and quality, ranging from mere rowboats to rope-strung rafts pulled by hand or dragged by mules on the bank. Bad roads, unreliable ferries, and the few extant bridges discouraged long

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[13] Jeff Klinkenberg, "Fort Gates Ferry still crossing St. Johns River," *St. Petersburg Times*. 23 August 2009.
[14] Junius E. Dovell, "The Development of Florida's Highways," *Economic Leaflet* 11(October 1952).
[15] Elizabeth F. Smith, "The Old Plank Road to Tallahassee," *Magnolia Monthly* (November 1971).
[16] T. Frederick Davis, *History of Jacksonville, Florida and Vicinity, 1513-1924* (Jacksonville, FL: Florida Historical Society Press, 1925).

distance overland travel and limited available transportation to a few stagecoach lines and freight wagon companies.

The failure to build and maintain roadways until the early twentieth century is largely due to the more convenient and pleasant transportation afforded by steamboats and railroads. Steamboats plied many Florida rivers and operated along the coasts, hauling goods as well as passengers. The St. Johns, St. Marks, and Apalachicola rivers became major arteries of the steamboat trade, although these waterways required constant attention to remove snags, sandbars, and other obstacles in the channel.[17] In some cases, navigation became impossible. Streams that reached deep into the backcountry of Florida and Georgia could not accommodate steamboats, thus leaving important agricultural regions without adequate transportation. Along with their navigational limitations, the expansion of the railroads, and later the popularity of the personal automobile, ultimately doomed the steamboat industry.

The Arrival of the Railroad

The first Florida railroads were built prior to the Civil War, mainly to haul farm goods from the interior to port towns.[18] Bridge construction was developed as a special branch of structural engineering, subsidized by railroad companies that needed rigid structures capable of carrying fast-moving, heavy loads. Metal truss bridges served this purpose well, and the railroads used them extensively. Some lines, such as the Pennsylvania Railroad, even originated exclusive designs for their own use. Florida's many waterways required the railroad companies to become active bridge builders, and they frequently constructed the first substantial spans over rivers. Surviving structures built during this era of rapid growth are reminders of the railroads' enormous contribution to the state's economic and technological development.

As the railroads made possible reliable long distance travel, they also focused attention on the dismal state of local roadways. Farmers and merchants came to realize that improvements in roads and bridge construction would enhance the overall transportation network, providing them with better access to railroad depots and hence larger markets for their goods. The railroads allowed cheap importation of steel and other materials necessary for bridge building. Additionally, many of the innovations made by railroad engineers were adapted by highway bridge builders.

EARLY TWENTIETH CENTURY (1900-1941)

The Age of the Automobile

The vast changes that occurred in American society at the turn of the century affected every area of life. In particular, the new mobility Americans experienced because of the availability of the personal

[17] George E. Buker, "Removing Navigation Hazards for Steamboat Travel," In *The Steamboat Era in Florida* (Gainesville, FL: Florida Maritime Heritage Program, 1984), 15-20.
[18] Gregg Turner, *A Short History of Florida Railroads* (Charleston, SC: Arcadia Publishing, 2003), 15-17.

automobile marked a monumental shift in both the way people lived and where they chose to live it. In the transportation arena, local governments were abruptly made aware of the need to improve roadways. While provision for new and improved transportation corridors was in itself a formidable task, the construction of bridges presented the greatest challenge. Bridges were big, complex and costly.

In 1902, Citrus County, needing to span the Withlacoochee River and other streams, advanced from erecting wooden bridges put together by local contractors at a cost of a few hundred dollars to acquiring its first metal bridge for $3,000. One of the benefits of bridge building was the cooperation it engendered in neighboring localities. Because of the great costs involved and because waterways often defined county borders, bridges often became the reason for the first cooperative ventures between counties.

To raise funds to build bridges, local politicians frequently chose to issue bonds, an approach that was unpopular and a step that was taken reluctantly. However, once they got beyond the funding barrier, the construction of a new bridge was cause for great excitement. As an example, in 1910, Hamilton County commissioners announced that, "notice is hereby given that the Board will receive bids at their next meeting... and contract with some firm or corporation for the purpose of building a steel bridge across the Alapaha River near Nobles Ferry, and all persons, firms, and corporations desiring to bid on said contracts will please govern themselves accordingly."

Figure 1. Two views of the Jennings Bridge over the Alapaha River, Hamilton County. This Pratt truss bridge was built from 1902-1903 by the American Bridge Company for $2,788. Source: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/139240.

In the early twentieth century, Florida industrial development was limited and did not include the fabrication of metal truss bridges. The state depended upon the northern industrial belt, which led the nation in the technology and manufacture of metal trusses at the region's iron and steel manufacturing plants.

One company that garnered a significant amount of Florida's bridge building business was the Champion Bridge Company of Ohio, founded in 1860 as Zimri Wall and Company. In the early years, it erected timber and wrought iron bridges. Champion Bridge Company, as it became known in 1881, was the first to use steel in small highway bridges. It was active in Florida from the 1890s through the early 1930s and constructed many movable bridges in the state. The company claimed that it introduced the rolling lift bascule bridge to Florida. Champion opened offices in Birmingham, Alabama, and Atlanta, Georgia, and built a reputation for quality work and fair prices. To further cement their relationship with the Southern states, the Champion Bridge Company appointed local citizens as their agents and engineers. Hugh Quinn, an engineer trained at the University of Georgia, joined the firm, and later helped establish a company at Fort Lauderdale that became the Powell Brothers, an important road and bridge contractor beginning in the 1920s.

While numerous northern companies built bridges in Florida, they met with strong competition from the few southern firms that drew upon the steel plants of Birmingham. Champion's principal competitor, particularly in the building of swing bridges, was the Austin Brothers Bridge Company of Atlanta. The company began with George L. Austin, who once traveled in the South as an agent for the George E. King Bridge Company of Des Moines, Iowa. While his brother Frank set up an Austin Brothers bridge firm in Dallas, Texas (known today as Austin Industries), George became an independent contractor in the Southeast and a leading builder of movable bridges in Florida.

Other bridge manufacturers that ranked among the leaders in Florida until the Great Depression included the Virginia Bridge Company of Roanoke, the Converse Bridge Company of Chattanooga, Tennessee, and the Nashville Bridge Company, also in Tennessee. William Converse, once an agent for Ohio companies, established his firm in the 1890s and sent his salesmen throughout the South. His company succeeded in winning contracts for pony and through truss bridges in counties of northern Florida, where two Converse bridges remain today.

Arthur Dyer, a graduate engineer of Vanderbilt University, founded the Nashville Bridge Company in 1902. Dyer claimed to have built more than half of the bascule bridges in Florida. The firm's success may be traced to its chief bridge engineer, L. O. Hopkins, who designed inexpensive and efficient bascule spans. The firm begun by Dyer remained active in Florida until the 1970s.

The Pensacola Shipbuilding Company emerged as Florida's principal in-state producer of steel bridges. Organized by Chicago financiers to build ships for the war effort in 1917, the company developed a bridge building business in the 1920s. It often supplied bascule spans from designs patented by Chicago engineering firms, such as Strauss and Scherzer. The Pensacola Shipbuilding Company may have fabricated bridges itself or may simply have supplied and installed structures made elsewhere.

In the early decades of the twentieth century, bridge construction addressed regional and local needs depending on the availability of resources. As a widely available and inexpensive material, timber answered most needs for building crude trestles or deck bridges. Counties that wanted more durability

Figure 2. Blackburn Point Bridge in Sarasota County, a Warren pony truss swing built in 1925-1926 by the Champion Bridge Company. Source: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/139314.

Figure 3. Vertical lift bridge built in 1928 by the Champion Bridge Company. Originally located at Northwest 36th Street, and moved in 1954 to East First Avenue over the Miami Canal. Source: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/138120.

Figure 4. Suwannee Springs Bridge over the Suwannee River, Suwannee County. Parker through truss built in 1931 by the Austin Brothers Bridge Company of Atlanta. http://floridamemory.com/items/show/139253.

Figure 5. A camelback truss bridge over the Withlacoochee River, built in 1912 by the Converse Bridge Company at a cost of $4,297. Source: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/139262.

and greater permanence in their bridges opted for metal trusses or reinforced concrete spans. Jackson County, for example, contracted with the Converse Bridge Company to build a standard design Pratt through truss over the Chipola River near Marianna. Completed for $2,289 in 1914, the Bellamy Bridge measured 119 feet long and rested on filled metal cylinder piers. The Bellamy Bridge remains in place today; however, the bridge and the road it carried are no longer in use. For lighter duties and narrower streams, the choice was often Pratt pony trusses. A good example is the 60-foot span purchased by Lafayette County from Converse in 1912 to cross the Steinhatchee River. This bridge, which carries Camp Grade Road, remains in use today.

Reinforced concrete grew in popularity through the 1920s. It was used first only for small spans and later for longer spans as the engineering improved. A number of companies with national reputations built reinforced concrete bridges in Florida, including A. Bentley and Sons of Toledo, Ohio and the Concrete Steel Bridge Company of New York City. Local firms, including C. T. Felix of St. Petersburg and George D. Auchter of Jacksonville, also became important bridge contractors.

The need for numerous inexpensive, low maintenance, and durable highway bridges enabled the Luten Bridge Company of York, Pennsylvania, to become a leading builder of reinforced concrete structures, in particular concrete arches. Engineer and entrepreneur Daniel B. Luten (1869-1946) of Indianapolis designed and promoted bridges that he and his agents sold as superior to "tin bridges." The company's bridges gained a reputation for strength and reliability under the hot, humid, and sometimes salty conditions in Florida. Luten succeeded in reducing the quantity of concrete required in his bridges without sacrificing its strength or resistance to floods. In some instances, he extended the steel tie rods from the bridge to underneath the streambed and buried them in concrete. This method reduced the need for heavy abutments, particularly desirable when stream banks were weak. In 1915, he also built an innovative half-arch bridge at the entrance to the luxurious Belleview Hotel near Belleair in Pinellas County. This bridge was built with a 46-foot main span and 23-foot half spans. While the half arches appeared to be cantilevered, the fact that they were supported by abutments made them true arches. The bridge maker claimed to have achieved greater stability and efficiency in material use.

Luten patented his designs, put them in catalogs, and promoted the bridges by establishing relationships with business partners throughout the country. By the mid-1920s, Luten reportedly held 50 patents for reinforced concrete bridges and had built more than 14,000 spans throughout the U.S.

The Role of the Bridge in Cities

Some of the most ambitious bridge building took place in Florida's rapidly growing urban areas. In Tampa, the spread of subdivisions west of the Hillsborough River necessitated the building of a new bridge. In 1913, an impressive bridge with concrete arches and a double-leaf Scherzer rolling lift main span was constructed on Lafayette Street (now Kennedy Boulevard). Its classically inspired design expressed the pervasive influence of the nationwide City Beautiful Movement. The bridge remains a fine example of the melding of function and form that created an attractive centerpiece in downtown Tampa.

Figure 6. The Lafayette Bridge in Downtown Tampa, 1925.
(*Florida Photographic Collection*)

Built after World War I, the Acosta Bridge over the St. Johns River in Jacksonville was another good example of a notable city-constructed bridge. Named for City Councilman St. Elmo W. Acosta, who convinced voters to approve a $950,000 bond issue for the bridge construction, the Acosta Bridge was the first vertical lift span in the state. The decision to build a vertical lift span was based on the river's operating needs that resulted from the heavy maritime traffic. The construction of this bridge involved several notable engineering accomplishments. Its designer, J. L. Harrington, enjoyed a national reputation as a distinguished engineer and co-founder of a prominent engineering firm. The Missouri Valley Bridge and Iron Company of Leavenworth, Kansas, built the foundation and was experienced in sub-aqueous construction. The building of the Acosta Bridge required pneumatic methods never before used in the region to sink the caissons. Acosta's size (2,865 feet) and cost ($1.2 million) made it a fitting symbol of the booming 1920s and its ever-increasing automobile traffic. In 1994, the state replaced the Acosta Bridge and the remnants of the historic span became an artificial reef for Atlantic sea life.[19]

[19] Jacksonville Offshore Sport Fishing Club (JOSFC), "Acosta Bridge Artificial Reef," accessed at http://www.jaxrrt.org/acosta.htm.

Figure 7. Acosta River Bridge over the St. Johns River.
(Florida Photographic Collection)

Travel in Rural Florida

In the years following World War I, traveling by automobile in Florida remained an adventure in most areas because of the poor roads, which more often resembled stump-ridden, overgrown and sandy trails. Some counties made an effort to improve their roadways by grading, adding a sand-clay mixture, or spreading pine needles or oyster shells on the surface. The specifications for spreading shell on the roadway called for the shell to be laid four inches deep and seven or eight feet wide. There were no rolling, binder or drainage facilities or anything of the sort. Mule and ox hooves, the iron tires of wagons, and the travel of a few automobiles over the surface were thought to be sufficient to convert the shell into a "high-speed" highway surface. After this shell was laid, cars that could negotiate the sand road between Melbourne and Eau Gallie could make the 40-mile trip from Melbourne to Titusville, the county seat, in half a day; that is, of course, only if the vehicles weren't shaken to pieces by the hard sand pull.

More satisfactory results came from gravel or crushed rock mixed with asphalt. One popular method combined asphalt with crushed slag that was shipped in from the steel mills of Birmingham. Polk County, which was using trails dating from the Seminole War, responded to Good Roads advocates, and in 1916, contracted for 217 miles of asphalt road. The Champion Bridge Company opened an office in Bartow in order to construct bridges for Polk County.

Miami Beach developer Carl Fisher, whose Indianapolis company, Prest-O-Lite, invented a vastly improved automobile headlight, became a champion for improving roadways.[20] In 1915, to convince

[20] Jerry M. Fisher, *The Pacesetter: The Untold Story of Carl G. Fisher* (Fort Bragg: Lost Coast Press, 1998); Mark S. Foster,

the public that Florida could be reached by car, Fisher organized a 15-car caravan that made the trip from Indianapolis to Miami. He called his expedition the "Dixie Highway Pathfinding Tour." That approximate route would be followed when the Dixie Highway was built. Counties that wanted to be included in this grand plan took on road construction projects. Some counties, particularly in the area south of Jacksonville in St. Johns, Flagler, and Putnam counties, laid nine-foot-wide brick roads. The majority of the paving bricks came from Birmingham. Other brick roads extended from Tampa and Orlando.

The Creation of a State Road Department

Since the 1890s, the federal government had been encouraging and offering some support for highway building. In 1916, Congress made a quantum leap when it passed the Bankhead Bill (The Federal Aid Road Act) that committed federal funds to the construction of rural post roads. Under the Act, federal and state governments began to consolidate road- and bridge-building activities. Up to this point, the majority of bridge building had been privatized. However, government control required standardized bridge construction. Luckily, this federal action coincided with a decline in patent protection for bridge designs and materials, which freed up access to developing bridge technologies that would have been too expensive to utilize under patent protection.

The 1916 legislation required that each state establish a road department to administer the program. In 1915, in anticipation of this federal legislation, Florida created a State Road Department and appointed William F. Cocke, an engineer from the Virginia Highway Department, as its first State Road Commissioner or Highway Engineer. In Florida, as elsewhere around the nation, the transition from solely local control of roads to state supervision moved ahead slowly. Progress was further impeded by World War I. As a result, it was not until 1923, that the Florida Legislature officially designated a system of state roads and authorized the SRD to complete those routes.[21]

Florida in the 1920s

Florida's road system experienced a hectic period of growth and change in the 1920s due to the impact of a frenzied real estate boom. In 1926, *Florida Highways* magazine concluded that the counties with the highest land values were also those counties that had the best roads; some counties voted enormous issues of bonds to build roads and bridges. The frantic pace made it difficult for the SRD to supervise highway projects. Roads and bridges were often built hastily and cheaply. The period produced many large bridges, but relatively few that were distinguished by their high quality of design or innovative engineering. In 1935, SRD Chairman Chester B. Treadway commented that, "until a comparatively recent date, the importance of bridges and bridge building was apparently overlooked, to a large extent. In the enthusiasm that surrounded highway construction during the days of the Boom, when money was literally plentiful, it is surprising to note that only a mere handful of the essential bridges connecting up the roads that were built were given consideration. There seems to have been an attitude that bridges, if

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Castles in the Sand: The Life and Times of Carl Graham Fisher (Gainesville, FL: University Press of Florida, 2000).
[21] "Two and One-half Years of Road Construction in Florida," *Florida Highways* 5:4 (1928), 18, 20.

not really of secondary consequence, should be placed in a classification other than that of actual road building."

Individual citizens were often the reason for the construction of bridges and building of roadways during the Boom. George Gandy, who spanned the bay from Tampa to St. Petersburg, was the most notable of the private builders.[22] Gandy's 1924 toll bridge, which was dismantled in 1975, was comprised of two-and-one-half miles of reinforced concrete spans and three miles of causeway.[23] The new bridge enabled a traveler to complete the passage from Tampa to St. Petersburg in half the time it previously took.

In Miami, a local private development company constructed a series of concrete spans, called the Venetian Causeway, to Miami Beach in 1926. The Venetian Causeway, listed on the National Register of Historic Places (NRHP), replaced a huge timber structure erected by pioneering Miami Beach developer John Collins in 1913.[24]

While there are a number of examples that illustrate the role of private development in the creation of Florida's roads and bridges, two projects in particular illustrate this. Ernest Kouwen-Hoven, developer of the resort Indialantic-by-the-Sea, for instance, built a wooden trestle and an $8,000 drawbridge (now demolished) on the Indian River near Melbourne in 1921.[25] On a grander scale, in 1928, Clay County banker and farmer Allie G. Shandy attracted New York and St. Louis investors to construct an 11,500-foot timber bridge with a Strauss bascule lift span on the St. Johns River at Green Cove Springs. It was reported that it took more than two million feet of southern pine to build the bridge. The "Shandy Bridge," which is no longer extant, was the longest timber vehicular bridge ever built. When engineers encountered problems in setting piers on the soft river bottom, they curved the bridge to firmer ground on the east end.

For its sheer scope and ambitious design, few projects in the state have matched the construction challenge of the Tamiami Trail. The "Trail" linked Miami and Tampa via Fort Myers by a road dug out of Everglades muck.[26] Begun in 1915, the building of the Trail was fraught with delays, as, underneath the surface, the hard limestone rock required 40,000 pounds of dynamite per mile to pulverize it. After its completion in 1928, *Florida Highways* magazine described the project as "a wilderness finally overpowered which will soon hum to the tune of heavy automobile traffic." The Tamiami Trail bridges were generally wooden stringers resting on timber piles sunk in the mud. While this road remains a well-traveled highway, the timber bridges have all been replaced.

[22] Anonymous, Official Opening Program and Pictorial History of the Gandy Bridge, November 20, 1924. On file, Florida Room, Florida State Library, Tallahassee.
[23] "Old Gandy Bridge is coming down," *St. Petersburg Times*, October 28, 1975, 4B.
[24] Florida Department of State, "The Great Floridians of Florida 2000 Program: John Stiles Collins," 1999, accessed at http://dhr.dos.state.fl.us/services/sites/floridians/?section=m#Miami.
[25] Frank J. Thomas, *Melbourne Beach and Indialantic* (Charleston, SC: Arcadia Publishing, 1999).
[26] Carrie Scupholm, "The Tamiami Trail: Connecting the East and West Coasts of the Sunshine State," *The Society for Commercial Archeology Journal* 15:2 (1997), 20-24.

Although timber remained a common bridge building material in the 1920s, reinforced concrete grew in popularity for permanence and on heavily traveled routes. In 1927, the SRD estimated that there were 11,214 feet of concrete bridges and 12,875 feet of timber structures on State Road No. 1 (The Old Spanish Trail). Based on a design of its own engineer, St. Johns County erected about 40 creosoted timber bridges on county roads utilizing a series of standard short spans combined with a central drawbridge. In 1928, Volusia County erected two pressure-treated timber bridges (no longer extant) on the Halifax River at Daytona Beach, each one exceeding 2,000 feet in length. The timber's low cost and ease of construction were among the factors that convinced the county to use the material.

The decision to use timber as a construction material was based not only on the number of waterways that would need to be crossed, but also on the existing and potential size of those waterways. Many of the state's rivers frequently overflowed their banks, thus requiring long causeways or multiple relief spans across wide "swamp valleys." As an example, in building a timber pile bridge over the Hillsborough River near Zephyrhills in 1934, engineers took into account that the normally placid stream measuring 100 feet wide and 20 feet deep would grow to become 1,700 feet wide and 25 feet deep during a flood stage.

The Boom also produced several exceptional examples of reinforced concrete construction. A primary example is St. Augustine's majestic Bridge of Lions across the Matanzas River. The bridge was built in 1926 from a design by the engineering firm of J. E. Greiner in Baltimore. Concrete was used to create a distinctive Mediterranean style on a steel arched girder bridge with a bascule span. The Bridge of Lions quickly became a landmark in the old Spanish city known for its historic landmarks; it was listed on the NRHP in 1982.

Daniel Luten, particularly successful in building small reinforced concrete arch deck bridges in Florida, erected a large and handsome shallow arch bridge (now demolished) over the Little Manatee River at Wimauma.[27] He completed the impressive Putnam County Memorial Bridge on the St. Johns River at Palatka in 1927. This bridge was 2,600 feet in length and cost $1.25 million. The structure consisted of 30 concrete arch spans, 10 with open spandrels, and a double-leaf bascule bridge at midstream. By all appearances, the Memorial Bridge represented one of Luten's finest works. Yet the concrete structure that garnered the greatest attention and praise within the SRD was the Victory Bridge over the Apalachicola River at Chattahoochee. The bridge was built by the Masters-Mullen Construction Company of Cleveland, Ohio between 1921 and 1922 as one of the first major bridge projects of the Department. At 2,027 feet in length, it may have ranked at the time of its construction as the largest reinforced concrete arch bridge in the South. While concrete found greater applications in bridge building, it also appeared in road paving. The first concrete highways in the state were built from Jacksonville west towards Lake City and near the town of Fellsmere.

[27] Daniel B. Luten, "Curves for Reinforced Arches," *Engineering Record* 53(April 14), 482-483, 1906; Daniel B. Luten, "Double-Drum and Cantilever Arches," *Engineering World* (July 1921), 11-15.

Figure 8. Luten's Memorial Bridge in Palatka, 1948. *(Florida Photographic Collection)*

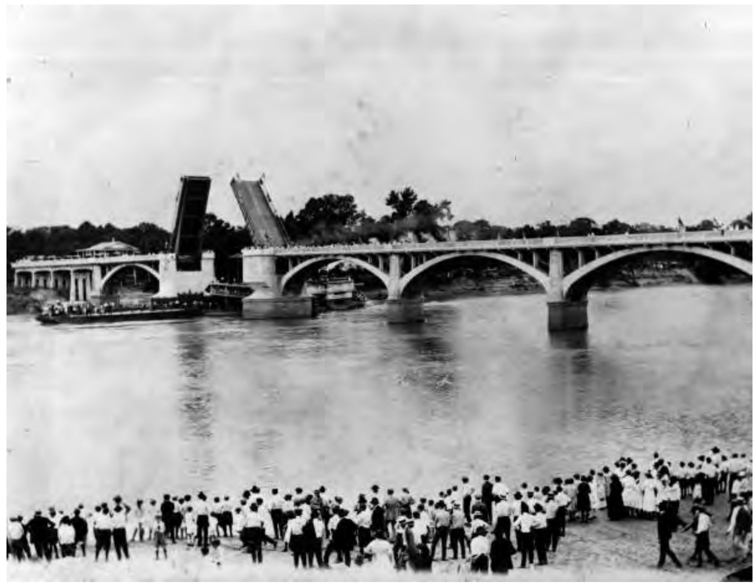

Figure 9. Victory Bridge across the Apalachicola River, Chattahoochee, viewed on day of dedication June 20, 1922. Source: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/28675.

Local governments and individuals built many of the early drawbridges over the state's navigable waterways. Most of these structures were crude affairs. In Florida, they were manually operated, hoisted by rope, built of wood with some iron parts, and placed in the middle of simple wooden deck bridges supported by spindly timber poles. Engineers vastly improved the movable span in the latter years of the nineteenth and into the twentieth century. This was accomplished by wedding the technology of steel truss bridges to that of swing pivots and lifting towers to move the structure and provide clearance for ships in the channel. Similarly, the application of new technology to the ancient principles of the drawbridge, which was counterweighted or balanced like a child's seesaw, resulted in the modern bascule bridge. The bascule would be built under various patented designs.

The swing bridge, in both its older rim-bearing and its improved center-bearing versions, became popular in Florida because of its simplicity, lower cost, ease of construction and dependability. However, this bridge type created an obstruction in the channel because of its pivot pier. Beginning at the turn of the century and lasting until the late 1920s, Ohio's Champion Bridge Company, along with the Austin Brothers Company in Atlanta, took the lead in building Florida's swing spans. Generally supported by a Warren-style truss, the swing span could be rotated 90 degrees.

However, when there was a need for full clearance in the channel, or when the channel was known to shift, engineers chose the vertical lift bridge type. The vertical lift bridge consists of a truss span hoisted by cables mounted on pulleys in high steel towers. Only a few examples remain in Florida, such as the massive Main Street Bridge over the St. Johns River at Jacksonville and the small, unusual hydraulically-operated lift over Billy Creek in Fort Myers.

Over the decades, the bascule bridge won wider acceptance among bridge builders. Bascule spans opened a clear channel, operated swiftly and dependably, required simple mechanisms with few moving parts, offered strength and safety, and lent themselves to artistic treatment. Engineering firms, primarily from Chicago where many bascule bridges were built, sold patented designs. Inventor William Scherzer claimed that his rolling-lift type bascule bridge operated with less friction, and therefore, needed less power. But the trunnion type, improved by Chicago engineer Joseph Strauss, who designed the Golden Gate Bridge in San Francisco, became the most preferred. In this type, the bascule span rotated around a trunnion or axle and made use of a heavy counterweight.

The bascule bridge was particularly suitable for Florida's many navigable streams. The prestigious engineering firm of Harrington, Howard and Ash of Kansas City, which specialized in movable structures, designed several bascule bridges to cross the Miami River in the 1920s. Tampa, likewise experiencing traffic congestion downtown and into its new suburbs, built bascule bridges on the Hillsborough River. Among the most notable was the Laurel Street Bridge, which used a Warren pony truss span in an overhead counterweight trunnion-type bascule.

The Great Depression

The bright optimism of the 1920s disappeared during the 1930s. "In the world of highways and bridges, the pendulum swing manifested itself in the move away from locally controlled, private, or entrepreneurial bridge design and towards consolidated, government-controlled and mandated design," [28] and bridge building as a federally-funded endeavor often favored simple, yet labor intensive, bridges.

Attempting to relieve the ill effects of the Great Depression, President Franklin Roosevelt implemented New Deal programs to stimulate the economy and to "make work" for the unemployed. The building of roads became a high priority, and the states were not required to match the federal funds granted for road construction. Also, for the first time, funding available through the Bureau of Public Roads "could be used in cities, and on 'secondary and feeder roads' off the Federal-aid system."[29] Under the Hayden-Cartwright Act of 1934, and similar legislation, the federal government expended about $1 billion on highway construction between 1933 and 1938. The total of all federal spending in Florida grew tremendously, and the state's road program leaped forward. The Hayden-Cartwright Act of 1936 authorized $217.5 million over two years, including $50 million for elimination of hazardous rail-highway grade crossings on primary highways and to replace them with grade separation structures.

[28] M&H Architecture, Inc., *Indiana Bridges Historic Context Study 1830s-1965*, February 2007, 48-49.
[29] Richard F. Weingroff, "Clearly Vicious as a Matter of Policy: The Fight Against Federal-Aid Part Three: To Control the Levers," accessed at http://www.fhwa.dot.gov/infrastructure/hwyhist06a.cfm.

One of the largest projects ever undertaken in Florida was building the Overseas Highway. In 1935, a hurricane struck the Florida Keys, and the Florida East Coast (FEC) Railway was destroyed. The state secured a $3.5 million loan from the Public Works Administration, and used $640,000 to purchase right of way and bridges of the FEC Railway.[30] The concrete arches, steel plate girders and trusses, along with a bascule and a swing bridge, were transformed into vehicular spans.[31] When the narrowness of the Bahia Honda through truss bridge could not provide for two lanes of automobile traffic, engineers transformed the structure into a deck truss by building the roadway on the top chords and cantilevering cross beams off each side to provide sufficient width. Opened for traffic on March 29, 1938, the 127-mile long Overseas Highway was the product of considerable skill and imagination in its engineering and construction. This system of causeways and bridges helped revive the area's economy and enabled Key West to serve critical military purposes during World War II.

Figure 10. Overseas Highway construction, 1937. Source: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/6882.

Florida added a number of other important bridges during the Great Depression, including the 1935 Gorrie Bridge over Apalachicola Bay in Franklin County.[32] To provide a sturdier foundation, contractors drove timber piles as much as 100 feet into the bottom of the bay as footing for the concrete piers. The central span of the 12,400-foot structure consisted of an electrically-operated swing that

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[30] C.R. Vinten, "A Highway Over the Sea," *The Regional Review*, 1 (July 1938), accessed at http://www.nps.gov/history/history/online_books/regional_review/vol1-1c.htm.

[31] Rodman Bethel, *Second Overseas Highway to Key West, Florida: Metamorphosis from Railroad to Highway* (Privately published by author, 1989); B.M. Duncan, "Making a Highway by Conversion of the Florida Overseas Railroad," *American Highways* 17 (October 1938), 8-11, 16-17; Alice Hopkins, "The Development of the Overseas Highway," *Tequesta* 46 (1986), 45-58.

[32] Kevin M. McCarthy, *Apalachicola Bay* (Sarasota, FL: Pineapple Press, Inc., 2004).

opened wide channels on each side of the pivot pier. Operators were present 24 hours a day, seven days a week, until 1988, when the bridge was torn down and used as an artificial reef out in the Gulf.

Figure 11. John Gorrie Bridge over Apalachicola Bay on US-98. This through truss swing bridge was built in 1936 and in use until 1989 when a new bridge was constructed.
Source: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/139361.

Using federal aid, Calhoun County completed a major long span steel bridge over the Apalachicola River near Blountstown. Erected by the Wisconsin Bridge and Iron Company and opened in 1938, it had a continuous truss design, a first for Florida, and stood 52 feet above the river to permit unrestricted navigation. Jacksonville gained a substantial and costly structure with the completion of the Main Street Bridge in 1941, which contained a 365-foot vertical lift span. The contractor had to take steps to protect the steel pilings by encasing them in additional layers of concrete. Built by the Mt. Vernon Bridge Company of Ohio, the Main Street Bridge reflected the rapidly expanding size of Jacksonville and the increasing flow of traffic south to the suburbs and beaches.

Figure12. Construction of the Blountstown Bridge over the Apalachicola River, 1937.
Source: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/138090.

WORLD WAR II AND THE MODERN AGE (1941-1956)

World War II

In 1941, America entered World War II. The war effort quickly curtailed work on the state highways, except for defense-related work. During the war years, the SRD provided access roads to military installations and improved highways that were deemed crucial to the movement of military traffic. These road projects were conducted at Pensacola, Tampa, Jacksonville, Orlando, as well as other locations around the state. Contractors modernized and shortened the Overseas Highway to Key West, which housed a naval training station, and new bridges were constructed over the Banana and Indian rivers to serve naval facilities at Cocoa.[33]

The war brought an end to the tradition of private toll roads and bridges. The move to eliminate private tolls on bridges, roads, and ferries had begun during the Great Depression, but there were holdouts. Two remaining toll bridges in Tampa, the Davis Causeway to Clearwater and the Gandy Bridge, became public property during the war and were freed of toll charges despite resistance by the owners of the Gandy Bridge.[34] The federal government, maintaining that tolls were impediments to the defense effort, invoked wartime powers to take over the bridge.

Figure 13. Gandy Bridge Toll Gate, 1930.
(FDOT at http:www.dot.state.fl.us/publicinformationoffice/
historic dotphotos/bridges/gandy.shtm)

[33] "Mathers Bridge-Banana River," *Florida Highways* 17:11 (1949), 29.
[34] Howard W. Hartley, "Courtney Campbell Parkway," *Florida Highways* 16:3 (1948), 9-12.

World War II became the first of many conflicts to shape the American efficiency and cost effectiveness that standardized manufacturing provided. Stone and timber as building materials, especially for bridges, were passé. Structural steel was prioritized for war efforts and, as such, was in short supply for other construction. The big American steel companies adopted standardized designs for production; there was no time or money to fabricate unique structures. This trend continued into the 1950s. Post-war economic prosperity ushered in the automotive age, which greatly overloaded the limited transportation infrastructure.

The Post-War Era and the Changing American Landscape

The post-World War II period opened the modern era of road and bridge building in Florida. Franklin D. Roosevelt passed the Federal-Aid Highway Act of 1944, which authorized construction of the National System of Interstate Highways. The social context for these strides in transportation development was stormy. A country in a seemingly perpetual state of war exposed the need for a national infrastructure of strategic military roads to support the military. The construction of the interstate highway system "was initially justified as a defense system for moving military vehicles and evacuating civilians. Defense requirements called for the interstate systems' geometry and structures to accommodate and aid the movement of large military equipment."[35] This Act also established the basis for federal-aid funding and distribution, although it was severely under-equipped to handle the dramatic increase in automobile usage after World War II. Revisions to this Act in 1950, 1952, and 1954 made significant steps in rectifying this shortcoming.

In the early 1950s, the Korean War dramatically curtailed the post-war boom of World War II, but had its own prolific period of post-war expansion that ushered in an era of standardization and cost-effective construction materials and methods. The steel shortage created by the Korean War (and later by the Vietnam War) had a direct affect on bridge development by creating a need for a cost-effective alternative to steel. Applied concrete technology in Europe and successful domestic examples from the 1920s lent credibility to concrete as a viable building material, especially for bridges.

Although it first was developed by French engineer Eugene Freyssinet in 1927, prestressed concrete did not gain widespread acceptance as a viable alternative to reinforced concrete until the mid-twentieth century. The first prestressed concrete bridge constructed in the U.S. was the 1950 Walnut Lane Memorial Bridge, which carries Lincoln Drive over Monoshone Creek in Philadelphia. Concrete became the preferred material for bridge construction because the individual components (cement, aggregate, water, chemical additives) were readily available and economical. Additionally, concrete's flexibility to be cast-in-place or precast in numerous forms allowed rapid and standardized construction.

The American landscape changed at an unprecedented rate as urban construction and suburban development continued, and the need for a safe and efficient roadway system increased. A method to standardize roadway construction became paramount to accommodate the growing demand on

[35] M&H Architecture, Inc., 2007, 41-42.

transportation infrastructure; this included bridge construction. Standardization became the new paradigm for roadway development, as reflected in a proliferation of simply designed and utilitarian slab, beam, and girder bridges. This trend was in stark contrast to the highly privatized and individualized bridge design, development, and construction of the early twentieth century.

Two national organizations were key sources of well-researched technical information that enabled standardized bridge design specifications: the Bureau of Public Roads (BPR, now known as the Federal Highway Administration [FHWA]) and the American Association of State Highway Officials (AASHO, now known as the American Association of State Highway and Transportation Officials [AASHTO]). These two organizations disseminated design standards for bridge construction in an unprecedented collaborative fashion. The focus of the BPR and AASHO were rural and state roadway development, respectively.

The BPR had its origins in the 1893 Office of Road Inquiry, whose mandate was to provide information for the construction and management of rural and agricultural roadways. The BPR issued design standards under the AASHO name in 1953, 1956, and 1962. They individually published findings on precast concrete in 1950, although this information was not included in AASHO specifications until 1961 to allow sufficient time for the "then-new" prestressed concrete technology to advance in research and use.

AASHO was established in December 1914, as a professional organization of state transportation officials in North Carolina, Virginia, and Maryland. The organization changed its name to AASHTO, established in November of 1974, but their mandate remained steadfast: to study and recommend improvements related to state-level road construction and to advocate transportation-related policies and provide technical services to support states in their efforts to efficiently and safely move people and goods.[36] AASHO published its first set of bridge specifications in 1931.

The Eisenhower Interstate Highway System

By 1954, President Dwight Eisenhower appointed a committee to study the nation's highway needs. The recommendations of this committee, under advisement by the brilliant yet polarizing Robert Moses, led to the enactment, on June 29, 1956, of the Federal-Aid Highway Act of 1956, popularly known as the National Interstate and Defense Highways Act; this Act provided funding for interstate highway construction for a 13-year period (1956-1969). It increased federal appropriations to states for highway construction, and brought nationwide uniformity to road building efforts by including a provision requiring the development of uniform interstate design standards to accommodate projected traffic volume through 1975. "Toll roads, bridges, and tunnels could be included in the system if they met system standards and their inclusion promoted development of an integrated system."[37]

[36] American Association of State Highway and Transportation Officials, "What is AASHTO?' accessed at http://www.transportation.org/?siteid=37&pageid=330.
[37] Richard F. Weingroff, "Federal-Aid Highway Act of 1956: Creating the Interstate System," *Public Roads* 60:1 (Summer 1996), accessed at http://www.fhwa.dot.gov/publications/publicroads/96summer/p96su10.cfm.

THE MODERN ERA (1956-1970)

The Federal-Aid Highway Act of 1956, occurring at the same time as the Baby Boom and a mass exodus to suburbia, initiated a building frenzy in transportation systems. Florida was emerging as a highly desirable place to live and work, since it featured a reasonable cost of living and no personal income tax. In addition, with beaches and good weather, Florida was a favorite tourist destination. This population influx put considerable pressure on the state highway system to expand and improve, and at the same time underscored the value of careful planning, sound construction techniques, and innovative engineering. During the construction boom in the 1950s and 1960s, hundreds of simple trunnion bascule bridges were constructed over the inland waterways. The Hopkins trunnion bascule configuration, patented in 1936, saw widespread use in Florida during this time, and was "the most prevalent type of bascule span utilized in Florida from the 1950s to the mid 1990s."[38]

The magnitude of the 49,700-mile Dwight D. Eisenhower National System of Interstate and Defense Highways and its historical significance presented administrative challenges to the FHWA. In 2005, the Advisory Council on Historic Preservation (ACHP) published an Exemption Regarding Effects to the Interstate Highway System in the *Federal Register*. This permitted federal agencies to proceed with the ongoing maintenance, improvements, and upgrades necessary to allow the Interstate Highway System to serve its primary function without the interruption of the review process found in Section 106 of the National Historic Preservation Act of 1966. This categorical exemption excludes certain elements of the Interstate Highway System that have been found to be eligible for listing in the NRHP. Elements of the Interstate Highway System in Florida that were found to be eligible include the Bob Graham Sunshine Skyway Bridge (I-275) in Pinellas and Manatee Counties, Alligator Alley (I-75) in Collier and Broward counties, the Snake Wall (I-75) in Alachua County, and the Myrtle Avenue Overpass (I-95) in Duval County.

William E. Dean, the FDOT's chief bridge engineer from 1948 to 1962, gained national prominence for advocating the use of a new innovative building material in bridge construction, prestressed concrete. He introduced prestressed concrete slabs into the state system when he sought durable replacements for timber decks on spans along the Tamiami Trail.

Prestressed concrete became crucial to modern concrete bridge design because it overcame concrete's natural weakness in tension. Early generations of concrete cantilevered bridges were box girders due to the efficiency of the structural form and its inherent stability without the need for falsework (temporary support frames used during construction). Without the requirement for falsework, bridges could be built at higher elevations above ground. With the development of prestressed concrete, bridges could span upwards of 500 feet.[39] Many of Dean's progressive ideas and methods went into building the Sunshine Skyway, which opened in 1954, and stretched approximately 15 miles to link the St. Petersburg and

[38] Timothy Noles and Michael Sileno, "Retrofit of the Christa McAuliffe Bridge," paper presented at the Ninth Biennial Symposium, Heavy Movable Structures, Inc., October 22-25, 2002, accessed at http://www.heavymovable structures.org/assets/technical_papers/00918.pdf.
[39] J. Murillo, "Brief History of Segmental Concrete Bridge Construction," *Segmental Bridges* 57:19 (February 2004).

Bradenton areas. Long, filled-in causeways led to a cantilevered steel truss, which rose 155 feet above Tampa Bay and provided wide clearance for ships. The size of the project gave Dean many opportunities to demonstrate the value and strength of prestressed concrete construction. In 1969, a virtually identical structure was completed adjacent to the original to accommodate the increasing volume of traffic. However, a tragic accident occurred in 1980 when a ship, the *Summit Venture*, rammed a concrete pier and toppled a main span into Tampa Bay. Consequently, a new structure, exhibiting a dramatic cable-stayed design by Figg and Mueller Engineers of Tallahassee, opened in 1987, providing the area once again with an exceptional example of bridge engineering.

Barrier Island Development

Increasing wealth throughout the country led to the intense development of coastal property. As discussed in *The Affluent Society*, economist John Kenneth Galbraith contended that prosperity had become a template for 1950s America. "Nowhere was prosperity rearranging America with more force and speed than along Florida's beaches. It was free enterprise at its best and worst."[40] The finger island concept, with narrow strips of dredge fill alternating with channels of water, offered every home a waterfront view. Beginning in the early 1950s and continuing through the 1960s, developers dug many "finger canals," with the fill deposited behind vertical cement seawalls, creating numerous large-scale canal communities.

Nowhere else was the dredge-and-fill method of construction more readily practiced than in Pinellas County. The Tierra Verde development was one such example. In 1959, the *New York Times* hailed a new project that featured building a new city on 15 uninhabited keys. The $12 million project, when completed, included 42 miles of seawall, 17 miles of canals and waterway, and five bridges, including the Madonna Boulevard Bridge and the 13th Street Bridge, concrete girder bridges that were known for their sculpted railings. Tierra Verde benefitted from a number of transportation projects, including the construction of the 1954 Sunshine Skyway Bridge and the 1962 Pinellas Bayway.

Further to the south, the Marco Island development changed the face of Collier County with a community designed as a water-oriented, second-home retirement community and resort center. Bay bottoms and mangrove swamps were transformed by dredge-and-fill into a complex of upland subdivisions and canal waterfront home sites with numerous small bridges using prestressed concrete of a slab or girder design connecting the network of canals. The SR-951 Bridge over Big Marco Pass, a continuous steel girder bridge, providing access to the island.

Canal development on Sanibel and Captiva Islands in southwest Florida began in the early 1960s, with dredging that altered saltwater lagoons and mangrove forests. By 1973, most canals on the south tip of Sanibel had been dredged, and a few concrete slab bridges and culverts had been constructed over the Sanibel River and the Mackinac Canal.

[40] Gary Mormino, *Land of Sunshine, State of Dreams: A Social History of Modern Florida* (Gainesville, FL: University Press of Florida, 2005).

Every beachfront development was unregulated and construction too close to the beach often resulted in destruction of the natural dune system. The combination of unregulated coastal development and the destabilization of many tidal inlets led to significant beach erosions issues in the mid-twentieth century. Controversy surrounding the dredge-and-fill practices led to the emergence of new environmental laws and planning policies. Under the guidance of Nathaniel Reed, Governor Claude Roy Kirk, Jr. championed two key conservation measures: the 1957 Bulkhead Act and the 1967 Florida Air and Water Pollution Control Act. A 1967 update to the Bulkhead Act, known as the Randell Act, urged the decision-making agencies to weigh the public benefits of proposed waterfront development against environmental losses. In addition, the Aquatic Preservation Law of 1968 prohibited dredge-and-fill development in designated areas. These three laws, in addition to the creation of the Environmental Protection Agency (EPA) by President Nixon's executive order, culminated in Zabel v. Tabb (430 F. 2D 199 5th Cir. 1970). It was during this case that the 5th Circuit Court upheld the Army Corps of Engineers' denial of a dredge-and-fill permit to landowners Alfred Zabel and David Russell, based on the potential harm that the development would have caused to the underlying Boca Ciega Bay. This landmark case acknowledged the state and federal responsibility to protect environmentally threatened land. It also effectively limited the future development of finger islands and dredge-and-fill practices.

In addition to the environmental laws enacted during the late 1960s, a number of planning and compliance policies also emerged. Metropolitan Planning Organizations were enacted by federal mandate in 1962. The National Historic Preservation Act (1966) and the National Environmental Policy Act (1969) provided protection to cultural and environmental resources. Florida's Outdoor Recreation and Conservation Act (1963) provided a means to acquire public land other than by donation or legislative line-item appropriation. The Act created the Outdoor Recreation and Conservation Program and the Land Acquisition Trust Fund, which used tax revenue to support bond sales for the purchase of parks and recreation areas. State parks that were developed during this time include Lake Griffin State Park; John Pennekamp Coral Reef State Park, the nation's first underwater park; and Windley Key Fossil Reef Geological State Park.

The End of an Era

During the 1960s, the U.S. economy continued to grow, and two key agencies were established: the U.S. Department of Transportation (1966) and the Federal Highway Administration (1967). The FHWA, as a division of the U.S. Department of Transportation, was tasked with the responsible oversight of funding for agencies, including state departments of transportation that used their funds for transportation needs. To qualify for funding, state agencies were required to adhere to FHWA standards and directives, which included AASHTO specifications to ensure safe and progressive roadway and bridge design and construction. This oversight provided quality control of projects, construction administration and standards for the nation's transportation infrastructure: "AASHTO specifications are the bible of highway bridge design engineers. They are intended to serve as a standard…for the preparation of state specifications and as a reference for bridge engineers. Because they have been adopted by all the state highway departments in the United States, they are a set of rules and regulations to be followed in designing the nation's highway bridges."[41]

The newly available funding for transportation projects fueled the road and bridge construction of the 1960s. Vehicular traffic volume continued to increase, and mounting pressure led to the creation of the Florida Department of Transportation (FDOT) on July 1, 1969. The newly created FDOT absorbed the powers of the previous SRD. The original Turnpike Authority was disbanded, and a reorganized Florida's Turnpike operation was made a part of the FDOT.[42]

Florida's Turnpike, also known as SR-91, runs approximately 312 miles through 11 counties, beginning in Miami-Dade County and terminating in Sumter County. On January 25, 1957, it opened to traffic as the Sunshine State Parkway and operated under the direction of the Florida State Turnpike Authority. At that time, the corridor extended 110 miles, connecting Golden Glades in Miami to Fort Pierce. In 1963, a 61-mile extension connecting Fort Pierce to Orlando was completed, and the next year an extension from Orlando to Wildwood was opened. Following its incorporation into the FDOT as the Florida Turnpike District (renamed Florida's Turnpike Enterprise in 2004), the Turnpike continued to grow. The final section of the mainline connected Miami to Homestead in 1974. Today there are 70 interchanges within the entire 312-mile Turnpike system, as well as 194 bridges, 90% of which use concrete or prestressed concrete.[43]

Figure 14. Construction of the West Palm Beach Canal Bridge which carries the Sunshine State Parkway (Florida Turnpike) over the West Palm Beach Canal and SR-80, 1956. Source: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/38581.

[41] Narendra Taly, *Design of Modern Highway Bridges* (New York: McGraw-Hill, 1998), 91, 93.
[42] Florida Department of Transportation, "Florida's Turnpike 50 Year Celebration," accessed at http://www.floridasturnpike.com/downloads/50thBookFinal.pdf.
[43] Florida's Turnpike Enterprise, "Florida's Turnpike: The first 50 years," accessed at http://www.floridasturnpike.com/about_history.cfm.; Peter Samuel, "Florida's Turnpike celebrating 50th birthday & half price transponders," *TOLL ROADS News*, January 25, 2007.

The construction of statewide transportation networks spurred local municipalities to improve their own infrastructure systems through funding programs. One such example was the Brorein Street Bridge. Completed in 1959, W.I. Nolen, the city bridge engineer, oversaw building of the double-leaf bascule bridge by the Paul Smith Construction Company. This bridge represented the first completed project from the $20 million Public Improvement Program for the City of Tampa.

Waterway Navigation

Other innovations included those in waterway navigation. In 1939, The U.S. Board of Engineers for Rivers and Harbors recognized the need to create a commercial water thoroughfare for passengers, goods, and services and recommended creation of the Gulf Intracoastal Waterway (ICWW), a 9-foot deep by 100-foot wide channel stretching from the mouth of the Caloosahatchee to Lemon Bay and beyond (to Tarpon Springs). As a result, a number of bridges were built crossing the ICWW, including the Madeira Beach Causeway and the Tierra Verde Causeway in Pinellas County, both of which are of double-leaf bascule and prestressed concrete girder design. The early ICWW bridges were typically of a movable design with steel or concrete construction. More recent designs, such as the Port Boulevard Bridge in Miami-Dade County and the A1A Bridge in Broward County use a continuous prestressed concrete segmental box girder design.

Figure 15. Construction of the East Channel Bridge over the Atlantic ICWW, Miami, 1959.
Source: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/104484

The Cross Florida Barge Canal was intended to cross northern Florida, connecting the Gulf ICWW with the Atlantic ICWW. The planned route of the canal followed the St. Johns River from the Atlantic coast to Palatka, the valley of the Ocklawaha River to the coastal divide, and the Withlacoochee River to the Gulf of Mexico. Although the project was authorized by Congress in 1942, construction did not begin on the canal in 1964. The project was halted by President Richard Nixon in 1971 after several lawsuits based on environmental concerns were filed seeking an injunction to the project. About 25 miles of the 110-mile project were built, including the cross-country section from the St. Johns River to the Ocklawaha River, part of the route along the Ocklawaha River, and a small section at the Gulf of Mexico, ending at the dammed Lake Rousseau. The completed infrastructure included three of the five planned locks, all three planned dams, and four of the 11 planned bridges. All the bridges over the St. Johns River north of the canal are high enough for ships, or have movable sections. High bridges were built over the canal, as well as several over the Ocklawaha River where it was not widened to the canal. The land intended for the canal is now a protected greenbelt known as the Marjorie Harris Carr Cross Florida Greenway, named for the leader of the opposition to the canal.[44]

Figure 16. Inglis lock and US-19 bridge over the Cross Florida Barge Canal, Levy County.
Source: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/1315.

The U.S. Space Program

In addition to roadway and waterway improvements, the 1960s saw a technological advancement that would have global impact. The "Space Race" that marked the mid-century history of both the U.S. and Russia, influenced State Senator Bernard Parrish to introduce a bill in 1963 calling for a "space university" to assist in providing the professional and technological education needed to support the growing space program.[45] A site was chosen in Orange County in early 1964, and the Florida Technological University opened for students in 1968. The school grew quickly and was renamed the University of Central Florida just a few years later. Another institution, the Brevard Engineering College (later the Florida Institute of Technology) also expanded its campus during the 1960s in an effort to meet the needs of the space program.

[44] Department of the Army, *Cross Florida Barge Canal Restudy Report Summary* (Jacksonville, FL: Jacksonville District Corps of Engineers, 1976), 1, 7.
[45] Jerrell H. Shofner, *History of Brevard County Volume 2* (Stuart, FL: Southeastern Printing Co., Inc., 1996), 195.

Brevard County and state officials were still grappling with traffic congestion resulting from the growth of the missile program and the new college campuses when the National Aeronautics and Space Administration (NASA) launched an ambitious building program. This created the need for new roads and bridges and the widening of most of those that were already in place. The new roads included arterial highways to facilitate the flow of traffic to and from Cape Canaveral, Patrick Air Force Base, and the Merritt Island Launch Area.

The four-laning of US-1 through Brevard County was completed in 1964. Plans for construction of Interstate 95 (I-95) were completed in 1961, and most of its construction was completed by the end of the decade. The NASA Causeway (SR-405), a four-span, prestressed concrete girder bridge, was constructed and connected to SR-50 in 1966. During the same period, the Emory L. Bennett Causeway (SR-528) was under construction. The Causeway carries the easternmost portion of SR-528 and SR-A1A from US-1 to the eastern terminus of SR-528, across the Indian and Banana Rivers, Sykes Creek, and Merritt Island via a series of prestressed concrete girder bridges.

Figure 17. Construction of the NASA Causeway East across the Indian River, October 29, 1964. Source: NASA file/1964 at http://www.nasa.gov/centers/kennedy/pdf/671435main_jul27-2012.pdf.

A high-speed road was also proposed to connect Brevard County to Orlando near McCoy Jetport (now Orlando International Airport). When the Walt Disney Company announced its ambitious plans for Orange County, Brevard County leaders began to see the proposal of a high-speed road as a way to bring visitors to the Kennedy Space Center (KSC). This road became the Martin Anderson Beeline (SR-528), which, together with the Bennett Causeway, provided access to Cape Canaveral. Port Canaveral also expanded in the 1960s, stimulated by the construction of the Merritt Island Launch Area and the Apollo program. In 1965, Port Canaveral completed a series of locks to connect the port with the barge canal across Merritt Island. The locks were first used to transport the Saturn rocket on its way to the Cape. Two bascule and concrete girder bridges were constructed in 1963 as part of this series.

Toll-Financed Bridges

The vigorous bridge building program begun in the 1950s has maintained its momentum throughout more recent decades. In 1967, Jacksonville acquired an imposing continuous through truss bridge, named for the City's founder, Isaiah Hart, that provides a 1,093-foot clear channel for shipping on the St. Johns River. Still another reminder of Jacksonville's historical tradition as a crossing point on the St. Johns occurred in 1988 with the opening of the Napoleon Bonaparte Broward Bridge at Dames Point, a major transportation facility in the city and state. Designed by the engineering firm of Howard, Needles, Tammen & Bergendoff, the cable-stayed bridge, having the longest central span of this type in the U.S., is a graceful addition to the river. While the Hart Bridge is now a free road, both the Hart Bridge and Dames Point Bridge were toll-financed. In addition, tolls originally financed at least three other bridges in Duval County: the Fuller Warren Bridge, a bascule span just south of the downtown built in 1954; the Trout River Bridge, an arched girder bridge built in 1926; and the Mathews Bridge, a steel through truss bridge built in 1953.

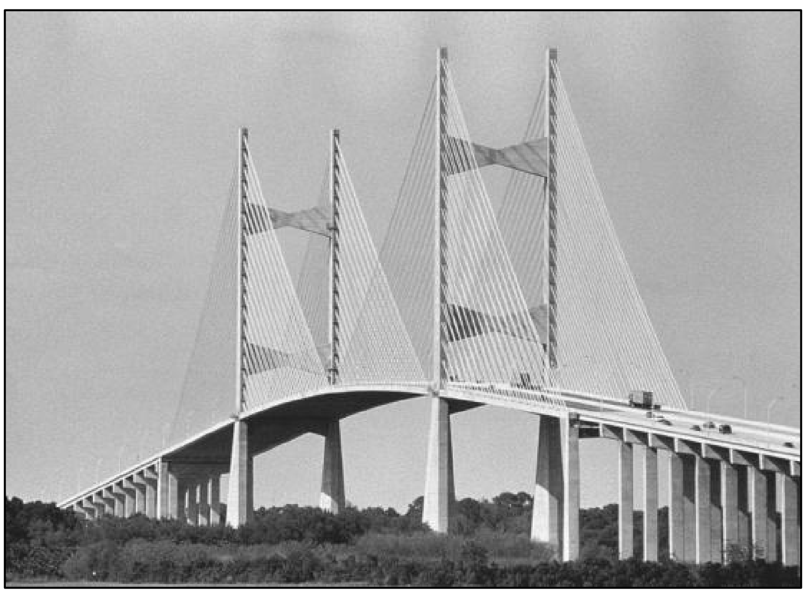

Figure 18. Napoleon Bonaparte Broward Bridge at Dames Point, Duval County.

The evolution of bridges in Florida is the story of ingenuity and perseverance. Begun as the proud achievements of their time, the historic bridges of Florida serve as a benchmark of Florida's growth and development.

BRIDGE MATERIALS

The primary structural materials used to build Florida's historic highway bridges are timber, steel, and concrete (both reinforced and prestressed). Historic decorative materials include, but are not limited to, stone, terracotta, cast-in-place concrete, and precast concrete.

Timber

Timber is one of the oldest structural materials. In the first half of the twentieth century, longitudinal sawn timber beams and transverse sawn lumber decking was the prevalent timber bridge construction system. The decking members were attached to adjacent pieces by nailing; toe-nailing was used to attach decking pieces to the timber beams. This system provided a structurally sound deck system when initially installed, but the effects of moisture, insects, and the dynamic impact of moving vehicles often resulted in decay and a loosening of mechanical fasteners. Timber bridges therefore have extensive maintenance requirements. Additionally, unlike manufactured steel and concrete, sawn timber does not have consistent structural properties. Its strength varies depending on species, density, and moisture content. These disadvantages led county and state bridge engineers to discontinue the use of timber in highway bridge construction in favor of reinforced concrete and steel. [46]

Timber bridges do have some advantages, as their members can resist both tensile and compressive stresses. Modern timber bridges overcome the inherent weaknesses of wood by using engineered glued-laminated (glulam) or stressed-laminated wood members.[47] Early timber beam bridges typically consist of multiple solid-sawn beams running between wood piers. The decks are often wood plank, although steel grating is sometimes found. Modern timber bridges are more likely to use more structurally efficient and cost effective glulam or stress-laminated wood members.

Steel

Modern steelmaking originated with Henry Bessemer, whose mid-nineteenth century invention of the Bessemer process enabled the mass production of steel. Bessemer's patented method of converting pig iron to steel greatly reduced the cost and increased the speed and scale of steel production. Steel was commonly used in the construction of truss, cantilever, arch, and suspension bridges throughout the U.S. in the late nineteenth and early twentieth centuries.[48]

Due to their strength, steel bridge members are used to carry axial forces as well as bending forces. Steel shapes are generally either rolled or built-up. Rolled steel bars and plates are frequently used in truss

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[46] Thomas G Williamson, "Timber Highway Bridge Construction Practices in the United States," paper presented at the National Conference on Wood Transportation Structures, Madison, WI, October 23-25, 1996, USDA, Forest Service, Forest Products Lab, FPL-GTR-94.
[47] U.S. Department of Transportation, Federal Highway Administration, *Bridge Inspector's Reference Manual* (Washington, D.C., 2006), 6.2.1.
[48] Sukhen Chatterjee, *The Design of Modern Steel Bridges* (Malden, MA: Blackwell Publishing, Inc., 2003), 10-17.

construction, and they may be connected with rolled angles to form bracing members. Rolled channels are used as diaphragms, struts, or other built-up members. Rolled beams are "I"-shaped sections used as main load-carrying members in which the load carrying capacity increases as the member size increases. During the early days of the iron and steel industry, the various manufacturers each rolled beams to their own standards. It was not until 1896 that the Association of American Steel Manufacturers adopted the American Standard beam, standardizing beam weights and dimensions.[49]

Built-up shapes, fabricated by either riveting or welding techniques, allow the bridge engineer to customize the members to their use as they offer a great deal of flexibility in design. Riveting steel shapes was a common practice from the 1800s through the 1950s. Welded steel boxes and girders began to be manufactured in the early 1960s. Typical built-up shapes include girders and boxes. Riveted I-beam girders were fabricated from plates and angles when the largest rolled beams were still not large enough as required by the bridge design. Riveted boxes, fabricated from plates, angles, or channels, were used for cross-girders, truss chord members, and substructure members. Welded girders and boxes are fabricated from plates. Welded boxes are commonly used for superstructure girders, truss members, and cross girders.[50]

Steel cables are tension members and are used in suspension, tied-arch, and cable-stayed bridges.[51]

Concrete

Structural concrete is concrete that includes structural steel as reinforcement, including both reinforced and prestressed concrete; both can be precast in numerous forms. On its own, concrete is inherently strong in compression but not in tension. Steel rebar embedded in the concrete increases its performance in tension, allowing for longer unsupported spans.

The difference between reinforced and prestressed concrete is how the embedded steel is treated. Both the steel placement and cure time for reinforced concrete are determined by very specific and tested engineering standards. The steel in conventional reinforced concrete is simply laid in its engineered placement in a form, and then the concrete is poured over the steel and cured appropriately.

In contrast, the steel in most prestressed concrete is stressed before the concrete is poured and cured. In pre-tensioned prestressed concrete technology, the steel is tensioned in the form before the concrete is poured. Once the concrete has cured to its required strength, the steel strands are cut and detensioned. As the strands attempt to regain their original untensioned length, they bond to the concrete and apply a compressive force. This process increases the load-carrying capacity and helps control cracking of the final structural components.[52] In post-tensioned prestressed concrete, the concrete is cast with open

[49] *Bridge Inspector's Reference Manual*, 1.10-2.
[50] Ibid., P.1.13-4.
[51] Ibid., P.1.15.
[52] Precast/Prestressed Concrete Institute (PCI). *Designing with Precast and Prestressed Concrete*, 2010, accessed at http://www.pci.org/designing_with_precast.cfm, 8.

ducts in the place of steel strands. After the concrete is cured, the steel strands are run through the ducts and then tensioned. Post-tensioning may be used to join together large precast concrete elements, such as box girders.[53] Post-tensioning using tendons was first introduced in Florida in 1954 by Bridge Engineer, Bill Dean in the first Sunshine Skyway Bridge in Pinellas County.[54]

The history of reinforced concrete begins in Europe. European experimentation, developments, construction, and early design theory occurred in England, France, and Germany during the nineteenth century. At that time, steel, masonry, and timber bridges were more common than concrete bridges in the United States. As early as 1903, the Swiss Institute of Engineers & Architects produced specifications for reinforced concrete. European examples provided the precedence to validate the material properties of reinforced concrete that were later incorporated into American practice. The first reinforced concrete bridge built in the United States was the 1908 Walnut Street Bridge in Philadelphia.

The material limitations of reinforced concrete, including a high weight-to-span-ratio, cracking, and spalling, and continued experimentation with concrete by French engineer Eugene Freyssinet led to the development of prestressed concrete in 1927. Despite this early date, the technology was severely hampered by stalled developments in steel engineering to reinforce the concrete due to the war.[55] Prestressed concrete did not gain widespread acceptance as a viable alternative to reinforced concrete until mid-century. The first prestressed concrete bridge constructed in the United States is the 1950 Walnut Lane Memorial Bridge over Monoshone Creek in Philadelphia. The successful completion of the Walnut Lane Memorial Bridge launched the development of the multi-billion dollar prestressed concrete industry and revolutionized the construction world.[56] Despite AASHTO did not publish specifications for prestressed concrete until 1961, when it released specifications based on a 1958 prestressed concrete report by the joint committee of the American Concrete Institute (ACI) and the American Society of Civil Engineers (ASCE).

As is true in fundamental post-and-lintel bridge design, the longer the span, the more intermediate support is required to be structurally sound. Reinforced concrete, while strong, is known for its "heavy" aesthetic. Prestressed concrete, in contrast, has a slimmer, more streamlined appearance due to its material properties. The advantages of prestressed concrete over reinforced concrete include:

- longer spans that allow for wider column-free spaces due to a higher span-to-depth ratio;
- beams that are approximately two-thirds the size and weight of reinforced concrete beams;
- reduced self-supporting weight that requires less material, which makes for more slender, aesthetic proportions;

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[53] Edward Allen, *Fundamentals of Building Construction: Materials and Methods* (New York, NY: John Wiley & Sons, 1990), 535.
[54] Corven Engineering, Inc., "Post-Tensioning in Florida Bridges," Volume 1 in *New Directions for Florida Post-Tensioned Bridges* (Tallahassee, FL: FDOT), 7, accessed at http://www.dot.state.fl.us/structures/posttensioning/NewDirectionsPostTensioning.pdf.
[55] George D. Nasser, "The Legacy of the Walnut Lane Memorial Bridge," in *Structure: A Joint Publication of NCSEA/CASE/SEI* (October 2008), accessed at http://www.structuremag.org/article.aspx?articleID=775, 27.
[56] Ibid., 1.

- approximately one-fourth the amount of steel required for reinforced concrete; and
- increased steel durability, which leads to less corrosion, and improved steel performance and resiliency.[57]

BRIDGE COMPANIES IN FLORIDA

Many bridge engineers, designers, and construction companies engaged in the construction of Florida's historic highway bridges. On larger projects, a number of companies contributed to the bridge through the design; the fabrication and installation of major structural elements such as the bascule main span; and the construction of the substructure and approach spans. The boom period of growth during the 1920s attracted many outside companies to Florida. Some established local offices, while others set up permanent facilities. Few Florida bridge builders were natives of the state until the 1930s. The Great Depression resulted in the demise of many bridge companies in the U.S. during this decade. The principal bridge engineers, designers, contractors and builders of Florida's bridges, including the location of their headquarters and examples of their work, are provided in the following table.

Name of Bridge Engineer, Designer, or Construction Company, and Location	Active Dates	Bridge Type or Form	Examples and Notes
American Bascule Bridge Company, Chicago, IL		Movable bridges	Ortega River Bridge, Duval Co.
American Bridge Company, New York, NY	Late 19th-Early 20th c.	Metal truss bridges	Jennings Bridge, Hamilton Co.
Auchter, George D., Company, Jacksonville, FL	Early 20th c.	Reinforced concrete bridges	John E. Mathews Bridge, Duval Co. and Macavis Bayou Bridge, Santa Rosa Co.
Austin Brothers Bridge Company, Atlanta, GA	Early 20th c.	Metal truss bridges; movable bridges	Suwannee Springs Bridge, Suwannee Co. and Sharp's Ferry Swing Bridge, Marion Co.
Bentley, A. and Sons, Toledo, OH	Early 20th c.	Reinforced concrete bridges	St. Mary's River Swing Bridge, Nassau Co. and Ortega River Bridge, Duval Co.
Blackwell, R.H.H., East Aurora, New York, NY	1920s	Metal truss bridges	Ellaville/Hillman Bridge, Madison Co.
T.C. Carrick, Duval County, FL	Early 20th c.	Duval County bridges	Duval County bridge engineer noted for the Maltese cross design. Myrtle Avenue Bridge, Duval Co.
Champion Bridge Company, Wilmington, OH	1880s-early 1930s	Metal truss bridges; movable bridges	Notable for swing bridges, including Blackburn Point Swing Bridge, Sarasota Co. and Miami River Canal Swing Bridge, Miami-Dade Co.
Cleary Brothers Construction Company, West Palm Beach, FL			Camino Real Bridge and Haven Ashe/Boca Inlet Bridge, both in Palm Beach Co.

[57] Amlan K. Sengupta and Devdas Menon, "Prestressed Concrete Structures," Indian Institute of Technology Madras: n.d., 2-3, accessed at http://nptel.itm.ac.in/courses/IIT-MADRAS/PreStressed_Concrete_Structures/pdf/1_Introduction / 1.1_Introduction.pdf.

Name of Bridge Engineer, Designer, or Construction Company, and Location	Active Dates	Bridge Type or Form	Examples and Notes
Concrete Steel Bridge Company, New York, NY and Miami Beach, FL	Early 20th c.	Reinforced concrete bridges	Fern Creek Bridge, Orange Co.
Cone Brothers Construction Company, Tampa, FL			Hillsborough River Lift Bridge, Hillsborough Co.
Converse Bridge and Steel Company, Chattanooga, TN	1890s-1930s	Metal truss bridges	Steinhatchee Springs Bridge, Lafayette Co. and Bellamy Bridge, Jackson Co.
Felix, C.T., St. Petersburg, FL	Early 20th c.	Reinforced concrete bridges	Billy Creek Lift Bridge, Lee Co.
Greiner, J.E., Baltimore, MD			Designed the Bridge of Lions, St. Johns Co. and the William H. Marshall Memorial Bridge, Broward Co.
Hardaway Construction Company, Columbus, GA			Sunset Islands Bridge, Miami-Dade Co.
Harrington, Howard and Ash, Kansas City, MO. (later, HNTB)	Early 20th c.	Movable bridges, notably drawbridge design	Brickell Avenue Bridge and NW 17th Avenue Bridge, both in Miami-Dade Co.
Horton, Freeman H., Bradenton, FL	1930s-1940s	Bradenton, Manatee County bridges	Bradenton engineer noted for the design of the Wares Creek bridges
Klutho, Henry J., Jacksonville, FL	Early 20th c.	Architectural design	Designed the Confederate Park bridges in Jacksonville
Lassiter, Robert G., and Company, Oxford, NC	Early 20th c.	Reinforced concrete bridges	Built the Confederate Park bridges in Jacksonville and Indian Creek Bridge in Miami-Dade Co.
Lockman, W.S., Construction Company, West Palm Beach, FL			Belle Glade Bridge (relocated), Palm Beach Co. and NW 17th Avenue Bridge, Miami-Dade Co.
Loving, T.A., and Company, Goldsboro, NC			NW 27th Avenue Bridge, Miami-Dade Co.
Luten Bridge Company, York , PA	1900-1932	Reinforced concrete bridges, particularly concrete arch bridges	Ran several bridge companies. Held nearly 50 bridge patents by mid-1920s.
Missouri Valley Bridge and Iron Co., Leavenworth, KS			Acosta Bridge, Duval Co.
Mt. Vernon Bridge Company, Mt. Vernon, OH	1900-mid-1960s	Metal truss bridges	Main Street Bridge, Duval Co.; Michigan Avenue/Columbus Drive Bridge, Hillsborough Co.
Nashville Bridge Company, Nashville, TN	1902-1960s	Metal truss bridges; bascule bridges	Brickell Avenue Bridge, Miami-Dade
Pensacola Shipbuilding Company, Pensacola, FL	Early 20th c.	Steel bridges, including bascules	Ellaville/Hillman Bridge, Madison Co.

Name of Bridge Engineer, Designer, or Construction Company, and Location	Active Dates	Bridge Type or Form	Examples and Notes
Powell Brothers Construction Company, Ft. Lauderdale, FL	1920s+		Established by former Champion Bridge Company engineer Hugh Quinn. Ft. Denaud Swing Bridge, Hendry Co. and SE 3rd Avenue Bridge,Broward Co.
Raymond Concrete Pile Company, New York, NY	1900+		Venetian Causeway, Miami-Dade Co. and Blind Pass Bridge, Pinellas Co.
Roanoke Bridge Co., Roanoke, VA. (Branch office in Jacksonville)	1906-1915 (purchased by Camden Iron Works in 1915)	Metal truss bridges	Apalahoochee River Bridge, Hamilton Co.
Scherzer Rolling Lift Bridge Co., Chicago, IL	Early 20th c.		Lafayette Street/Kennedy Boulevard Bridge, Hillsborough Co.
Strauss Bascule Bridge Company, Chicago, IL	Early 20th c.	Bascule bridges	Bridges over the Hillsborough River, City of Tampa
Virginia Bridge and Iron Company, Roanoke, VA	1900-1930s	Metal truss bridges	Belle Glade Bridge, Palm Beach Co.; Bridge of Lions, St. Johns Co.
Wisconsin Bridge and Iron Company, Milwaukee, WI	Early 20th c.	Metal truss bridges	Blountstown Bridge, Calhoun Co.

INTRODUCTION

Although Florida possesses a great number of navigable waterways, the majority of its bridges cross smaller bodies of water, rail lines, or roadways. In these cases, road builders used fixed bridges constructed of timber, steel, or concrete. In Florida, there are eight main categories of fixed bridges: truss, arch, frame, slab, beam, girder, cable, and culvert. In addition, three types of movable bridges are found: vertical lift, swing, and bascule. The following section contains a description of each bridge type, as well as the respective significance and National Register registration requirements.

Florida's historic highway bridges are typically significant under Criterion A in the areas of Transportation, Community Planning and Development, and/or Politics/Government, and under Criterion C in the areas of Architecture and/or Engineering. To be eligible for the National Register under Criterion A, a bridge must have a clear historic association with a significant chapter in Florida's transportation history, in a community's planning and development, or as part of a national movement, such as a federal relief program. Bridges that have played a key role in the state's transportation history include those that cross navigable bodies of water, such as major rivers and the Intracoastal Waterway. This category of bridges may also include those that cross man-made canals, such as portions of the Miami River, the Kissimmee River, and the Cross Florida Barge Canal. Other bridges significant for their association with transportation history include those that cross Florida's railroad corridors, such as the Lilly Avenue Bridge in Polk County, the oldest remaining example of a grade separation. The Overseas Highway Bridges in Monroe County, originally built to carry the Florida East Coast Railway, are significant as representations of both Florida's railroad and highway histories.

Bridges eligible for listing under Criterion A in the area of Community Planning and Development may be associated with the development of adjacent communities. The Nurmi Isles Bridges in Fort Lauderdale in Broward County provided access to the man-made finger islands built with dredged spoil during the Land Boom Era of the 1920s. Some bridges served to connect adjoining cities, such as the Columbus Drive Swing Bridge in Hillsborough County; this structure fostered economic development between Tampa and West Tampa. The Venetian Causeway, which crosses Biscayne Bay between Miami and Miami Beach in Miami-Dade County, is another example of a physical connection between growing communities that enhanced development on both sides. Bridges considered eligible in the area of Politics/Government may be associated with the New Deal public works programs during the Great Depression, including the Works Progress Administration (WPA) and the Public Works Administration (PWA).

A bridge may be significant under Criterion C for its architecture and aesthetic design. Many early bridges constructed during the City Beautiful movement reflect high-style architectural elements. Especially popular were tender stations with Mediterranean Revival style motifs and Neoclassical Revival style urn-shaped balustrades, seen in bridges throughout the state. Other bridges exhibit decorative railing patterns, such as the Maltese crosses seen in bridges in Duval County; eight-point stars, as found on the Platt Street and Cass Street Bridges in Hillsborough County; and the zig-zag patterns in the railings of the Ware's Creek bridges in Manatee County. The Duval County bridges designed by architect Henry J. Klutho exhibit several Beaux Arts and Neoclassical Revival style elements, including obelisks, urns, decorative lighting, and relief sculptures.

Many bridges possess significance under Criterion C as examples of national or regional advances and trends in engineering. For example, a bridge constructed using innovative engineering techniques for its time, such as an early 1950s prestressed concrete channel beam bridge, may be significant. A bridge constructed using engineering techniques common at the time, but no longer in use, and of which few examples remain, such as a 1920s movable swing bridge, may also be significant. Other bridges are examples of specific engineering responses associated with the location, site, and period in which they were constructed. One such example is the bascule bridge that carries A1A over the Boca Inlet in Palm Beach County, one of only four bridges built in the nation using the patented Hanover Skew design to address site design challenges.

Additionally, bridges may be significant under Criterion C for their associations with important architects, engineers, designers, or builders. Examples include the concrete arch bridges throughout Florida designed by Daniel Luten and built by the Luten Bridge Company, as well as the bridges in Manatee County designed by local engineer Freeman Horton. Steel and movable bridges may also be significant if they were designed and constructed by prominent companies, such as the Converse Bridge and Steel Company, the Champion Bridge Company of Ohio, and the Strauss Bascule Bridge Company.

Some bridges are eligible under a combination of the criteria and areas of significance listed above, such as the Springfield and Confederate Park bridges in Duval County. These bridges are eligible under Criterion A for Community Planning and Development as highly visible elements of master-planned communities. They are also eligible under Criterion C for their architecture, as they were designed by a prominent architect, Henry Klutho, and they exhibit several Beaux Arts style architectural elements.

PROPERTY TYPES

Property Type F.1: Truss bridges

Description: There are three main subtypes of steel fixed truss bridges in Florida: **through**, **deck**, and **pony**. These terms describe the placement of the travel surface in relation to the superstructure. A **through truss** is cross-braced above and below the traffic, which flows through the truss. In a **deck truss** configuration, the traffic travels on top of the main truss structure. In a **pony truss** bridge, the traffic passes between the parallel superstructure trusses.[58] Various truss designs were often patented by and named after their inventor, such as Pratt, Warren, Parker, and Howe.

Truss bridges represent an important phase in the development of American bridge building and were often the first attempts at making permanent improvements on county roads. The truss is a skeletal

[58] *Bridge Inspector's Reference Manual,* 8.6.1-3.

structure comprised of several small beams that together can support a large amount of weight and span great distances. Typically, the design, fabrication, and erection of a truss are relatively simple. The superstructure of a truss bridge typically consists of two parallel trusses. Truss bridges consist of top and bottom chords connected by diagonal and vertical web members, which are always joined in a triangular formation. Lateral bracing between the upper and lower chords serves to keep the parallel trusses in line with each other.[59] Older trusses were usually constructed of built up metal components that were riveted together. Riveting is no longer used as a means of joining together structural steel bridge components.

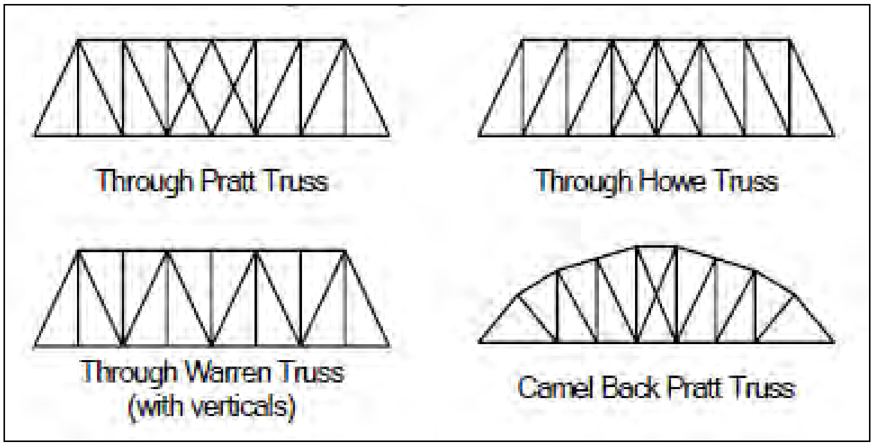

Figure 19. Various Truss Designs.
(*Bridge Inspector's Reference Manual*, 8.6.5)

Significance: All truss bridges in Florida are rare, and therefore, any truss bridge that has maintained physical integrity is considered eligible for the National Register under Criteria A and C. Certain truss designs also are rare; only two Pratt pony trusses, one camelback truss span, and one Parker truss bridge survive. Under Criterion A in the area of Transportation, fixed truss bridges may derive significance from their historic associations with significant events. Bridges constructed under the auspices of early federal aid programs, such as the Ellaville/Hillman Bridge on SR 1 in Madison County; as part of a Depression-era public works project, such as the Blountstown Truss Bridge in Calhoun County, which improved the regional economy through better transportation; or built as part of major growth and development ventures, such as the Bahia Honda Bridge within the Overseas Highway system, would be eligible under Criterion A. Under Criterion C in the area of Engineering, truss bridges may be significant as a rare surviving example of its type, such as the Mathews Bridge in Duval County, the only cantilevered steel Warren through truss bridge still in use; as an early example of truss bridge design and construction, such as the Pratt pony truss Steinhatchee Springs Bridge in Lafayette County; or because of its association with a prominent bridge designer or builder, such as the Blountstown Truss in Calhoun County, constructed by the Wisconsin Bridge and Iron Company.

[59] *Bridge Inspector's Reference Manual*, 8.6.9, 21.

Registration Requirements: The period of significance for truss bridges in Florida begins in 1902, the earliest construction date for an extant bridge of this type. The period of significance ends no later than a date 50 years before the present, unless it possesses exceptional historical, engineering, or architectural significance. Alterations made during a bridge's period of significance are considered part of the bridges' historic fabric; bridges that have been rehabilitated or reconstructed after the period of significance must have been altered in a manner that maintains the historic physical integrity in order to be considered eligible.

Integrity is essential for the bridge to qualify for the National Register under any criterion. For truss bridges eligible under Criterion A, they must retain their integrity of location, setting, and association. Specifically, the truss bridge must be in the same location as it was when it was built or moved, providing that the relocation occurred during the bridge's period of significance. Since truss bridges were designed to be moved, relocation in itself will not diminish the integrity of location. The specific location of a bridge is important as it relates to historic events associated with its construction as well as the specific engineering and construction methods used to build the bridge at its location. The relocation of a historic bridge from its original location outside of its period of significance will compromise the bridge's integrity of location. The setting of the historic truss bridge consists of the bridge's physical environment, including the bridge itself, the feature it carries, the feature it crosses, and the properties adjacent to the right-of-way. To retain integrity of setting, the general uses on and near the truss bridge must be similar to its historic uses. Bridges that are no longer in use, or that have been converted from one use to another, may not retain their integrity of setting. The historic character of the truss bridge, including the direct link between the bridge and an important historic event, must be retained to possess integrity of association.

Under Criterion C, truss bridges that are significant for their engineering must possess integrity of design, materials, workmanship and feeling. Design is the combination of physical elements, including the form, plan, structure, and style used in the construction of a bridge. Design relates to the engineering system used to create and build the bridge, including the deck, superstructure, and substructure, as well as the approach. Integrity of design requires that the truss bridge retain its significant defining structural elements, including the truss form, method of connection, top and bottom chords, vertical and diagonal members, and floor beams and stringers. For through truss bridges, the lateral top bracing, struts, and portal features must also survive. To possess historic physical integrity, the truss bridge must retain its materials dating from its period of significance. Materials used during rehabilitation and reconstruction may not negatively affect the integrity if they are representative materials of the bridge's period of significance or if they do not affect the bridge's exterior appearance. The replacement of original visually-apparent elements with materials other than like-kind materials generally will result in the bridge being considered ineligible. Workmanship is the physical evidence of the craft and skill of the truss bridge engineer, designer, or builder that dates from the bridge's period of significance. The integrity of workmanship is important, for steel truss bridges manufactured using patented designs. The historic engineered elements should display their original workmanship. Feeling is the bridge's visual expression of the aesthetic or historic sense of its period of significance. A truss bridge retains its integrity of feeling if its historic character is still conveyed through a combination of its historic physical features. In general, a truss bridge that retains its original design, materials, workmanship, and setting will convey its historicity. Bridges that have been altered in terms of design and materials may no longer convey a historic feeling or a sense of place.

Specific Registration Requirements under Criterion A:

1. Associated with a significant chapter or event in the development of Florida's highway and/or railroad transportation system.
2. Played an instrumental role in the initial development and growth of a community or communities by providing access for travel and commerce. Served to connect adjoining cities.
3. Is a distinguished example of a locally-sponsored and funded infrastructure improvement project
4. Constructed as an early project of the State Road Department
5. Constructed as part of a national movement, such as an early federal aid or work relief program
6. Significant as a contributing resource to a National Register listed or potentially-eligible historic district.

Specific Registration Requirements under Criterion C:

1. Early and/or rare surviving example of its type, period or method of construction. Truss bridges are sufficiently rare in Florida that any intact example is considered significant.
2. Exemplifies important engineering trends and achievements on the local, regional, statewide, or nationwide level
3. Represents an early application of new engineering techniques, such as the change from pinned to riveted connections, or of new advances in materials technology
4. Associated with a prominent bridge engineer, builder, designer or planner

Property Type F.2: Arch bridges

Description: An arch is a structure in which the supporting component forms a semicircle or curve, the purpose of which is to reduce or eliminate the tensile force in that component. Arches can be stone, brick, steel, or concrete. The arch bridge represents one of the oldest types of bridges because of its natural strength. This technology generally is not used for modern bridges. In arch bridges, an elliptical arch, in a state of pure axial compression, transfers the weight of the traffic and structure from the deck to the land on both sides by means of abutments. The abutments carry the load to the ground and keep the bridge from spreading out.[60]

[60] *Bridge Inspector's Reference Manual,* 7.5.1.

There are two subtypes of arches used in bridges: **arch decks** and **through arches**. An **arch deck** bridge consists of an arched support system with a deck placed over it. Unreinforced concrete is viable only in an arched form. An unreinforced concrete arch deck bridge is poured as one solid, monolithic piece around an arched formwork. The required compressive strength within the concrete can span up to 100 feet. Reinforced concrete arch deck bridges can span from 40 to 150 feet.[61] A **through arch** bridge is constructed with the crown of the arch above the deck and the arch foundations below the deck. Concrete through arch bridges often are called "rainbow arches."[62] These, as well as steel arch bridges, are rare in Florida.

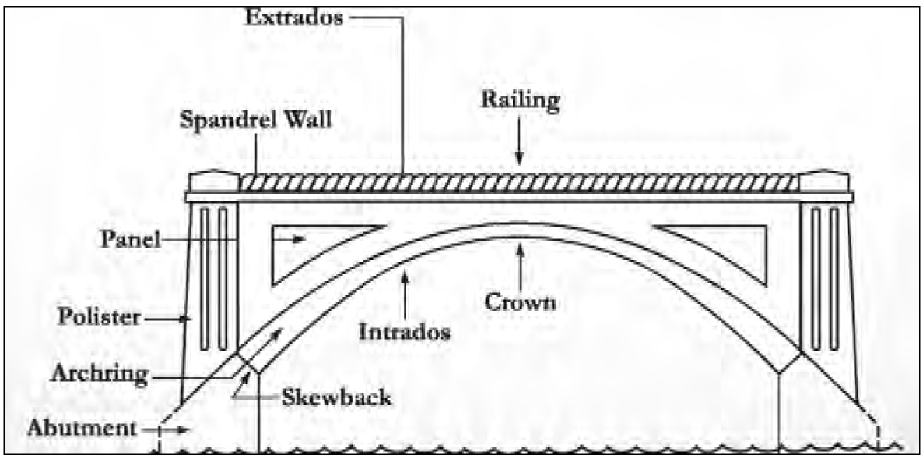

Figure 20. Arch Deck Bridge.

Significance: Arch deck bridges may be significant for their important associations with historical trends or events under Criterion A, particularly in the areas of Transportation, Community Planning and Development, and Politics/Government. For example, the Peace River Bridge at Arcadia in DeSoto County, which is linked to the development of Arcadia, is noteworthy in the areas of Transportation and Community Planning and Development. Similarly, the Old San Mateo Road Bridge in Putnam County reflects the efforts of Putnam County to build permanent roads and bridges prior to World War I and before the creation of a State Road Department. Both the 1940 Torreya Stone Arch in Liberty County, built as part of the federal New Deal Era programs, and the Baggett Creek Arch in Okaloosa County, constructed under the Federal Aid Road Act of 1916, are significant under Politics/Government. In the area of Community Planning and Development, the Grand Canal Arch Deck Bridge in Broward is significant for its historical associations with the finger islands of Las Olas Boulevard. Similarly, the Seybold Canal Bridge in Miami-Dade County is important for its historical associations with an early planned suburban development.

[61] M.S. Troitsky, *Planning and Design of Bridges* (New York: John Wiley & Sons, Inc., 1994), 137.
[62] *Bridge Inspector's Reference Manual*, 7.5.2.

Arch bridges also may be eligible for listing under **Criterion C** in the areas of Engineering and Architecture. Notable for their rarity of design are Florida's only steel through arch bridge, the Myrtle Avenue Overpass in Duval County, and the single concrete through arch Moss Rainbow Arch in Pinellas County. Under Criterion C, some arch bridges are associated with significant designers, engineers, and builders. For example, the 1945 9th Avenue West/Ware's Creek Bridge in Sarasota County is associated with noteworthy engineer Freeman Horton. Several arch bridges were designed by Daniel Luten, a prominent bridge designer of the early twentieth century and leader in building lower cost reinforced concrete structures. Luten-designed arch bridges, generally distinguished by their high aesthetic qualities, include the unique and experimental Half-Arch Bridge in Pinellas County, constructed in 1915; the Osprey Avenue Bridge in Sarasota County and the San Mateo Road Bridge in Putnam County, both built in 1916; the 1923 Deep Creek Bridge in Volusia County and the North Crystal Springs Road Bridge in Pasco County; the 1925 NRHP-listed Moore's Creek Bridge in St. Lucie County; and several 1920s-era bridges in Pinellas County, including the Philippi Parkway Bridge at Mullet Creek. Arch bridges also may be significant in the area Architecture for their high aesthetic values, as embodied in elements such as decorative railings. The Osprey Avenue Bridge in Sarasota County was designed with Neoclassical Revival style features; the graceful Sunny Isles Bridge No. 2 in Miami-Dade County features a shallow arch with limestone facing.

Additionally, an arch bridge may be significant as a contributing resource to a listed or potentially-eligible historic district. The Grand Canal Arch Deck Bridge in Broward County, for example, is a contributing resource to the Las Olas Historic District; the Washington Street Bridge in Orange County is located within the locally-designated Lake Lawsona historic district.

Registration Requirements: The heyday in arch bridge construction in Florida ended in the 1940s; roughly 36 percent of Florida's arch bridges were built in the 1920s. The most recent arch deck bridge identified in the statewide survey was built in 1956. The period of significance for arch bridges in Florida begins in 1908, the earliest construction date for an extant bridge of this type. The period of significance ends no later than a date 50 years before the present, unless it possesses exceptional historical, engineering, or architectural significance. Alterations made during the period of significance may be considered part of the bridges' historic fabric; bridges that have been rehabilitated or reconstructed after the period of significance must have been altered in a manner that maintains the historic physical integrity in order to be eligible for listing.

Integrity is essential for the bridge to qualify for the National Register under any criterion. For arch bridges eligible under Criterion A, they must retain their integrity of location, setting, and association. Specifically, the arch bridge must be in the same location as it was when it was built. The specific location of a bridge is important as it relates to historic events associated with its construction as well as the specific engineering and construction methods used to build the bridge at its location. The setting of the historic arch bridge consists of the bridge's physical environment, including the bridge itself, the feature it carries, the feature it crosses, and the properties adjacent to the right-of-way. To retain integrity of setting, the general uses on and near the arch bridge must be similar to its historic uses. Bridges that are no longer in use, or that have been converted from one use to another, may not retain their integrity of setting. The historic character of the arch bridge, including the direct link between the bridge and an important historic event, must be retained to possess integrity of association.

Under Criterion C, arch bridges that are significant for their engineering and/or architecture must possess integrity of design, materials, workmanship and feeling. Design is the combination of physical elements, including the form, plan, structure, and style used in the construction of a bridge. Design relates to the engineering system used to create and build the bridge, including the deck, superstructure, and substructure, as well as the approach. Integrity of design requires the retention of significant defining structural elements. For steel through arch bridges, these elements include the curved top girder or truss, suspenders, and well as ties, bottom, chord, and floor systems. For concrete through arch bridges, the arch, end posts, vertical ties, lower chord, and floor beams must survive. Concrete arch deck bridges must retain their arch, ring, spandrels, and ribs or barrel. To possess historic physical integrity, the arch bridge must retain its materials dating from its period of significance. Materials used during rehabilitation and reconstruction may not negatively affect the integrity if they are representative materials of the bridge's period of significance or if they do not affect the bridge's exterior appearance. The replacement of original visually-apparent elements with materials other than like-kind materials generally will result in the bridge being considered ineligible. Workmanship is the physical evidence of the craft and skill of the arch bridge engineer, designer, or builder that dates from the bridge's period of significance. The historic designed and engineered elements should display their original workmanship. Feeling is the bridge's visual expression of the aesthetic or historic sense of its period of significance. An arch bridge retains its integrity of feeling if its historic character, including aesthetic value, is still conveyed through a combination of its historic physical features. In general, a bridge that retains its original design, materials, workmanship, and setting will relate the feeling of a historic bridge. Arch bridges that have been altered in terms of design and materials, such as the removal of character-defining decorative railings, may no longer convey a historic feeling or a sense of place. To be considered eligible under Criterion C in the area of Architecture, an arch bridge must retain its historic decorative elements.

Specific Registration Requirements under Criterion A:

1. Associated with a significant chapter or event in the development of Florida's highway and/or railroad transportation system.
2. Played an instrumental role in the initial development and growth of a community or communities by providing access for travel and commerce. Served to connect adjoining cities.
3. Is a distinguished example of a locally-sponsored and funded infrastructure improvement project
4. Constructed as an early project of the State Road Department
5. Constructed as part of a national movement, such as an early federal aid or work relief program
6. Significant as a contributing resource to a National Register listed or potentially-eligible historic district.

Specific Registration Requirements under Criterion C:

1. Early and/or rare surviving example of its type, period or method of construction. Both steel and concrete through arch bridges are rare in Florida. Therefore, any intact example is considered significant. Also, rainbow arches and arch bridges exhibiting open spandrels are uncommon, and thus, are considered significant.
2. Exemplifies important engineering trends and achievements on the local, regional, statewide, or nationwide level
3. Represents an early application of a new technology
4. Associated with a prominent bridge engineer, builder, designer or planner. For example, during the early 20th century, Daniel Luten developed proprietary concrete arch bridge designs that are considered nationally significant. Accordingly, these designs are considered significant in Florida arch bridges.
5. Exhibits distinctive architectural embellishments or features (e.g., railings and balustrades) that depart from standard design and lend high aesthetic value.

Property Type F.3: Frame bridges

Description: A concrete **frame bridge** is a three-sided structure consisting of a top slab and two walls. A frame differs from a culvert in that there is no continuous floor. Florida's rare rigid frame bridges consist of a simple concrete slab superstructure cast in place as one unit with its substructure abutments. The rigid frame structure was so economical that it was often used for bridges of moderate span (40-120 feet) and railroad grade separations throughout the U.S. In older bridges of this type, the horizontal component is often thicker at the ends than in the middle, forming a shallow arch. In more modern examples, the rigid frame bridge often looks like an inverted "U."[63] Frame bridges are rare in Florida.

Significance: Historic frame bridges are exceptionally rare in Florida, and therefore, any frame bridge that has maintained physical integrity is considered eligible for the National Register under Criteria A and/or C. Only two frame bridges were identified in the 2010 update survey: the 1940 Atlanta and St. Andrews Bay Railway Bridge over US 90/SR 10 in Jackson County and the 1937 Washington Avenue Bridge over Collins Canal in Miami-Dade County. The latter has been substantially altered and no longer retains its historic integrity. Frame bridges may be significant for their important associations with historical events under Criterion A, particularly in the area of Transportation, including both highway and railroad history. They also may be significant as a contributing resource to a listed or potentially-eligible historic district. Frame bridges also may be eligible under Criterion C in the area of Engineering as a rare surviving example of its type; because it exhibits distinct engineering elements or represents an early application of new technology; and/or is associated with a prominent builder, designer, engineer or planner.

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[63] Parsons Brinkerhoff and Engineering and Industrial Heritage, *A Context for Common Historic Bridge Types, NCHRP Project 25-25, Task 15* (Washington, D.C.: National Cooperative Highway Research Program, Transportation Research Board, 2005).

Registration Requirements: The period of significance for frame bridges in Florida begins in the mid-1930s, the earliest construction date for an extant bridge of this type. The period of significance ends no later than a date 50 years before the present, unless it possesses exceptional historical, engineering, or architectural significance. Alterations made during the period of significance may be considered part of the bridges' historic fabric; bridges that have been rehabilitated or reconstructed after the period of significance must have been altered in a manner that maintains the historic physical integrity in order to be eligible for listing.

Integrity is essential for the frame bridge to qualify for the National Register under any criterion. For frame bridges eligible under Criterion A, they must retain their integrity of location, setting, and association. Specifically, the frame bridge must be in the same location as it was when it was built or moved, providing that the relocation occurred during the bridge's period of significance. The specific location of a bridge is important as it relates to historic events associated with its construction as well as the specific engineering and construction methods used to build the bridge at its location. The relocation of a historic bridge from its original location outside of its period of significance will compromise the bridge's integrity of location. The setting of the historic frame bridge consists of the bridge's physical environment, including the bridge itself, the feature it carries, the feature it crosses, and the properties adjacent to the right-of-way. To retain integrity of setting, the general uses on and near the frame bridge must be similar to its historic uses. Bridges that are no longer in use, or that have been converted from one use to another, may not retain their integrity of setting. The historic character of the frame bridge, including the direct link between the bridge and an important historic event, must be retained to possess integrity of association.

Under Criterion C, frame bridges that are significant for their engineering must possess integrity of design, materials, workmanship and feeling. Design is the combination of physical elements, including the form, plan, structure, and style used in the construction of a bridge. Design relates to the engineering system used to create and build the bridge, including the deck, superstructure, and substructure, as well as the approach. Integrity of design requires the retention of significant defining structural elements. For frame bridges, these elements include the integral superstructure and substructure, the mass ratios between the superstructure and the substructure, and the materials finish. To possess historic physical integrity, the frame bridge must retain its materials dating from its period of significance. Materials used during rehabilitation and reconstruction may not negatively affect the integrity if they are representative materials of the bridge's period of significance or if they do not affect the bridge's exterior appearance. The replacement of original visually-apparent elements with materials other than like-kind materials generally will result in the bridge being considered ineligible. Workmanship is the physical evidence of the craft and skill of the frame bridge engineer, designer, or builder that dates from the bridge's period of significance. The historic designed and engineered elements should display their original workmanship. Feeling is the bridge's visual expression of the aesthetic or historic sense of its period of significance. A frame bridge retains its integrity of feeling if its historic character is still conveyed through a combination of its historic physical features. In general, a frame bridge that retains its original design, materials, workmanship, and setting will convey its historicity. Frame bridges that have been altered in terms of design and materials may no longer convey a historic feeling or a sense of place.

Specific Registration Requirements under Criterion A:

1. Associated with a significant chapter or event in the development of Florida's highway and/or railroad transportation system.
2. Played an instrumental role in the initial development and growth of a community or communities by providing access for travel and commerce. Served to connect adjoining cities.
3. Is a distinguished example of a locally-sponsored and funded infrastructure improvement project
4. Constructed as an early project of the State Road Department
5. Constructed as part of a national movement, such as an early federal aid or work relief program
6. Significant as a contributing resource to a National Register listed or potentially-eligible historic district

Specific Registration Requirements under Criterion C:

1. Early and/or rare surviving example of its type, period or method of construction. Frame bridges are sufficiently rare in Florida. Therefore, any intact example is considered significant.
2. Exhibits important engineering achievements on the local, regional, statewide, or nationwide level
3. Represents an early application of new technology
4. Associated with a prominent bridge engineer, builder, designer or planner

Property Type F.4: Slab bridges

Description: A **slab bridge** consists of a flat slab that is both the riding surface for the vehicles using the bridge and the main structural component supporting this loading. Slab bridges are simple structures that carry relatively short spans. They consist of a timber or concrete slab that spans a distance between two supports. The slab functions as both the deck and the structural element that carries all stresses and loads to its pier supports and/or abutments. Timber slab bridges can carry loads across short spans. They consist of timber planks that lay directly on abutments or pier caps.

A concrete slab can be unreinforced, reinforced, or prestressed. Monolithic concrete slabs can only span short distances; the longer the span, the deeper the slab required and therefore reinforcement must be added. For reinforced slabs, the recommended and most economical length is 20-25 feet but can span up to 35 feet.[64] Early reinforced concrete examples could be cast in place, with the slab serving as the superstructure and the deck. Slab bridges are reinforced by steel in the lower portion of the slab, where

[64] Ibid., 129.

bending is the greatest, and at the ends, where shear is maximum. Historic concrete slab bridges are very common in Florida.

Significance: While concrete slab bridges are very common, those built of timber are relatively rare in Florida. Thus, any timber slab bridge that has maintained physical integrity, such as the 1931 Hill Road Bridge over Little Mills Creek in Nassau County, is considered eligible for the National Register under Criteria A and C.

In general, slab bridges may be eligible for the National Register under Criterion A for their associations with significant historical events in the areas of Transportation and Community Planning and Development. For example, a number of concrete slab bridges over Hogan Creek in Duval County are distinguished under Criterion A in the area of Community Planning and Development for their association with the Confederate Park neighborhood. They also may be significant as a contributing resource to a listed or potentially-eligible historic district.

Early examples of slab bridges built to standard plans may be eligible under Criterion C because as their number diminishes, surviving examples may become rare. One such example is the 1922 concrete slab bridge which carries Old US 17 over the Crescent Lake Outflow in Putnam County. The CR 721A Bridge in Glades County is significant as an early example of a prestressed concrete slab bridge. Slab bridges may also be considered significant under Criterion C in the area of Architecture because it exhibits distinct architectural elements or embellishments. In both areas of engineering and architecture, a concrete slab bridge may be distinguished by its association with a prominent builder, designer, engineer or planner. For example, the Hogan Creek bridges in Duval County are distinguished for the aesthetic quality of their design and association with noteworthy engineer Henry Klutho.

Registration Requirements: The period of significance for slab bridges in Florida made of timber or concrete begins in 1922, the earliest construction date for an extant bridge of this type. The period of significance ends no later than a date 50 years before the present, unless it possesses exceptional historical, engineering, or architectural significance. Alterations made during the period of significance may be considered part of the bridges' historic fabric; bridges that have been rehabilitated or reconstructed after the period of significance must have been altered in a manner that maintains the historic physical integrity in order to be eligible for listing.

Integrity is essential for the bridge to qualify for the National Register under any criterion. For timber and concrete slab bridges eligible under Criterion A, they must retain their integrity of location, setting, and association. Specifically, the slab bridge must be in the same location as it was when it was built or moved, providing that the relocation occurred during the bridge's period of significance. The specific location of a bridge is important as it relates to historic events associated with its construction as well as the specific engineering and construction methods used to build the bridge at its location. The relocation of a historic bridge from its original location outside of its period of significance will compromise the bridge's integrity of location. The setting of the historic slab bridge consists of the bridge's physical environment, including the bridge itself, the feature it carries, the feature it crosses, and the properties adjacent to the right-of-way. To retain integrity of setting, the general uses on and near the slab bridge must be similar to its historic uses. Bridges that are no longer in use, or that have been converted from one use to another, may not retain their integrity of setting. The historic character of the slab bridge, including the direct link between the bridge and an important historic event, must be retained to possess integrity of association.

Under Criterion C, slab bridges that are significant for their engineering and/or architecture must possess integrity of design, materials, workmanship and feeling. Design is the combination of physical elements, including the form, plan, structure, and style used in the construction of a bridge. Design relates to the engineering system used to create and build the bridge, including the deck, superstructure, and substructure, as well as the approach. Integrity of design requires the retention of significant defining structural elements. For timber slab bridges, these elements include timber member size and material, deck depth, and construction techniques. For concrete slab bridges, defining elements include the materials finish, deck depth, superstructure and substructure member sizes, and construction techniques. To possess historic physical integrity, the slab bridge must retain its materials dating from its period of significance. Materials used during rehabilitation and reconstruction may not negatively affect the integrity if they are representative materials of the bridge's period of significance or if they do not affect the bridge's exterior appearance. The replacement of original visually-apparent elements with materials other than like-kind materials generally will result in the bridge being considered ineligible. Workmanship is the physical evidence of the craft and skill of the slab bridge engineer, designer, or builder that dates from the bridge's period of significance. The historic designed and engineered elements must display their original workmanship. Feeling is the bridge's visual expression of the aesthetic or historic sense of its period of significance. A slab bridge retains its integrity of feeling if its historic character, including aesthetic value, is still conveyed through a combination of its historic physical features. In general, a bridge that retains its original design, materials, workmanship, and setting will convey its historicity. Slab bridges that have been altered in terms of design and materials, such as the removal of character-defining decorative railings, may no longer convey a historic feeling or a sense of place. To be considered eligible under Criterion C in the area of Architecture, a slab bridge must retain its historic decorative elements.

Specific Registration Requirements under Criterion A:

1. Associated with a significant chapter or event in the development of Florida's highway and/or railroad transportation system.
2. Played an instrumental role in the initial development and growth of a community or communities by providing access for travel and commerce. Served to connect adjoining cities.
3. Is a distinguished example of a locally-sponsored and funded infrastructure improvement project
4. Constructed as an early project of the State Road Department
5. Constructed as part of a national movement, such as an early federal aid or work relief program

6. Significant as a contributing resource to a National Register listed or potentially-eligible historic district

Specific Registration Requirements under Criterion C:

1. Very early or particularly important and well preserved example of its type, period or method of construction. Timber slab bridges are rare in Florida. Therefore, any intact example is considered significant.
2. Includes spans of exceptional length or complexity
3. Exhibits important engineering achievements on the local, regional, statewide, or nationwide level
4. Represents an early application of a new technology, such as a change in bridge materials technology
5. Displays elements that were engineered to respond to a unique environmental context, or exhibits innovative solutions to particular construction challenges
6. Associated with a prominent bridge engineer, builder, designer or planner. For example, the concrete slab bridges associated with Henry Klutho are notable for their high aesthetic quality.
7. Exhibits distinctive architectural embellishments or features (e.g., railings and balustrades) that depart from standard design and lend high aesthetic value

Property Type F.5: Beam bridges

Description: Beam bridges consist of a series of beams topped with a deck. A beam is a linear structural member designed to span from one support to another and support vertical loads.[65] The beams can be wood, steel, or concrete. In its simplest form, a beam bridge can be a plank or log across a stream. It consists of a horizontal beam supported at each end by piers. The beam must be strong enough to support both its own weight and the traffic that crosses it. When a load pushes down on the beam, the top edge is compressed together, while the bottom edge is stretched.

Although technologically simple, modern developments in steel and concrete technology have often made beam bridges some of the most durable bridges constructed. Beams made of steel or prestressed concrete are usually topped with a cast-in-place concrete deck. Steel beams can be made composite (monolithic) with the deck by welding steel studs to the top flange of the beam that penetrate into the cast-in-place deck. Prestressed concrete beams have reinforcing steel that sticks out of the top of the beam and into the cast-in-place deck to make the two composite. On some older bridges, a rectangular beam and the deck are cast-in-place together.

[65] *Bridge Inspector's Reference Manual*, G-3.

Beams, like girders, represent a simple, straightforward method of creating a bridge. However, many variations in their use result in several subtypes. Historic tee-beam, channel beam, and box beam bridges are found in Florida.

Tee-beam bridges were commonly constructed in the 1930s and 1940s as integral cast-in-place reinforced concrete decks and beam stems. Reinforced steel runs longitudinally at the bottom of the beam stem and perpendicular to the stem in the deck. Typical spans range from 30 to 50 feet, although they can span up to 80 feet.[66] Relatively few prestressed concrete tee-beam bridges were constructed in Florida.

Channel beam bridges are much more likely to have been constructed with prestressed concrete. Channel beams are similar in appearance to tee-beams, with integral decks and stems. However, the concrete beams are cast in place around u-shaped forms, to create a channel between two stems. This bridge type is very common in some Florida counties. For example, roughly one-third of the bridges in Hillsborough County are channel beams. The earliest date to the 1960s. "The beams were sized by certain engineering tables and were shipped directly to the site for installation."[67]

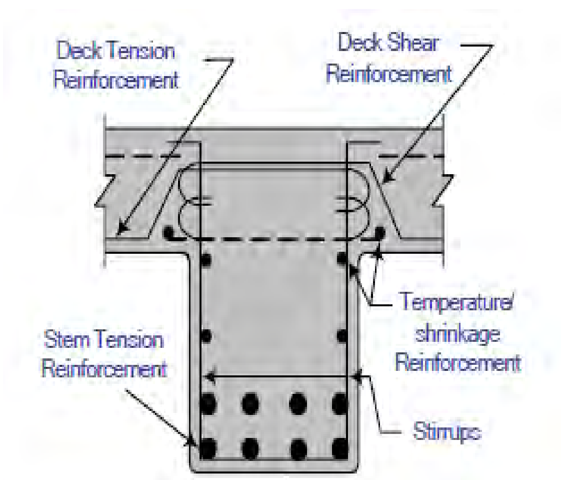

Figure 21. Tee-Beam Cross Section.
(Bridge Inspector's Reference Manual, 7.2.4)

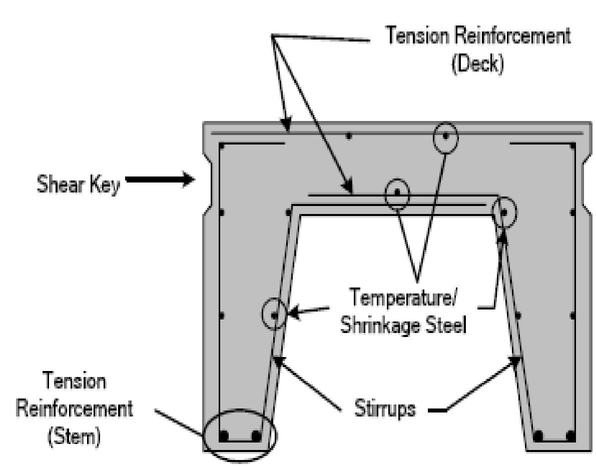

Figure 22. Channel Beam Cross Section.
(Bridge Inspector's Reference Manual, 7.4.3)

A **box beam bridge** derives its name from its shape. A box beam is a hollow unit, bounded by top and bottom flanges and two webs along the sides. The voided center of the beam reduces the dead load of the bridge. The single void is generally square or rectangular, although examples from the 1950s may contain a round void. Concrete box beam technology dates from the late 1930s. By the 1950s, with the

[66] Troitsky, *Planning and Design of Bridges*, 131.
[67] "Space Age Technology Applied to Hillsborough County Bridges," *SPANS* (Volume I, Issue 2, April 2003), 1.

introduction of prestressed concrete technology, reinforced concrete box beam bridge construction waned in favor of the stronger prestressed concrete box beam bridge. This bridge type is used in longer ranges of 60 to 100 feet for reinforced concrete and up to 300 feet for prestressed concrete. Box beams are advantageous in their resistance to torsional loading, which allows for horizontal and vertical curves and their adaptability as continuous structures.[68] The prestressed reinforcement of high strength steel strands is typically found in the bottom flange and the side webs. Box beams are commonly precast, which reduces bridge construction time.

Along with girder bridges, beams are the backbone of the highway system bridges because of the uniform designs that can be easily standardized to fit numerous locations, spans, and geographical conditions. The uniformity and standardization of the bridge designs are considered critical for maintaining bridges in large transportation networks. Standardization minimizes the need for multiple codes and specifications for engineers to follow in the design of new and the rehabilitation of existing bridges. Uniformity also means that consistent, and therefore economical, methods are used in repairing deteriorated bridges.[69]

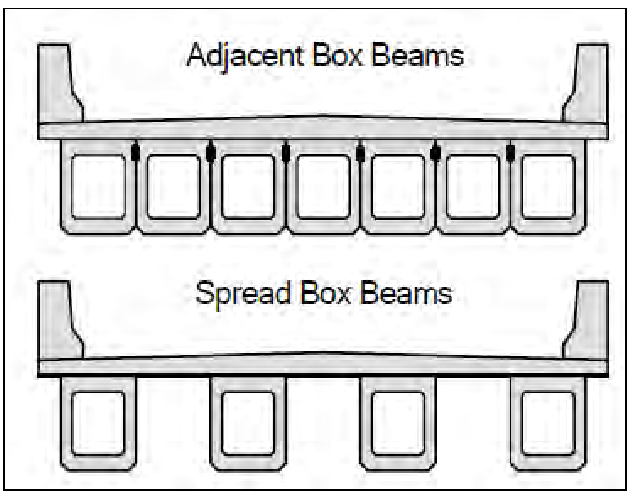

Figure 23. Box Beam Bridge Cross Sections.
(Bridge Inspector's Reference Manual, 7.10.2.)

Significance: Since beam bridges are very common, significance may reflect a unique design, as seen more often in early concrete tee-beam bridges, or those that have historic associations with significant events. Early examples of beam bridges built to standard plan also may be significant. In general, beam bridges may be eligible for the National Register under Criterion A for their associations with significant historical events in the areas of Transportation and Community Planning and Development. For example, the Ten Mile Creek Bridge in Levy County, a reinforced concrete tee-beam built in 1933, is significant in the area of Transportation because of its early associations with the Florida State Road

[68] Troitsky, 131.
[69] Demetrios E. Tonias and Jim J. Zhao, *Bridge Engineering: Design, Rehabilitation, and Maintenance of Modern Highway Bridges* (New York: McGraw Hill, 1995), 13.

Department and the U.S. Bureau of Public Roads. Under Criterion A in the area of Community Planning and Development, the 1930 Indian Creek Bridge in Miami-Dade County provided access to Indian Creek, an island community in Biscayne Bay. The Venetian Causeway tee-beam bridges that cross Biscayne Bay between Miami and Miami Beach in Miami-Dade County provided a physical connection between growing communities, and the bridges enhanced development on both sides. The Poinsettia Avenue Bridge in Orange County is significant in the areas of both Transportation and Community Planning and Development for its historical associations with the development of the residential College Park neighborhood and for its association with the WPA. Beam bridges also may be significant as a contributing resource to a listed or potentially-eligible historic district.

Early examples of beam bridges built to standard plans may be eligible under Criterion C as their numbers diminish and few survive. The Lake Conway Bridge in Orange County, completed in 1926, is a high integrity example of an early continuous concrete tee-beam bridge. The SR-115A Flyover in Duval County, built in 1961, is significant as Florida's earliest box beam, a type that did not become common until the 1980s. Also, the use of reinforced concrete for this bridge appears to be unique. A beam bridge may also be considered significant under Criterion C in the area of Architecture because it exhibits distinct architectural elements or embellishments. In both areas of Engineering and Architecture, a concrete beam bridge may be distinguished by its association with a prominent builder, designer, engineer or planner. For example, the Myrtle Avenue Bridge in Duval County is among the few remaining examples of its type which embody the work of district bridge engineer T.B. Carrick. This bridge features concrete railings with Carrick's signature stylized Maltese Cross pattern in each panel. The Whitaker Bayou Bridge in Sarasota County, a 1926 concrete tee-beam, is distinguished by its association with the bridge designer and builder Daniel Luten, and for the Neoclassical Revival style urn-shaped balusters. The three Duck Key channel beam bridges in Monroe County are notable for their various aesthetic treatments as well as their historical association with the real estate development of Duck Key. The designs of the decorative elements, as well as the balusters and piers, are unique to each bridge. The small, standard reinforced continuous concrete beam type Burlington Avenue Bridge in Pinellas County is important for its unique Art Moderne architectural style.

Registration Requirements: The period of significance for beam bridges in Florida begins in 1915, the earliest construction date for an extant tee-beam bridge. The earliest channel beam and box beam date to 1955 and 1961, respectively. The period of significance ends no later than a date 50 years before the present, unless it possesses exceptional historical, engineering, or architectural significance. Alterations made during a bridge's period of significance are considered part of the bridges' historic fabric; bridges that have been rehabilitated or reconstructed after the period of significance must have been altered in a manner that maintains the historic physical integrity in order to be considered eligible.

Integrity is essential for the bridge to qualify for the National Register under any criterion. For beam bridges eligible under Criterion A, they must retain their integrity of location, setting, and association. Specifically, the beam bridge must be in the same location as it was when it was built or moved, providing that the relocation occurred during the bridge's period of significance. The specific location of a bridge is important as it relates to historic events associated with its construction as well as the specific engineering and construction methods used to build the bridge at its location. The relocation of a historic bridge from its original location outside of its period of significance will compromise the bridge's integrity of location. The setting of the historic beam bridge consists of the bridge's physical environment, including the bridge itself, the feature it carries, the feature it crosses, and the properties adjacent to the right-of-way. To retain integrity of setting, the general uses on and near the beam bridge must be similar to its historic uses. Bridges that are no longer in use, or that have been converted from one use to another, may not retain their integrity of setting. The historic character of the beam bridge, including the direct link between the bridge and an important historic event, must be retained to possess integrity of association.

Under Criterion C, beam bridges that are significant for their engineering and/or architecture must possess integrity of design, materials, workmanship and feeling. Design is the combination of physical elements, including the form, plan, structure, and style used in the construction of a bridge. Design relates to the engineering system used to create and build the bridge, including the deck, superstructure, and substructure, as well as the approach. Integrity of design requires the retention of significant defining structural elements. For concrete tee- and channel beams, these elements include the slab integrated with longitudinal beams. For box beams, the defining elements are the box beam form and curvature, as well as the structural height and pier placement. To possess historic physical integrity, the beam bridge must retain its materials dating from its period of significance. Materials used during rehabilitation and reconstruction may not negatively affect the integrity if they are representative materials of the bridge's period of significance or if they do not affect the bridge's exterior appearance. The replacement of original visually-apparent elements with materials other than like-kind materials generally will result in the bridge being considered ineligible. Workmanship is the physical evidence of the craft and skill of the beam bridge engineer, designer, or builder that dates from the bridge's period of significance. The historic designed and engineered elements must display their original workmanship. Feeling is the bridge's visual expression of the aesthetic or historic sense of its period of significance. A beam bridge retains its integrity of feeling if its historic character, including aesthetic value, is still conveyed through a combination of its historic physical features. In general, a bridge that retains its original design, materials, workmanship, and setting will convey its historicity. Beam bridges that have been altered in terms of design and materials, such as the removal of character-defining decorative railings, may no longer convey a historic feeling or a sense of place. To be considered eligible under Criterion C in the area of Architecture, a beam bridge must retain its historic decorative elements.

Specific Registration Requirements under Criterion A:

1. Associated with a significant chapter or event in the development of Florida's highway and/or railroad transportation system.
2. Played an instrumental role in the initial development and growth of a community or communities by providing access for travel and commerce. Served to connect adjoining cities.
3. Is a distinguished example of a locally-sponsored and funded infrastructure improvement project

4. Constructed as an early project of the State Road Department
5. Constructed as part of a national movement, such as an early federal aid or work relief program
6. Significant as a contributing resource to a National Register listed or potentially-eligible historic district

Specific Registration Requirements under Criterion C:

1. Very early or particularly important and well preserved example of its type, period or method of construction
2. Includes spans of exceptional length or complexity
3. Exhibits important engineering achievements on the local, regional, statewide, or nationwide level
4. Represents an early application of a new technology, such as a change in bridge materials technology
6. Displays elements that were engineered to respond to a unique environmental context, or exhibits innovative solutions to particular construction challenges
6. Associated with a prominent bridge engineer, builder, designer or planner
7. Exhibits distinctive architectural embellishments or features (e.g., railings and balustrades) that depart from standard design and lend high aesthetic value

Property Type F.6: Girder bridges

Description: A **girder** is essentially a large beam that serves as the primary support for a bridge. A girder bridge usually has a floor system in between the deck and superstructure, unlike a beam bridge, which generally features a composite or integral deck and superstructure.[70] Girders are constructed from timber, concrete and steel. Girder bridges generally feature a monolithic concrete deck that is cast in place on top of two or more rolled or built-up steel or concrete girders that run the length of the bridge. A floor system of floorbeams and stringers transfers the weight of the deck to the girder superstructure. Occasionally, the deck is cast in between the girders. In these **through girder bridges**, the girders also serve as a parapet or railing along the top of the bridge.

[70] *Bridge Inspector's Reference Manual*, G-21.

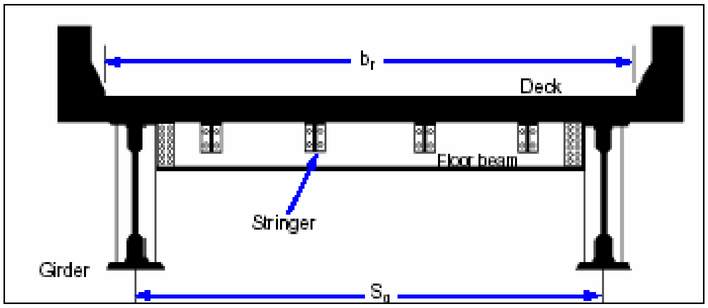

Figure 24. Deck Girder Cross Section.
(Department of the Army Field Manual No. 3-34.343. Military Nonstandard Fixed Bridging, February 2002, Washington D.C.)

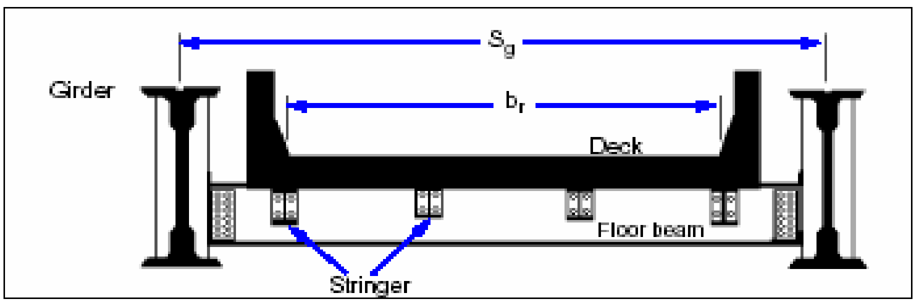

Figure 25. Through Girder Cross Section.
(Department of the Army Field Manual No. 3-34.343. Military Nonstandard Fixed Bridging, February 2002, Washington, D.C.)

In the case of timber bridges, the beams (called stringers) are usually topped with a wood deck. Timber girder bridges, while not often seen on public roads, are inexpensive to construct and are commonly used in remote areas without much traffic such as military lands, state forests, and national parks. Due to the rapidity at which the material decomposes, these bridges are subject to frequent alterations when members must be replaced.

The two most active decades for girder bridge construction in Florida were the 1930s and 1960s, which account for 29 percent and 42 percent, respectively, of the bridges selected for study. Roughly two-thirds of the 1930s girder bridges were built of steel. In the 1960s, bridge materials are divided almost equally between steel and prestressed concrete. The earliest prestressed concrete girder bridges date to the 1950s.

Like beam bridges, girders are a common bridge type that are characterized by their uniformity and standardization of design. Although technologically simple, modern developments in steel and concrete technology have often made them some of the most durable bridges constructed.

Significance: Since girder bridges are very common, significance may reflect a unique design, or those that have historic associations with significant persons or events. In general, girder bridges may be eligible for the National Register under Criterion A for their associations with significant historical events in the areas of Transportation, Community Planning and Development, and Politics/Government. For example, the CR-316 Bridge over the proposed Cross Florida Barge Canal in Marion County, one of four bridges (out of 11 planned) constructed for the canal project, is significant as a living relic to the planned endeavors of Congress to connect the Gulf and Atlantic Intracoastal waterways through the Cross Florida Barge Canal. The continuous steel girder bridge that carries US 1/SR 5 over the Miami River in downtown Jacksonville is significant for its historical associations with the urban development of Jacksonville. Also significant in the area of Transportation is the Haines City Overpass in Polk County, the oldest example of a grade separation remaining in Florida that retains its historic physical integrity. Girder bridges built in the late 1930s as grade separation structures (overpasses) between a highway and railroad may be significant in the area of Politics/Government for their association with national programs to eliminate dangerous at-grade railroad crossings. Such programs included the Works Progress Grade Crossing Program (1935-1936) and the Federal Aid Grade Crossing Program (1937-1941). Girder bridges also may be significant as a contributing resource to a listed or potentially-eligible historic district.

As their numbers diminish, early examples of girder bridges built to standard plans may be eligible under Criterion C in the area of Engineering. The few surviving steel through girder bridges, such as the SW 117th Avenue Bridge in Miami-Dade County, are considered eligible because of their rarity of type. Also, girder bridges representing early innovations in technology are considered important. For example, the SR 78 Bridge over the Kissimmee River in Okeechobee County is an excellent example of a continuous steel girder bridge that also includes a removable deck and early-form strutted piers. The Sebastian Inlet Bridge in Indian River County represents an early post-tensioned bridge design in Florida and a high-integrity embodiment of a prestressed concrete bridge. In the area of Engineering, a girder bridge may be distinguished by its association with a prominent builder, designer, engineer or planner. The Seventh Avenue Bridge over Wares Creek in Sarasota County, a steel girder built in 1949, was designed by Freeman H. Horton, an internationally known, influential bridge designer.

Registration Requirements: The period of significance for girder bridges in Florida begins in 1915, the earliest construction date for an extant bridge of this type. The earliest extant steel through girder was completed in 1937. The period of significance ends no later than a date 50 years before the present, unless it possesses exceptional historical, engineering, or architectural significance. Alterations made during a bridge's period of significance are considered part of the bridges' historic fabric; bridges that have been rehabilitated or reconstructed after the period of significance must have been altered in a manner that maintains the historic physical integrity in order to be considered eligible.

Integrity is essential for the bridge to qualify for the National Register under any criterion. For girder bridges eligible under Criterion A, they must retain their integrity of location, setting, and association. Specifically, the girder bridge must be in the same location as it was when it was built or moved, providing that the relocation occurred during the bridge's period of significance. The specific location of a bridge is important as it relates to historic events associated with its construction as well as the specific engineering and construction methods used to build the bridge at its location. The relocation of a historic bridge from its original location outside of its period of significance will compromise the bridge's integrity of location. The setting of the historic girder bridge consists of the bridge's physical environment, including the bridge itself, the feature it carries, the feature it crosses, and the properties adjacent to the right-of-way. To retain integrity of setting, the general uses on and near the girder bridge must be similar to its historic uses. Bridges that are no longer in use, or that have been converted from one use to another, may not retain their integrity of setting. The historic character of the girder bridge, including the direct link between the bridge and an important historic event, must be retained to possess integrity of association.

Under Criterion C, girder bridges that are significant for their engineering and/or architecture must possess integrity of design, materials, workmanship and feeling. Design is the combination of physical elements, including the form, plan, structure, and style used in the construction of a bridge. Design relates to the engineering system used to create and build the bridge, including the deck, superstructure, and substructure, as well as the approach. Integrity of design requires the retention of significant defining structural elements. For all subtypes of girder bridges, these defining elements may include railings, decorative materials, architectural embellishments, and plaques. Original abutments, wingwalls, piers, and bents may be considered defining elements if they contribute to the integrity of the structure. For timber girder bridges, these elements include the original or in-kind members, specially the longitudinal beams. For concrete and steel girders, the defining elements are the monolithic deck and girder system. Material treatment and the ratio between the substructure and superstructure are significant for steel through girders. To possess historic physical integrity, the girder bridge must retain its materials dating from its period of significance. Materials used during rehabilitation and reconstruction may not negatively affect the integrity if they are representative materials of the bridge's period of significance or if they do not affect the bridge's exterior appearance. The replacement of original visually-apparent elements with materials other than like-kind materials generally will result in the bridge being considered ineligible. Workmanship is the physical evidence of the craft and skill of the girder bridge engineer, designer, or builder that dates from the bridge's period of significance. The historic designed and engineered elements must display their original workmanship. Feeling is the bridge's visual expression of the aesthetic or historic sense of its period of significance. A girder bridge retains its integrity of feeling if its historic character, including aesthetic value, is still conveyed through a combination of its historic physical features. In general, a bridge that retains its original design, materials, workmanship, and setting will convey its historicity. Girder bridges that have been altered in terms of design and materials, such as the removal of character-defining decorative railings, may no longer convey a historic feeling or a sense of place. To be considered eligible under Criterion C in the area of Architecture, a girder bridge must retain its historic decorative elements.

Specific Registration Requirements under Criterion A:

1. Associated with a significant chapter or event in the development of Florida's highway and/or railroad transportation system

2. Played an instrumental role in the initial development and growth of a community or communities by providing access for travel and commerce. Served to connect adjoining cities.
3. Is a distinguished example of a locally-sponsored and funded infrastructure improvement project
4. Constructed as an early project of the State Road Department
5. Constructed as part of a national movement, such as an early federal aid or work relief program, or an early program to eliminate dangerous at-grade railroad crossings on primary highways and their replacement with grade separation structures
6. Significant as a contributing resource to a National Register listed or potentially-eligible historic district

Specific Registration Requirements under Criterion C:

1. Very early or particularly important and well preserved example of its type, period or method of construction.
2. Includes spans of exceptional length or complexity
3. Exhibits important engineering achievements on the local, regional, statewide, or nationwide level
4. Represents an early application of a new technology, such as a change in bridge materials technology
7. Displays elements that were engineered to respond to a unique environmental context, or exhibits innovative solutions to particular construction challenges
6. Associated with a prominent bridge engineer, builder, designer or planner
7. Exhibits distinctive architectural embellishments or features (e.g., railings and balustrades) that depart from standard design and lend high aesthetic value

Property Type F.7: Cable bridges

Description: Cable-supported bridges can be either suspension bridges or cable-stayed bridges. The cable system carries much of the load of the superstructure, reducing the need for support under the bridge (i.e., substructure piers and bents) and thereby allowing longer spans.

A **suspension bridge** is composed of cables draped between towers with vertical suspenders connecting the cables to the deck. The cables continue over the main span and approach spans and are anchored at each end of the bridge. The deck can be stiffened to resist wind loads with the addition of a steel truss. The cables, suspenders, and structural components of the deck are made of steel. Newer suspension bridges usually have cables made of wire that is spun in place on site. Older bridges may have suspension cables made of metal chain or eyebars. The above water portion of the towers is usually steel or concrete and the underwater portion of the tower is usually reinforced concrete. Suspension bridges are well-suited for spanning great distances, and some of the most monumental and historically significant bridges in the United States are of this type. However, several suspension bridges of very modest span length were built across the country due to the type's basic simplicity, ease of erection, and adaptability to unstable ground.[71] The 1947 Hal Adams Bridge in Lafayette County is Florida's only suspension bridge located on a state road.

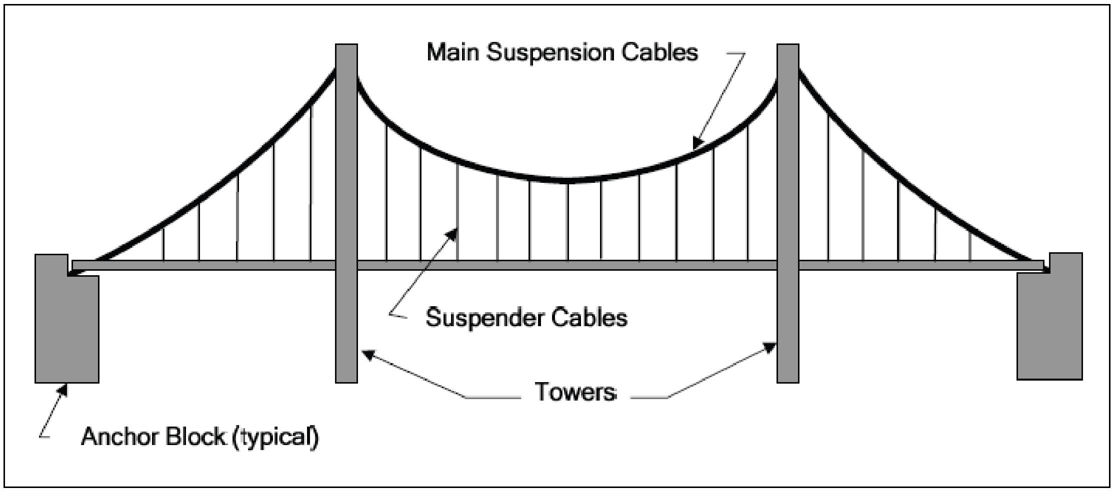

Figure 26. Suspension Bridge Schematic.
(Bridge Inspector's Reference Manual, 12.1.9)

A **cable-stayed bridge** has one or more towers with cables that connect the tower to the deck. The cables can be arranged in a harp pattern in which the cables are parallel and attach to various points on the tower or a fan pattern in which the cables converge near the top of the tower. The cable stayed bridge differs from a suspension bridge in that there is no draped suspension cable and no anchorages at the ends of the bridge. The deck and cables on one side of the tower balance the deck and cables on the other side, thereby eliminating the need for the anchorages at the ends of the bridge. Both of Florida's cable-stayed bridges, the Bob Graham Sunshine Skyway Bridge in Pinellas and Manatee Counties and the Dames Point Bridge in Duval County, feature the harp array.

[71] Parsons Brinckerhoff and Engineering and Industrial Heritage, 2005.

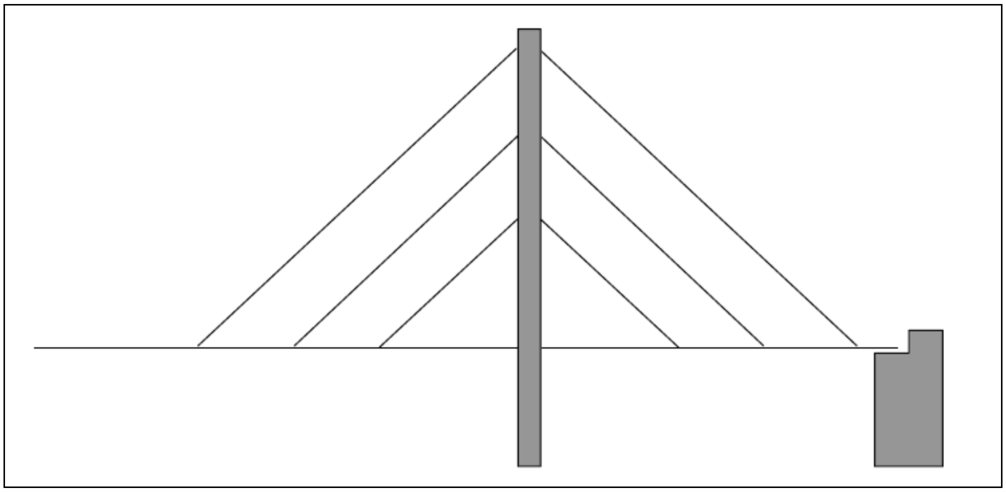

Figure 27. Harp Array Cable System Schematic.
(Bridge Inspector's Reference Manual, 12.1.5)

Significance: Cable-supported bridges are very rare in Florida, and therefore, any bridge of this type that has maintained physical integrity is considered eligible for the National Register under Criteria A and C. Only three cable-stayed bridges were identified in the 2010 update survey. Cable-stayed bridges may be significant for their important associations with historical events under Criterion A, particularly in the area of Transportation, or under Criterion C in the area of Engineering as a rare example of its type; because it exhibits distinct engineering elements or represents an early application of new technology; and/or is associated with a prominent builder, designer, engineer or planner.

Registration Requirements: The period of significance for cable-supported bridges in Florida begins in 1947, the earliest construction date for an extant bridge of this type. The period of significance ends no later than a date 50 years before the present, unless it possesses exceptional historical, engineering, or architectural significance under Criteria Consideration G. Both the 1987 Bob Graham Sunshine Skyway Bridge and the 1989 Napoleon Bonaparte Broward Bridge on Dames Point (SR 9A) meet Criteria Consideration G.

Alterations made during a bridge's period of significance are considered part of the bridges' historic fabric; bridges that have been rehabilitated or reconstructed after the period of significance must have been altered in a manner that maintains the historic physical integrity in order to be considered eligible.

Integrity is essential for the bridge to qualify for the National Register under any criterion. For those eligible under Criterion A, they must retain their integrity of location, setting, and association. Specifically, the cable-stayed bridge must be in the same location as it was when it was built or moved, providing that the relocation occurred during its period of significance. The specific location of a cable-stayed bridge is important as it relates to historic events associated with its construction as well as the specific engineering and construction methods used to build the bridge at its location. The relocation of a historic bridge from its original location outside of its period of significance will compromise the bridge's integrity of location. The setting of the historic cable-stayed bridge consists of the bridge's physical environment, including the bridge itself, the feature it carries, the feature it crosses, and the properties adjacent to the right-of-way. To retain integrity of setting, the general uses on and near the bridge must be similar to its historic uses. Bridges that are no longer in use, or that have been converted from one use to another, may not retain their integrity of setting. The historic character of the cable-stayed bridge, including the direct link between the bridge and an important historic event, must be retained to possess integrity of association.

Under Criterion C, cable-stayed bridges that are significant for their engineering must possess integrity of design, materials, workmanship and feeling. Design is the combination of physical elements, including the form, plan, structure, and style used in the construction of a bridge. Design relates to the engineering system used to create and build the bridge, including the deck, superstructure, and substructure, as well as the approach. Integrity of design requires the retention of significant defining structural elements. For cable-stayed bridges, these elements include the towers and piers, the cable array design (i.e., fan or harp), and the stayed span, including the truss or girder structure. For suspension type bridges, the defining elements include the material integrity, towers and piers, and the suspension span, including the truss or girder structure. To possess historic physical integrity, the bridge must retain its materials dating from its period of significance. Materials used during rehabilitation and reconstruction may not negatively affect the integrity if they are representative materials of the cable-stayed bridge's period of significance or if they do not affect the bridge's exterior appearance. The replacement of original visually-apparent elements with materials other than like-kind materials generally will result in the bridge being considered ineligible. Workmanship is the physical evidence of the craft and skill of the bridge engineer, designer, or builder that dates from the bridge's period of significance. The historic designed and engineered elements should display their original workmanship. Feeling is the bridge's visual expression of the aesthetic or historic sense of its period of significance. A cable-stayed bridge retains its integrity of feeling if its historic character is still conveyed through a combination of its historic physical features. In general, a cable-stayed bridge that retains its original design, materials, workmanship, and setting will convey its historicity. Cable-stayed bridges that have been altered in terms of design and materials may no longer convey a historic feeling or a sense of place.

Specific Registration Requirements under Criterion A:

1. Associated with a significant chapter or event in the development of Florida's highway and/or railroad transportation system.
2. Played an instrumental role in the initial development and growth of a community or communities by providing access for travel and commerce. Served to connect adjoining cities.
3. Is a distinguished example of a locally-sponsored and funded infrastructure improvement project
4. Significant as a contributing resource to a National Register listed or potentially-eligible historic district.

Specific Registration Requirements under Criterion C:

1. Early and/or rare surviving example of its type, period or method of construction. Cable-stayed bridges are rare in Florida, and any intact example is considered significant.
2. Exemplifies important engineering trends and achievements on the local, regional, statewide, or nationwide level
3. Represents an early application of new engineering techniques, such as the change from pinned to riveted connections, or of new advances in materials technology
4. Associated with a prominent bridge engineer, builder, designer or planner
5. Exhibits distinctive architectural embellishments or features that lend high aesthetic value

Property Type F.8: Culverts

Description: Culverts are often thought of as small bridges, but they differ in structure. Culverts are essentially structures for hydraulic control, whereas bridges are constructed primarily to carry traffic over an obstruction. A culvert usually consists of structural material that is continuous around the waterway, including the bottom and covering the stream bed. A culvert can have one or several openings called barrels. Multiple pipes surrounded by earth fill are considered as one structure if the clear distance between openings is less than half the pipe opening. Culverts included in this survey update that were not identified in the previous survey measure at least 20 feet in length, the standard minimum measurement for inclusion in the NBI.

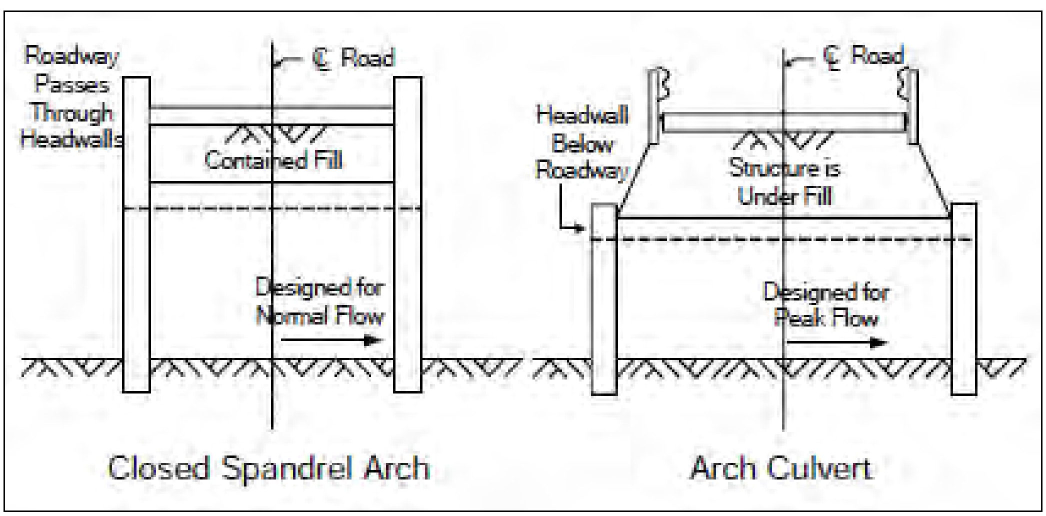

Figure 28. An Arch Deck (L) vs. Arch Culvert (R).
(Bridge Inspector's Reference Manual, 7.5.6)

Like bridges over waterways, culverts function to allow water to flow efficiently despite the construction of a roadway. Culverts are constructed entirely below and independent of the roadway surface, and they do not have decks, superstructures, or substructures. Culverts are designed to support the dead load of the embankment over the culvert as well as live loads of traffic. However, in most culvert designs the soil or embankment material surrounding the culvert provides lateral pressures that enhance the culvert's ability to support vertical loads. While most culverts feature continuous structural material around their entire perimeter, including the bottom, arch and frame culverts may not have a floor, allowing the streambed to serve as the bottom of the culvert.

Culverts may be constructed of rigid material, such as reinforced concrete or masonry (seen in early examples), or of flexible material, like aluminum or steel. Rigid materials are used in the construction of arch, box, and frame culverts, whereas flexible materials are used in circular or elliptical pipe culverts.

Significance: Culverts are common in Florida. In general, culverts may be eligible for the National Register under Criterion A for their associations with significant historical events in the areas of Transportation, Community Planning and Development, and Politics/Government. For example, culverts built during the New Deal era, and specifically those constructed by the Works Progress Administration (WPA) and Civilian Conservation Corps (CCC), may qualify for listing under Criterion A.

Early examples of concrete and steel culverts built to standard plans may be eligible under Criterion C in the area of Engineering because as their number diminishes, surviving examples may become rare. Early arch culverts are often notable for their rarity of design, especially when they exhibit decorative elements such as stone or rubble facing. One such example is the ca. 1936 Blackwater Creek Overflow Bridge that carries SR 39 over the Blackwater Creek Relief in Hillsborough County. Early examples of cast-in-pace, unadorned concrete box culverts, which were introduced in the 1930s, also may be significant. Similarly, late examples of arched culvert design may be important as representations of the culmination of a design trend which continued through the 1940s. Such examples include several unadorned corrugated steel arch culverts constructed in 1940 along CR 18 in Bradford County. Culverts also may be significant as a contributing resource to a listed or potentially-eligible historic district.

Registration Requirements: The period of significance for culverts in Florida begins in 1919, the earliest construction date for an extant example of this type. The period of significance ends no later than a date 50 years before the present, unless it possesses exceptional historical, engineering, or architectural significance. Alterations made during the period of significance may be considered part of the culverts' historic fabric; culverts that have been rehabilitated or reconstructed after the period of significance must have been altered in a manner that maintains the historic physical integrity in order to be eligible for listing.

Integrity is essential for a culvert to qualify for the National Register under any criterion. For culverts eligible under Criterion A, they must retain their integrity of location, setting, and association. Specifically, the culvert must be in the same location as it was when it was built. The specific location of a culvert is important as it relates to historic events associated with its construction as well as the specific engineering and construction methods used to build the culvert at its location. The setting of the historic culvert consists of its physical environment, including the culvert itself, the feature it conveys, and the adjacent properties. To retain integrity of setting, the general uses on and near the culvert must be similar to its historic uses. Culverts that are no longer in use, or that have been converted from one use to another, may not retain their integrity of setting. The historic character of the culvert, including the direct link between it and an important historic event, must be retained to possess integrity of association.

Under Criterion C, culverts that are significant for their engineering must possess integrity of design, materials, workmanship and feeling. Design is the combination of physical elements, including the form, plan, structure, and style used in the construction of a culvert. Design relates to the engineering system used to create and build it. Integrity of design requires the retention of significant defining structural elements. For both metal and concrete culverts, these elements include the span, the size of the opening, and the façade ornamentation, if any. To possess historic physical integrity, the culvert must retain its materials dating from its period of significance. Materials used during rehabilitation and reconstruction may not negatively affect the integrity if they are representative materials of the culvert's period of significance or if they do not affect its exterior appearance. The replacement of original visually-apparent elements with materials other than like-kind materials generally will result in the bridge being considered ineligible. Workmanship is the physical evidence of the craft and skill of the culvert engineer, designer, or builder that dates from its period of significance. The historic designed and engineered elements must display their original workmanship. Feeling is the culvert's visual expression of the aesthetic or historic sense of its period of significance. A culvert retains its integrity of feeling if its historic character, including aesthetic value, is still conveyed through a combination of its historic physical features. In general, a culvert that retains its original design, materials, workmanship, and setting will convey its historicity. Culverts that have been altered in terms of design and materials, such as the removal of character-defining stone-facing, may no longer convey a historic feeling or a sense of place.

Specific Registration Requirements under Criterion A:

1. Associated with a significant chapter or event in the development of Florida's highway transportation system
2. Is a distinguished example of a locally-sponsored and funded infrastructure improvement project
3. Constructed as an early project of the State Road Department
4. Constructed as part of a national movement, such as an early federal aid or work relief program, such as the New Deal Era WPA or CCC.
5. Significant as a contributing resource to a National Register listed or potentially-eligible historic district

Specific Registration Requirements under Criterion C:

1. Early and/or rare surviving example of its type, period or method of construction. Early arch culverts, especially with stone facing, are rare. Therefore, most intact examples are considered significant.

2. Exemplifies important engineering trends and achievements on the local, regional, statewide, or nationwide level
3. Represents an early application of new engineering techniques, or of new advances in materials technology
4. Associated with a prominent bridge engineer, builder, designer or planner
5. Exhibits distinctive features that depart from standard design and lend high aesthetic value. For example, stone facing, particularly with locally-sourced materials, was used on many arch culverts constructed as part of the New Deal Era programs.

Property Type F.9: Vertical lift bridges

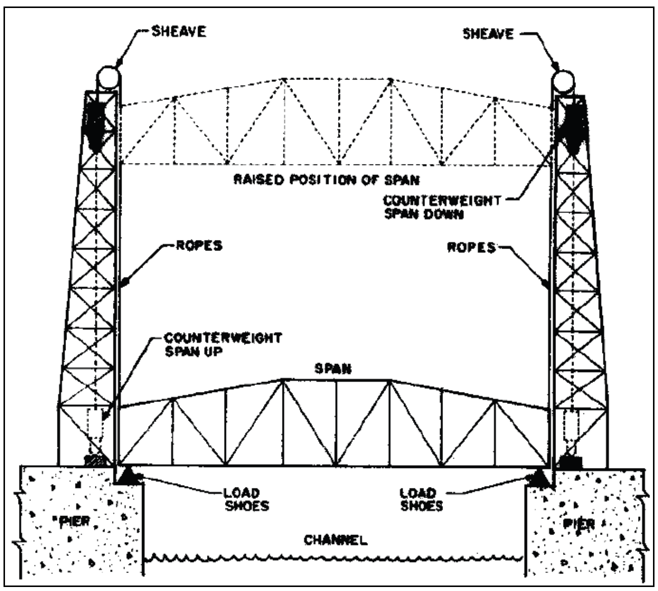

Figure 29. Vertical Lift Bridge Schematic.
(*Bridge Inspector's Reference Manual*, 12.2.12)

Description: Vertical lift structures were first constructed in Europe. Beginning in the 1870s, increasing numbers were built in the United States. A vertical lift bridge consists of a movable (lift) span that can be raised to allow the passage of vessels underneath the bridge. On most lift bridges, cables attached to each end of the lift span extend vertically up towers at each end of the span, and attach to counter weights. In lieu of this system, hydraulic jacks can be used to raise and lower the lift span. The lift span and above water section of the towers are usually made of steel trusses and the underwater section of the towers are reinforced concrete. The spans are typically of a truss configuration.

Significance: Vertical lift bridges are rare in Florida. Only four survive, and thus, any bridge of this type that has maintained physical integrity is considered eligible for the National Register under Criteria A and C. Vertical lift bridges may be significant for their important associations with historical events under Criterion A, particularly in the areas of Transportation and Community Planning and Development. For example, the Main Street Bridge in Duval County is important for its role in facilitating the development of the City of Jacksonville; the Hillsborough River Lift Bridge in Hillsborough County is associated with an important road expansion project that connected the northern suburbs of Tampa. Under Criterion C in the area of Engineering, a vertical lift bridge may be significant as a rare example of its type; because it exhibits distinct engineering elements or represents an early application of new technology; and/or is associated with a prominent builder, designer, engineer or planner. The Hialeah-Miami Springs Vertical Lift Bridge in Miami-Dade County, for example, is the oldest extant example of vertical lift technology in Florida, and the only example of a Parker through truss lift span. It is also important for its association with the notable Champion Bridge Company. The Hillsborough River Lift Bridge is the only tower-driven, mechanical lift bridge remaining in the state, and is one of only two operable vertical lift bridges in Florida. Vertical lift bridges also may be significant as a contributing resource to a listed or potentially-eligible historic district.

Registration Requirements: The period of significance for vertical lift bridges in Florida begins in 1927, the earliest construction date for an extant bridge of this type covered in this multiple property nomination. The period of significance ends no later than a date 50 years before the present, unless it possesses exceptional historical, engineering, or architectural significance. Alterations made during the period of significance may be considered part of the bridges' historic fabric; bridges that have been rehabilitated or reconstructed after the period of significance must have been altered in a manner that maintains the historic physical integrity in order to be eligible for listing.

Integrity is essential for the bridge to qualify for the National Register under any criterion. For those eligible under Criterion A, they must retain their integrity of location, setting, and association. Specifically, the vertical lift bridge must be in the same location as it was when it was built or moved, providing that the relocation occurred during its period of significance. The specific location of a vertical lift bridge is important as it relates to historic events associated with its construction as well as the specific engineering and construction methods used to build the bridge at its location. The relocation of a historic bridge from its original location outside of its period of significance will compromise the bridge's integrity of location. The setting of the historic vertical lift bridge consists of the bridge's physical environment, including the bridge itself, the feature it carries, the feature it crosses, and the properties adjacent to the right-of-way. To retain integrity of setting, the general uses on and near the bridge must be similar to its historic uses. Bridges that are no longer in use, or that have been converted from one use to another, may not retain their integrity of setting. The historic character of the vertical lift bridge, including the direct link between the bridge and an important historic event, must be retained to possess integrity of association.

Under Criterion C, vertical lift bridges that are significant for their engineering must possess integrity of design, materials, workmanship and feeling. Most importantly, they must retain their machinery and movable parts. Design is the combination of physical elements, including the form, plan, structure, and style used in the construction of a bridge. Design relates to the engineering system used to create and build the bridge, including the deck, superstructure, and substructure, as well as the approach. Integrity of design requires the retention of significant defining structural elements. For vertical lift bridges, these elements include the towers, the lift span design and materials, including the truss or girder structure, and the operational machinery. To possess historic physical integrity, the bridge must retain its materials dating from its period of significance. Materials used during rehabilitation and reconstruction may not negatively affect the integrity if they are representative materials of the vertical lift bridge's period of significance or if they do not affect the bridge's exterior appearance. The replacement of original visually-apparent elements with materials other than like-kind materials generally will result in the bridge being considered ineligible. Workmanship is the physical evidence of the craft and skill of the bridge engineer, designer, or builder that dates from the bridge's period of significance. The historic designed and engineered elements should display their original workmanship. Feeling is the bridge's visual expression of the aesthetic or historic sense of its period of significance. A vertical lift bridge retains its integrity of feeling if its historic character is still conveyed through a combination of its historic physical features. In general, a vertical lift bridge that retains its original design, materials, workmanship, and setting will convey its historicity. Vertical lift bridges that have been altered in terms of design and materials may no longer convey a historic feeling or a sense of place.

Specific Registration Requirements under Criterion A:

1. Associated with a significant chapter or event in the development of Florida's highway and/or railroad transportation system
2. Played an instrumental role in the initial development and growth of a community or communities by providing access for travel and commerce. Served to connect adjoining cities.
3. Is a distinguished example of a locally-sponsored and funded infrastructure improvement project
4. Constructed as an early project of the State Road Department
5. Constructed as part of a national movement, such as an early federal aid or work relief program
6. Significant as a contributing resource to a National Register listed or potentially-eligible historic district

Specific Registration Requirements under Criterion C:

1. Early and/or rare surviving example of its type, period or method of construction. Vertical lift bridges are rare in Florida, and any intact example is considered significant.
2. Exemplifies important engineering trends and achievements on the local, regional, statewide, or nationwide level
3. Represents an early application of new engineering techniques, or of new advances in materials technology
4. Associated with a prominent bridge engineer, builder, designer or planner
5. Exhibits distinctive architectural embellishments or features that lend high aesthetic value

Property Type F.10: Swing bridges

Description: A swing bridge consists of a movable (swing) span that can be rotated horizontally to allow the passage of vessels. The swing span is balanced on a pivot pier. Usually, the swing span is symmetrical over the pivot pier; however, an asymmetrical swing span can be achieved by adding extra weight to the short end of the swing span. The swing span is usually made of steel trusses and the piers are reinforced concrete.

More common than vertical lifts but still an endangered bridge type, swing bridges represent another type of historic movable bridge technology. Swing bridges accommodate river navigation by rotating the swing span on a pivot pier into a position parallel to the channel. Unfortunately, this central pier usually lies in, and therefore often blocks, part of the navigable channel. Consequently, bridge engineers developed several modifications of this technology. An earlier method of adapting swing bridges for channel clearance involved changing the location of the pivot pier in relation to the swing span. This variant form became known as the "bob-tailed" swing because of the asymmetrical location of the pivot pier. Sometimes the designers simply extended the length of the movable span so that the central pier could be located outside the channel. With time, this effort changed the nature of the central spans as more technology was applied to extending their length.

Swing bridges utilize one of two main types of pivot piers, center bearing or rim bearing. Center-bearing pivots support the swing span via a cross-girder situated over a disc. Balance wheels along the rim of the pivot pier stabilize the center span while it is opening. The movable span on rim-bearing pivots is supported by a circular girder that, in turn, is supported by rollers placed along its outer edge.

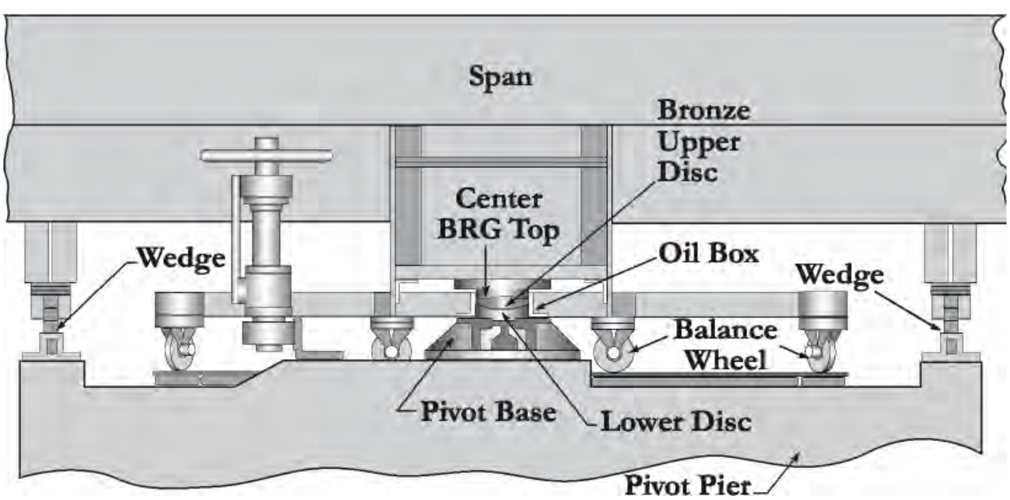

Figure 30. Roadway Diagram of Center-Bearing Swing Mechanism.

Besides the difference in forms and machinery, swing bridges also present varying types of structural technologies. Most swing bridges in Florida use a truss configuration on the main span, though rarely on the approach spans. Slow, cumbersome in operation, and restrictive of the channel, swing bridges passed their peak use by the 1930s.

Significance: Swing bridges are rare in Florida. Only 11 remain, and thus, any bridge of this type that has maintained physical integrity is considered eligible for the National Register under Criteria A and C. Swing bridges may be significant for their important associations with historical events under Criterion A, particularly in the areas of Transportation and Community Planning and Development. For example, the Blackburn Point Bridge in Sarasota County is important for its role in spurring development and tourism on the Gulf beaches. The St. Mary's River Bridge in Nassau County played a crucial role in opening Florida to tourists and settlers from northern areas and enabled Jacksonville to become a gateway to Florida's Atlantic Coast. Under Criterion C in the area of Engineering, a swing bridge may be significant as a rare example of its type; because it exhibits distinct engineering elements or represents an early application of new technology; and/or is associated with a prominent builder, designer, engineer or planner. The Belle Glade Swing Bridge in Palm Beach County, for example, is the earliest example of swing bridge technology in Florida, and the only example of a Pratt deck truss span. It is also important as one of two surviving Virginia Bridge and Iron Company bridges. The Miami River canal Swing Bridge in Miami-Dade County is a rare example of a bob-tailed swing bridge built by the Champion Bridge Company. Swing bridges also may be significant as a contributing resource to a listed or potentially-eligible historic district.

Registration Requirements: The period of significance for swing bridges in Florida begins in 1916, the earliest construction date for an extant bridge of this type covered in this multiple property nomination. The period of significance ends no later than a date 50 years before the present, unless it possesses exceptional historical, engineering, or architectural significance. Alterations made during the period of significance may be considered part of the bridges' historic fabric; bridges that have been rehabilitated or reconstructed after the period of significance must have been altered in a manner that maintains the historic physical integrity in order to be eligible for listing.

Integrity is essential for the bridge to qualify for the National Register under any criterion. For those eligible under Criterion A, they must retain their integrity of location, setting, and association. Specifically, the swing bridge must be in the same location as it was when it was built or moved, providing that the relocation occurred during its period of significance. The specific location of a swing bridge is important as it relates to historic events associated with its construction as well as the specific engineering and construction methods used to build the bridge at its location. The relocation of a historic swing bridge from its original location outside of its period of significance will compromise the bridge's integrity of location. The setting of the historic swing bridge consists of the bridge's physical environment, including the bridge itself, the feature it carries, the feature it crosses, and the properties adjacent to the right-of-way. To retain integrity of setting, the general uses on and near the bridge must be similar to its historic uses. Bridges that are no longer in use, or that have been converted from one use to another, may not retain their integrity of setting. The historic character of the swing bridge, including the direct link between the bridge and an important historic event, must be retained to possess integrity of association.

Under Criterion C, swing bridges that are significant for their engineering must possess integrity of design, materials, workmanship and feeling. Most importantly, they must retain their machinery and movable parts. Design is the combination of physical elements, including the form, plan, structure, and style used in the construction of a bridge. Design relates to the engineering system used to create and build the bridge, including the deck, superstructure, and substructure, as well as the approach. Integrity of design requires the retention of significant defining structural elements. For swing bridges, these elements include the swing span design and materials, including the truss or girder structure, the pivot pier, and the operational machinery. To possess historic physical integrity, the bridge must retain its materials dating from its period of significance. Materials used during rehabilitation and reconstruction may not negatively affect the integrity if they are representative materials of the swing bridge's period of significance or if they do not affect the bridge's exterior appearance. The replacement of original visually-apparent elements with materials other than like-kind materials generally will result in the bridge being considered ineligible. Workmanship is the physical evidence of the craft and skill of the bridge engineer, designer, or builder that dates from the bridge's period of significance. The historic designed and engineered elements should display their original workmanship. Feeling is the bridge's visual expression of the aesthetic or historic sense of its period of significance. A swing bridge retains its integrity of feeling if its historic character is still conveyed through a combination of its historic physical features. In general, a swing bridge that retains its original design, materials, workmanship, and setting will convey its historicity. Swing bridges that have been altered in terms of design and materials may no longer convey a historic feeling or a sense of place.

Specific Registration Requirements under Criterion A:

1. Associated with a significant chapter or event in the development of Florida's highway and/or railroad transportation system.
2. Played an instrumental role in the initial development and growth of a community or communities by providing access for travel and commerce. Served to connect adjoining cities.
3. Is a distinguished example of a locally-sponsored and funded infrastructure improvement project
4. Constructed as an early project of the State Road Department
5. Constructed as part of a national movement, such as an early federal aid or work relief program
6. Significant as a contributing resource to a National Register listed or potentially-eligible historic district

Specific Registration Requirements under Criterion C:

1. Early and/or rare surviving example of its type, period or method of construction. Swing bridges are sufficiently rare in Florida that any intact example is considered significant.
2. Exemplifies important engineering trends and achievements on the local, regional, statewide, or nationwide level
3. Represents an early application of new engineering techniques, or of new advances in materials technology
4. Associated with a prominent bridge engineer, builder, designer or planner
5. Exhibits distinctive architectural embellishments or features that lend high aesthetic value

Property Type F.11: Bascule bridges

Description: A bascule bridge is a movable bridge in which the movable span (or leaf) rotates vertically to allow the passage of vessels. With rare exception, the bascule bridge may be either a single or double leaf. The leaf(s) rotate around a large axle called a trunnion. A counterweight on the other side of the trunnion balances the weight of the leaf. In lieu of a trunnion, a rolling lift bascule bridge uses a curved track at the end of the leaf that is mated with a horizontal track on the pier. The piers at the end of the leaf are usually quite large to provide a room for the counterweight. The leaf is usually composed of steel stringers and the counter weight is usually a steel structure filled with concrete. The piers are usually reinforced concrete.

Believed to possess a number of advantages over other movable types, the bascule bridge, or drawbridge, provides an open channel with unlimited clear headway, swift and dependable operation, and simple mechanisms with few moving parts. It consists of a single- or double-leaf bascule span that rotates from a horizontal to a near vertical position. The weight of the counterweight is adjusted by removing or adding balance blocks in pockets to position the center of gravity of the moving leaf at the center of rotation. In a single-leaf bascule span, the entire span lifts above one end. The double-leaf has a center joint, and half of the span rotates about each end. The most common mechanical types of bascule bridges are the rolling lift (Scherzer) bridge, the simple trunnion (Chicago) bridge, and the multi-trunnion (Strauss) bridge.

The bascule span bridge also offered strength and safety, and it could be aesthetically treated. Engineering firms that sold patented bascule designs were mainly from Chicago, where many of this bridge type were built. Inventor William Scherzer claimed that his rolling lift type operated with less friction and, therefore, reduced power. The Scherzer bascule was infrequently chosen for highway use because it required a complicated mechanism with a curved base which rocked back on a girder track and required more substantial foundations. For these reasons, designers preferred the trunnion-type bascule. The trunnion type, improved by Chicago engineer Joseph Strauss, who designed the Golden Gate Bridge, became dominant. In this type, the bascule span rotated around a trunnion or axle and made use of a heavy counterweight.

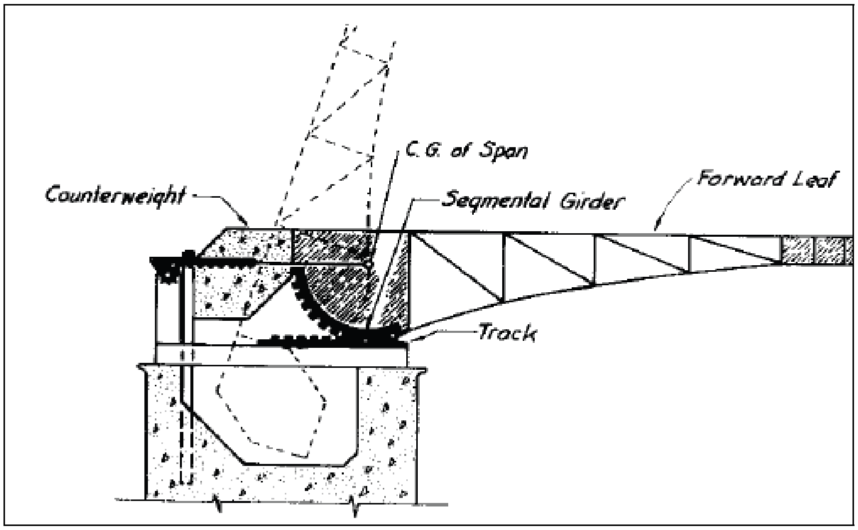

Figure 31. Rolling Lift Bascule Bridge Schematic.
(Bridge Inspector's Reference Manual, 12.2.7)

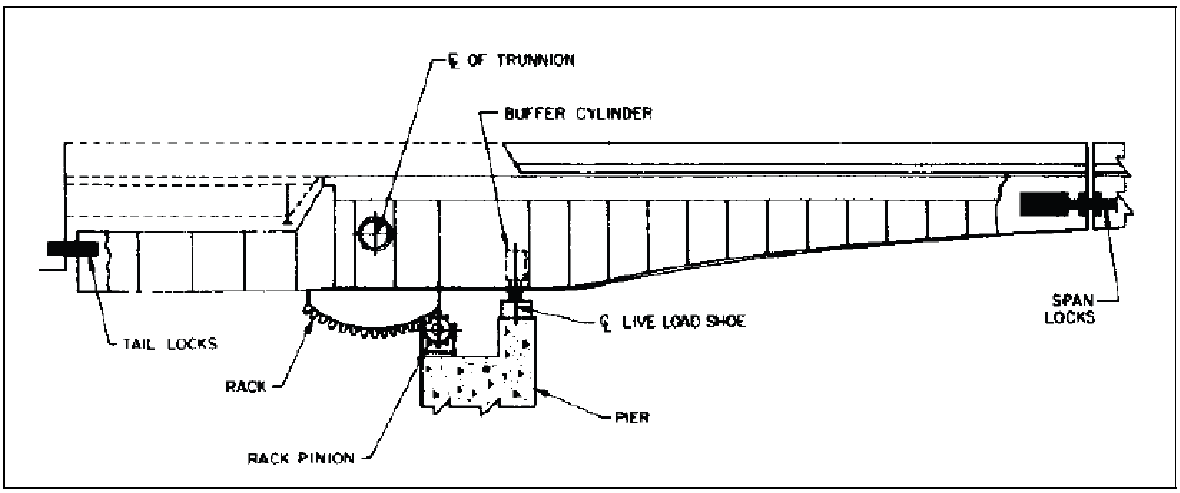

Figure 32. Trunnion Bascule Bridge Schematic.
(Bridge Inspector's Reference Manual, 12.2.9)

Significance: Bascule span bridges are the most common of the movable bridge types in Florida. Most bascule bridges were constructed in the 1950s and 1960s; about half of Florida's bascule bridges span the Intracoastal Waterway (ICWW). In general, the most significant are early examples (pre-1950), especially those designed by notable engineers or engineering firms and which exhibit unique or high architectural design. In addition, a dwindling number of rolling lift bascule bridges has resulted in this type becoming significant for its increasing rarity.

Bascule bridges may be eligible for the National Register under Criterion A for their associations with significant historical events in the areas of Transportation and Community Planning and Development. For example, the SW 1st Street Bridge and the NW 17th Avenue Bridge, both in Miami-Dade County, represent the two remaining bascule bridges associated with the Harbor Bond Issue of 1926, a major initiative passed for the sole purpose of constructing bridges in the Miami area. The George Bush Boulevard Bridge in Palm Beach County played a major role during the post-World War II land boom period in promoting the growth of the city of Palm Beach by providing the improved access that was instrumental in shaping the area's development.

Bascule bridges also may be significant under Criterion C in the area of Engineering as a rare example of its type; because it exhibits distinct engineering elements or represents an early application of new technology; and/or is associated with a prominent builder, designer, engineer or planner. The Boca Inlet Bascule Bridge in Palm Beach County is significant at the national level as the only intact and functioning bascule bridge in the United Stets possessing the patented Hanover skew design. The Platt Street Bridge in Hillsborough County is important as an early example of a double-leaf trunnion bascule bridge designed by the Strauss Bascule Bridge Company. Bascule bridges also may be distinguished in the area of Architecture/Aesthetics. The Ortega River Bascule Bridge in Duval County, for example, is notable for its historical associations with bridge engineer T.B. Carrick, whose trademark was the Maltese cross design. The Kennedy Boulevard Bridge in Hillsborough County exhibits Neoclassical Revival styling, which was commonly used as part of the City Beautiful Movement to improve the aesthetic quality of metropolitan areas. Bascule bridges also may be significant as a contributing resource to a listed or potentially-eligible historic district.

Registration Requirements: The period of significance for bascule bridges in Florida begins in 1913, the earliest construction date for an extant bridge of this type covered in this multiple property nomination. The period of significance ends no later than a date 50 years before the present, unless it possesses exceptional historical, engineering, or architectural significance. Alterations made during the period of significance may be considered part of the bridges' historic fabric; bridges that have been rehabilitated or reconstructed after the period of significance must have been altered in a manner that maintains the historic physical integrity in order to be eligible for listing.

Integrity is essential for the bridge to qualify for the National Register under any criterion. For those eligible under Criterion A, they must retain their integrity of location, setting, and association. Specifically, the bascule bridge must be in the same location as it was when it was built or moved, providing that the relocation occurred during its period of significance. The specific location of a bascule bridge is important as it relates to historic events associated with its construction as well as the specific engineering and construction methods used to build the bridge at its location. The relocation of a historic bascule bridge from its original location outside of its period of significance will compromise the bridge's integrity of location. The setting of the historic bascule bridge consists of the bridge's physical environment, including the bridge itself, the feature it carries, the feature it crosses, and the properties adjacent to the right-of-way. To retain integrity of setting, the general uses on and near the bridge must be similar to its historic uses. Bridges that are no longer in use, or that have been converted from one use to another, may not retain their integrity of setting. The historic character of the bascule bridge, including the direct link between the bridge and an important historic event, must be retained to possess integrity of association.

Under Criterion C, bascule bridges that are significant for their engineering and/or architecture must possess integrity of design, materials, workmanship and feeling. Most importantly, they must retain their machinery and movable parts. Design is the combination of physical elements, including the form, plan, structure, and style used in the construction of a bridge. Design relates to the engineering system used to create and build the bridge, including the deck, superstructure, and substructure, as well as the approach. Integrity of design requires the retention of significant defining structural elements. For bascule bridges, these elements include the bascule span design and materials, including the truss or girder structure, the tender station, the piers, and the operational machinery. To possess historic physical integrity, the bridge must retain its materials dating from its period of significance. Materials used during rehabilitation and reconstruction may not negatively affect the integrity if they are representative materials of the bascule bridge's period of significance or if they do not affect the bridge's exterior appearance. The replacement of original visually-apparent elements with materials other than like-kind materials generally will result in the bridge being considered ineligible. Workmanship is the physical evidence of the craft and skill of the bridge engineer, designer, or builder that dates from the bridge's period of significance. The historic designed and engineered elements, including decorative railings, lamp posts, and tender stations, should display their original workmanship. Feeling is the bridge's visual expression of the aesthetic or historic sense of its period of significance. A bascule bridge retains its integrity of feeling if its historic character is still conveyed through a combination of its historic physical features. In general, a bascule bridge that retains its original design, materials, workmanship, and setting will convey its historicity. Bascule bridges that have been altered in terms of design and materials may no longer convey a historic feeling or a sense of place.

Specific Registration Requirements under Criterion A:

1. Associated with a significant chapter or event in the development of Florida's highway and/or railroad transportation system.
2. Played an instrumental role in the initial development and growth of a community or communities by providing access for travel and commerce. Served to connect adjoining cities.
3. Is a distinguished example of a locally-sponsored and funded infrastructure improvement project
4. Constructed as an early project of the State Road Department
5. Constructed as part of a national movement, such as an early federal aid or work relief program
6. Significant as a contributing resource to a National Register listed or potentially-eligible historic district

Specific Registration Requirements under Criterion C:

1. Early and/or rare surviving example of its type, period or method of construction. Single-leaf bascules, four-leaf bascules, rolling lift bascules designed by the Scherzer Bridge Company, and the Hanover skew design bascule are all relatively rare types.
2. Exemplifies important engineering trends and achievements on the local, regional, statewide, or nationwide level
3. Represents an early application of new engineering techniques, such as the change from pinned to riveted connections, or of new advances in materials technology
4. Associated with a prominent bridge engineer, builder, designer or planner, such as the Strauss Bascule Bridge Company, the Scherzer Bridge Company, and the American Bascule Bridge Company, among others.
5. Exhibits distinctive architectural embellishments or features that depart from standard design and lend high aesthetic value

SELECT CASE STUDIES

The following case studies provide examples of the evaluation of different historic highway bridge types as per the NRHP criteria.

<u>Old San Mateo Bridge</u>

Figure 33. Old San Mateo Road Bridge in Putnam County (FDOT No. 764024)

The Old San Mateo Road Bridge, a concrete arch deck structure, spans Mill Creek between San Mateo and Palatka. A successful bond election in 1915 enabled Putnam County to contract with the Luten Bridge Company to build this bridge in 1916, under the supervision of county engineer S.G. Stallings. Construction of the span was part of a larger project to build a brick road for a distance of approximately four miles to connect the small town of San Mateo with the county seat Palatka on the St. Johns River. One of the oldest examples of Daniel Luten's work in Florida, the four-span structure extends 100 feet in length. The roadway is 16 feet wide and bordered by a solid concrete railing marked with a rectangular design. The panels are divided by short concrete pilasters so that one panel is located over each arch span.

The Old San Mateo Road Bridge is significant for several reasons. It is among the oldest Luten bridges in Florida and represents the kind of concrete structures the Luten Bridge Company would successfully promote and build throughout the state in the 1920s. This bridge also reflects the effort of Putnam County to build permanent roads and bridges prior to World War I and before the creation of a state road department. Thus, the Old San Mateo Road Bridge is considered NRHP-eligible under Criteria A and C in the areas of Transportation and Engineering, respectively.

Columbus Drive Swing Bridge

Figure 35. Columbus Drive Swing Bridge in Hillsborough County (FDOT No. 105504)

Completed in 1927, the Columbus Drive Swing Bridge carries Columbus Drive over the Hillsborough River. It was developed as a joint project between the City of Tampa, the Tampa Developers Corporation and the Florida Interurban Rapid Transit Railway Company. This bridge was designed by consulting engineer Norman S. Sprague of Pittsburgh, and approved by R.D. Martin, the City of Tampa engineer. The majority of the bridge was constructed by Roberts Supply Company of Lima, Ohio. The steel truss swing span was fabricated by the Mt. Vernon Bridge Company of Mt. Vernon, Ohio. This bridge is one of two bridges by this company in the State of Florida. The 12-span bridge measures 470 feet long and 55 feet wide. The 164-foot long movable span of this swing bridge features a pony truss placed at three-quarters level with the deck. This truss deepens at the pivot point, which is a feature that seems particular to this bridge and no other in Florida. The swing span rests on a rim-bearing pivot, located on the west side of the Hillsborough River channel, resulting in a configuration known as a bob-tail swing span. The main span is flanked by 11 reinforced concrete tee-beam approach spans. The Columbus Drive Bridge features Neoclassical Revival-style urn-shaped balusters. An unembellished wood frame tender station is located at the northeastern corner of the bridge.

Built as a neighborhood bridge between two communities that were just getting established in the mid-1920s, the Columbus Drive Swing Bridge connected upper West Tampa and western Tampa Heights along what was then known as Michigan Avenue. The bridge was a catalyst to the simultaneous development of the historic communities. The Columbus Drive Swing Bridge retains its historic physical integrity. It is one of 10 remaining swing bridges in Florida and one of three bob-tailed swing bridges. Additionally, it may be the only swing bridge in the state featuring a pony truss both below and above the deck. This bridge was determined NRHP-eligible by the SHPO in 2005. It is eligible under Criterion A in the areas of Transportation and Community Planning and Development and under Criterion C in the area of Engineering as a rare example of a bob-tailed swing bridge.[72]

[72] Kimberly Hinder, West Columbus Drive Bridge, National Register of Historic Places Registration Form, 2005.

Haines City Overpass

Figure 36. Haines City Overpass in Polk County (FDOT No. 165700)

The Haines City Overpass carries Lilly Avenue over the Atlantic Coast Line (ACL) Railroad corridor in Haines City, Polk County. It was constructed in 1927 as a joint project between Haines City and the ACL Railroad. The 125- feet long, three-span steel girder features a concrete deck and railings with rectangular recessed panels; this decorative element commonly appeared on bridges at that time. The Haines City Overpass exhibits a graceful arched look that sets it apart from most railroad overpasses. Though conventional in engineering and construction, the overpass appears to be the oldest example of a grade separation remaining in Florida, and retains its historic physical integrity. The Haines City Overpass was determined NRHP-eligible during the 2000 survey under Criterion A in the area of Transportation.

Hill Road over Little Mills Creek

This 1931 timber slab bridge carries Hill Road over Little Mills Creek near Callahan in Nassau County. It is the only remaining historic timber slab bridge in Florida that retains its integrity. This two-span bridge has a vertically-laid wood slat deck and is 40-feet in length. It features a wooden post and lintel railing, and is supported by circular wooden posts with cross-bracing. Although reconstructed in 1982, work was done with in-kind materials and construction methods. Thus, the bridge retains its historic and structural integrity, and is newly recommended NRHP-eligible under Criterion C in the area of Engineering as the only remaining example of its type.

Figure 37. Hill Road over Little Mills Creek in Nassau County (FDOT No. 744006)

SW 117th Avenue Bridge over North Canal

Figure 38. SW 117th Avenue Bridge over the North Canal, Miami-Dade County (FDOT No. 874307).

This 1937 through girder bridge carries SW 117th Avenue near Homestead over the North Canal (C-104), a non-navigable waterway. The single 51-foot span carries a cast-in-place concrete deck between two simple steel girders, which also serve as the bridge railings. The 1937 bridge and the canal predate the U.S. Army Corps of Engineers' Central and Southern Florida Project for flood control, authorized by Congress in 1948, but they were later incorporated into this system. This bridge may be Florida's only remaining steel through girder bridge used to carry automobile traffic. It appears to retain its historic physical integrity. Therefore, the SW 117th Avenue Bridge is eligible for listing in the NRHP under Criterion C in the area of Engineering as a rare example of its type.

County Road 18 (CR-18) over Braggs Branch

Figure 39. CR-18 over Braggs Branch in Bradford County (FDOT No. 280036)

This unadorned corrugated steel arch culvert along CR 18 in Bradford County, built in 1940, is an interesting late example of its type. In contrast to the arched, stone-faced New Era Deal culverts, the CR-18 over Braggs Branch culvert has a smooth concrete facade. The intermediate piers feature fluted boots to assist with water flow. This structure has two spans and measures26 feet in length.

The Bauhaus and International movement influence and the cost-constraints of the Great Depression meant an end to high-style, ornate structures in the built environment. After the 1930s, adorned structures became a rarity. Specifically with culverts, this was manifested in a shift from an arched to boxed form and a stone-faced to unadorned façade. As concrete gained further acceptance as a bridge building material, cast-in-place, unadorned concrete box culverts emerged in the 1930s and have been prevalent ever since.

This corrugated steel arch culvert represents a continuum in the design trends for its type. Due to its integrity, increasing rarity, and at-risk condition, this culvert is noteworthy. It is considered NRHP-eligible under Criterion C in the area of Engineering as a high integrity example of corrugated steel arch culvert and a good representative of the culmination of a design trend for arched culverts witnessed through the 1940s.

Isaiah D. Hart Bridge

Figure 40. Isaiah D. Hart Bridge in Duval County (FDOT No. 720107).

This continuous steel through truss bridge carries SR-228 over the St. Johns River in Jacksonville. The four-lane, 17-span structure has a cast-in-place concrete deck and is 3,844-feet in length. Construction began in 1964 and was complete by November of 1967. The three-span main unit over the navigational channel is 1,093-feet, making it the longest bridge span of all highway bridges in Florida. It was designed by the consulting engineering firm Sverdrup & Parcel and Associates of St. Louis. The B.F. Diamond Construction Co. of Savannah built the substructure; the superstructure was built by the Allied Structural Steel Co. of Chicago.

Named for the founder of Jacksonville, the Isaiah D. Hart Bridge is the hallmark feature of the five-mile Commodore Point Expressway (aka Hart Bridge Expressway) that connects downtown Jacksonville to its southwest neighborhood. It is considered eligible under Criterion A in the areas of Community Planning and Development and Transportation for its associations to the historic and continued development of Jacksonville. The Isaiah Hart Bridge is also considered eligible under Criterion C in the area of Engineering as an exceptional example of continuous steel through truss bridge. It is one of only six through trusses verified as extant, and one of two dating to the post-World War II period.

James H. Pruitt Memorial Bridge

Figure 41. James H. Pruitt Memorial Bridge in Indian River County (FDOT No. 880005)

The 1964 prestressed concrete girder James H. Pruitt Memorial Bridge carries SR-A1A over the Sebastian Inlet near Vero Beach. Built by the Clearly Brothers Construction Company, the bridge features lightweight concrete prestressed side spans and a three-span main unit. The total bridge length is 1,548 feet. The superstructure is made of variable depth I-girders; each line of these I-girders is composed of five precise beam elements. The 65-foot long cantilever beams located over the channel piers vary from six to nine feet in depth and are spliced with the end beams and cantilever 30 feet into the main span. The fifth beam is a 120-foot pretensioned drop-in beam supported by cantilever beams resting on the main piers. The end beams of the side spans and the drop-in span were designed to be entire pretensioned with ½-inch diameter straight and deflected strands. The variable depth portion that cantilevers over each pier was designed to be post-tensioned using 15 tendons. The tendons draped over the top at the pier and anchor at the ends of the variable depth cantilever portion. Two of these tendons were to be post-tensioned after casting for shipping and erection, the rest were post-tensioned in phases as the construction of the deck proceeded. During construction, the contractor made use of special provisions that permitted changing the prestressing of the variable depth members from post-tensioned to pretensioned.[73]

According to the *New Direction for Florida Post-Tensioned Bridges* report published for the FDOT in 2002, the Sebastian Inlet Bridge represents a significant early post-tensioned bridge design in Florida although it was eventually built as a pre-tensioned bridge. It is considered NRHP-eligible under Criterion C in the area of engineering for its high-integrity embodiment of a prestressed concrete bridge in Florida.

[73] Corven Engineering, Inc., 7-8.

CR-316 over Proposed Cross Florida Canal

This continuous steel girder bridge carries CR-316 over the proposed Cross Florida Canal near Fort McCoy in Marion County. It was designed and built by the U.S. Army Corps of Engineers in 1969. The 4,449-foot-long bridge incorporates 52 concrete approach spans and three main spans with a cast-in-place concrete deck. It features a vertical clearance of nearly 150 feet which allows the structure to have a low environmental impact on the natural resource below and around it.

Figure 42. CR-316 over Proposed Cross Florida Canal in Marion County (FDOT No. 364040)

This structure is a remarkable example of an ordinary bridge elevated to a higher status. Nestled in the southwest corner of the Ocala National Forest, experiencing the approach with its apparent vanishing point and suspended feeling above the forest canopy at its crest is memorable. The selection of this bridge design not only respects its natural surroundings but was also done in anticipation of the proposed Cross Florida Barge Canal. Although never completed, the Cross Florida Barge Canal was intended to cross northern Florida, connecting the Gulf Intracoastal Waterway with the Atlantic Intracoastal Waterway. Authorized by Congress in 1942, construction of the canal did not begin until 1964. The project was halted by President Nixon in 1971 after several lawsuits based on environmental concerns were filed seeking an injunction to the project. About 25 miles of the 110-mile project were built: the cross-country section from the St. Johns River to the Ocklawaha River, part of the route along the Ocklawaha River, and a small section at the Gulf of Mexico ending at the dammed Lake Rousseau. The completed infrastructure included three of the five planned locks, all three planned dams, and four of the 11 planned bridges. High bridges like this one were built over the canal, as well as several over the Ocklawaha River.[74]

This bridge exists as a living relic to the planned endeavors of Congress to connect the Gulf and Atlantic Intracoastal waterways through the Cross Florida Barge Canal. It remains one of only four bridges constructed for the project. The girder bridge is considered NRHP-eligible under Criterion A in the areas of Community Planning and Development and Transportation for its association with the proposed Cross Florida Barge Canal. It is also eligible under Criterion C in the area of Engineering as a high integrity example of a continuous steel girder bridge.

[74] Department of the Army, 1976, 1, 7.

Bob Graham Sunshine Skyway Bridge

Figure 43. Bob Graham Sunshine Skyway Bridge in Pinellas and Manatee Counties (FDOT No. 150189)

The 1986 Bob Graham Sunshine Skyway Bridge, which carries I-275 over Tampa Bay, was designed by the renowned Figg & Muller Engineering Group and built by the American Bridge Company. It was constructed following the partial collapse of the 1971 southbound cantilevered steel through truss bridge when the *Summit Venture* freighter collided into its piers in 1980. The new bridge includes a protection system, designed by Parsons Brinckerhoff, which consists of large concrete bumpers, called dolphins, located around the piers and designed to withstand an impact from an 87,000-ton tanker traveling at 10 knots.

The Bob Graham Sunshine Skyway Bridge is 29,040 feet in length, with a main span measuring 1,200 feet and a vertical clearance of 193 feet. Eight approach spans fabricated from precast concrete flank the cable-stayed spans, four at each side. The main span features 21 steel cables in a harp design, which carry the weight of the structure. The cables are encased in yellow-painted steel pipes. It is one of the first cable-stayed bridges constructed with the cables attached at the center of the roadway instead of at the outer edges. This bridge was awarded the Presidential Design Award from the National Endowment for the Arts in 1988.

Several significant modern bridges in Florida were designed by Eugene C. Figg. He graduated in 1958 from The Citadel, the military university in South Carolina, and was introduced to prestressed concrete by William Dean, then the chief engineer for FDOT, during a three-year bridge design training program. After Figg left the FDOT in 1964, he went on to work with the architectural/engineering firm of Barrett, Daffin and Figg in Tallahassee. Later, he began his own firm, Figg and Muller Engineers, with French engineer Jean Muller. Their firm promoted the idea of segmental bridge construction with prestressed concrete as an economically viable option. When Figg and Muller coupled the prestressed concrete segmental technology with cable-stayed supports, they increased the effective use of high-strength concrete in long-span bridges and changed the way bridges were built in America.

While this bridge is less than 50 years old, it has been excluded by the FHWA from the Advisory Council for Historic Preservation's Section 106 Exemption Regarding Effects to the Interstate Highway System, and was determined eligible for listing in the NRHP in 2007 under Criterion C in the area of Engineering. Because it has achieved exceptional significance within the past 50 years, Criterion Consideration G is applicable.

Geographical Data

The geographical limits are the Florida State Line and the coastal limits of the State of Florida.

SUMMARY OF IDENTIFICATION AND EVALUATION METHODS

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Three surveys of historic highway bridges were previously conducted in Florida, in 1981, 1991, and 2000. The 1981 survey was conducted in response to the inherent conflict between the *Emergency Bridge Repair Act of 1971* and the *National Historic Preservation Act of 1966*. The *Emergency Bridge Repair Act* required that state highway agencies pursue a strategy to replace structurally deficient bridges, while the *National Historic Preservation Act* required that consideration be given to the preservation of many of the same bridges. The 1991 and 2000 surveys were designed to comply with the Highway Bridge Replacement and Rehabilitation Program enacted by the *Surface Transportation and Uniform Relocation Assistance Act of 1987.* This legislation required each state transportation agency to complete an inventory and assessment of historic highway bridges within the federal aid program ("on system") as well as those owned by county and municipal authorities ("off system"). The intent was to encourage the rehabilitation, reuse, and preservation of historic bridges that are listed in or eligible for the NRHP. In passing this legislation, Congress also recognized the importance of historic bridges as "links to our past" that "serve as safe and vital transportation routes in the present, and can represent significant resources for the future."

The 1981 survey, conducted by Stephen B. Atkins and William E. Keeler of the FDOT, focused only on metal fixed truss, swing, and vertical lift bridges, selected because of the rare number of such extant bridges and the high percentage of them slated for replacement.[82] The first comprehensive survey of all bridge types in Florida constructed in 1950 or earlier was completed in 1991.[83] FDOT published the results of this survey under the title *The Historic Highway Bridges of Florida*. The 2000 survey, published in 2004, identified notable historic bridges constructed prior to 1960.[84]

The 2010 update was conducted in accordance with the requirements set forth in the *National Historic Preservation Act of 1966* (Public Law 89-665), as amended; the *Archaeological and Historical Preservation Act* (Public Law 93-291), as amended; Executive Order 11593; Chapter 267, *Florida Statutes* (*F.S.*); Section 123(f) of the *Surface Transportation and Uniform Relocation Assistance Act of 1987*; the Section 106 Exemption Regarding Effects to the Interstate Highway System issued by the

[82] Florida Department of Transportation, *Survey of Metal Truss, Swing, and Vertical Lift Bridges in Florida* (Tallahassee, FL: Environmental Management Office, 1981).
[83] Florida Department of Transportation, *The Historic Highway Bridges of Florida* (Tallahassee, FL: Environmental Management Office, 1992).
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Advisory Council on Historic Preservation; and the Interstate Highway Exemption enacted in Section 6007 of the *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU).

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- Bridge files at the District Bridge Maintenance Offices, including bridge inspection reports, photo inventories, bridge histories, and correspondence regarding bridge alterations;
- Bridge design manuals from the 1960s;
- FMSF forms for documented bridges;
- Cultural Resource Assessment Survey reports on file at the DHR;
- NRHP registration forms and determinations of eligibility;
- SHPO correspondence regarding bridge eligibility for listing in the NRHP;
- Files maintained by the state's water management districts;
- Miscellaneous resources at the University of South Florida and the University of Central Florida libraries;
- Miscellaneous materials at the Florida State Archives, including the digital archives; and
- Books, articles, and manuscripts concerning general bridge history, engineering, and construction, including the National Cooperative Highway Research Program's publication, *A Context for Common Historic Bridge Type*, and the FHWA's *Bridge Inspector's Reference Manual;*
- Articles published in journals and papers presented at conferences; and
- Historic maps, plats, and aerial photographs, used to confirm the locations of historic bridges.

The most comprehensive source of current information about bridges along public highways is the NBI, maintained by the FHWA. The NBI provides data such as location, ownership, and physical features, as well as condition and appraisal ratings, for culverts and bridges greater than 20 feet in length. In Florida, this data is collected for bridges in use as part of regular bridge inspections by the FDOT, which generally are conducted every two years. Included in the NBI data is descriptive information such as bridge length and width, the number of main and approach spans, superstructure types (for both the main and approach spans), superstructure and deck materials, and dates of construction and reconstruction. Using a cut-off date of 1970, the NBI was used to identify highway bridges that were not previously recorded in the FMSF, but that were potential candidates for inclusion in this survey update. The NBI lists approximately 11,800 bridges in Florida. An initial screening eliminated all bridges built after 1970; all bridges that are part of the Interstate Highway System (IHS); and all bridges not located on public roads, such as those on military lands, tribal lands, and in state and national parks. As a result, 4,160 bridges were identified for consideration.

Additionally, interviews with FDOT District Bridge Engineers, Cultural Resource Coordinators, and local government engineers helped identify significant bridges that were not readily identifiable from the NBI list and other data sources. Interviews were conducted either in person or via electronic mail. Also, a questionnaire was sent to FDOT personnel and the heads of regional Metropolitan Planning Organizations and Transportation Planning Organizations, as well as attendees of a monthly meeting of the American Society of Highway Engineers (ASHE) held in Tampa. This questionnaire asked the recipients to provide information on bridges that were constructed in the 1960s that were considered:

- excellent examples of construction materials or engineering methods considered innovative in the 1960s;
- representative of construction materials or engineering methods not usually found in bridges from the 1960s;
- representative of architectural or aesthetic design elements not commonly seen in 1960s bridges;
- constructed through major federal, state, or local funding programs of the 1960s;
- constructed as a direct result of new federal or state legislation, such as the 1962 Federal-Aid Highway Act and the resulting comprehensive transportation plans carried out by newly established Metropolitan Planning Organizations;
- associated with events or persons significant in 1960s social history; or
- associated with the development of barrier islands or other areas that had limited access prior to the bridge construction.

The questionnaire also asked recipients to identify bridges that had received engineering or design awards, that were designed by renowned engineers, or that were rare examples of bridge types no longer constructed.

At several stages in the study process, informal meeting were held with structural engineers Bob Heck and Frank Haunstetter of Cardno/TBE to address specific bridge issues. Mr. Haunstetter also provided clarification and answered questions relevant to 1960s bridge design and construction.

Field Survey

Of the 4,160 bridges pre-1971 candidate bridges identified during the research, approximately 520 were selected for a district-by-district, statewide field survey. ACI Architectural Historians Elaine Lund, Kisa Hooks, and Marielle Lumang conducted the field survey over a period of six months in 2009 and 2010. With the exception of a few inaccessible structures, all bridges identified as previously listed in or eligible for listing in the NRHP, plus all additional bridges considered eligible or likely eligible for listing, were field inspected. Each bridge was documented with color digital photographs to include the bridge roadway, profile, and distinguishing engineering and architectural features. To supplement the information derived from the field survey, ACI reviewed Bridge Inspection Reports, photo inventories, and bridge histories (when available) from the District Bridge Maintenance Offices, as well as FMSF records, NRHP registration forms, cultural resource assessment survey reports, Section 106 Case Study Reports, and other relevant materials.

Analysis

The analysis of Florida's historic highway bridges included status updates on bridges considered eligible for listing in the NRHP in 2000; the identification of severely altered or demolished bridges that were considered eligible for listing in 2000; the identification of bridges considered newly eligible for listing in the NRHP; the preparation of new and updated FMSF historic bridge forms; and preparation of this thematic NRHP Multiple Property cover nomination for candidate bridge groups.

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At several stages in the study process, informal meeting were held with structural engineers Bob Heck and Frank Haunstetter of Cardno/TBE to address specific bridge issues. Mr. Haunstetter also provided clarification and answered questions relevant to 1960s bridge design and construction.

Field Survey

Of the 4,160 bridges pre-1971 candidate bridges identified during the research, approximately 520 were selected for a district-by-district, statewide field survey. ACI Architectural Historians Elaine Lund, Kisa Hooks, and Marielle Lumang conducted the field survey over a period of six months in 2009 and 2010. With the exception of a few inaccessible structures, all bridges identified as previously listed in or eligible for listing in the NRHP, plus all additional bridges considered eligible or likely eligible for listing, were field inspected. Each bridge was documented with color digital photographs to include the bridge roadway, profile, and distinguishing engineering and architectural features. To supplement the information derived from the field survey, ACI reviewed Bridge Inspection Reports, photo inventories, and bridge histories (when available) from the District Bridge Maintenance Offices, as well as FMSF records, NRHP registration forms, cultural resource assessment survey reports, Section 106 Case Study Reports, and other relevant materials.

Analysis

The analysis of Florida's historic highway bridges included status updates on bridges considered eligible for listing in the NRHP in 2000; the identification of severely altered or demolished bridges that were considered eligible for listing in 2000; the identification of bridges considered newly eligible for listing in the NRHP; the preparation of new and updated FMSF historic bridge forms; and preparation of this thematic NRHP Multiple Property cover nomination for candidate bridge groups.

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UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
EVALUATION/RETURN SHEET

Requested Action: COVER DOCUMENTATION

Multiple Name: Florida's Historic Highway Bridges MPS

State & County: FLORIDA, Hillsborough

Date Received: 8/9/2017 Date of 45th Day: 9/25/2017

Reference number: MC100001667

Reason For Review:

__ Appeal	__ PDIL	__ Text/Data Issue
__ SHPO Request	__ Landscape	__ Photo
__ Waiver	__ National	__ Map/Boundary
__ Resubmission	__ Mobile Resource	__ Period
__ Other	__ TCP	__ Less than 50 years
	__ CLG	

__X__ Accept _____ Return _____ Reject __9/25/2017__ Date

Abstract/Summary Comments: Very good context document for highway bridges, one that emphasizes the importance of bridges as key links in transportation corridors and that links them to subsequent economic development

Recommendation/ Criteria: Accept cover

Reviewer: Jim Gabbert Discipline: Historian

Telephone: (202)354-2275 Date: ____________

DOCUMENTATION: see attached comments: No see attached SLR: No

If a nomination is returned to the nomination authority, the nomination is no longer under consideration by the National Park Service.

FLORIDA DEPARTMENT *of* STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

August 4, 2017

J. Paul Loether, Deputy Keeper and Chief,
National Register of Historic Places
Mail Stop 7228
1849 C St, NW
Washington, D.C. 20240

Dear Mr. Loether:

The enclosed disks contain the true and correct copy of the nomination for the **Florida's Historic Highway Bridges Multiple Property Submission Cover Document** and the **Michigan Avenue Bridge, Tampa Hillsborough County, Florida (FMSF# HI06672)**, to the National Register of Historic Places. The related materials (digital images, maps, and site plan) are included.

Please do not hesitate to contact me at (850) 245-6364 if you have any questions or require any additional information.

Sincerely,

Ruben A. Acosta

Ruben A. Acosta
Supervisor, Survey & Registration
Bureau of Historic Preservation

RAA/raa

Enclosures