CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39, HAULOVER CANAL BRIDGE (John F. Kennedy Space Center)
Kennedy Parkway N, crosses the 'new' Haulover Canal
John F. Kennedy Space Center (outside of controlled access area)
Cape Canaveral
Brevard County
Florida

HAER No. FL-8-C

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
U.S. Department of the Interior
100 Alabama Street, SW
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CANAVERAL AIR FORCE STATION,
LAUNCH COMPLEX 39, HAULOVER CANAL BRIDGE
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Location: Kennedy Parkway N, crosses the 'new' Haulover Canal
John F. Kennedy Space Center (outside of controlled access area)
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Florida

The center of the Haulover Canal Bridge is located at latitude: 28.736383, longitude: -80.754658. These coordinates were obtained on March 28, 2013, through Google Earth™. The coordinates datum are North American Datum 1983.

Present Owner/
Occupant: National Aeronautics and Space Administration (NASA)
Kennedy Space Center, FL 32899-0001

Present Use: Transportation facility-bridge

Significance: The Haulover Canal Bridge was determined eligible for listing in the National Register of Historic Places in 2013. It is significant under Criterion A in the areas of Transportation, Community Planning and Development, and Space Exploration, and under Criterion C in the area of Engineering. The Haulover Canal Bridge, along with the Indian River Bridge and the Banana River Bridge, are associated with the early development of the John F. Kennedy Space Center (KSC) and were "essential for the flow of thousands of new employees, building materials, and spacecraft parts to and from KSC."[1]

Historian: Patricia Slovinac, Architectural Historian
Archaeological Consultants, Inc. (ACI)
8110 Blaikie Court, Suite A
Sarasota, Florida 34240

March 2014

Project Information: The documentation of the Cape Canaveral Air Force Station (CCAFS), Launch Complex 39, Haulover Canal Bridge was conducted in 2013 for

[1] David Price, "Architectural Survey and Evaluation of 45 Facilities That Have Reached the Age of 45-50 Years, John F. Kennedy Space Center, Brevard County, Florida," survey report, New South Associates, Stone Mountain, GA, 2013, 84.

KSC by ACI, under contract to InoMedic Health Applications (IHA), and in accordance with KSC's Programmatic Agreement Regarding Management of Historic Properties, dated May 18, 2009. The field team consisted of architectural historian, Patricia Slovinac (ACI), and independent photographer, Penny Rogo. Assistance in the field was provided by Barbara Naylor, KSC Historic Preservation Officer, and Nancy English, KSC Cultural Resource Specialist. The written narrative was prepared by Ms. Slovinac; it was edited by Joan Deming, ACI Project Manager; Elaine Liston, KSC Archivist; Ms. Naylor and Ms. English; and Jane Provancha, Environmental Projects-Manager, IHA. The photographs and negatives were processed by Zebra Color, Inc., an independent photography/processing studio.

The Scope of Services for the project, which was written based on the Programmatic Agreement, specifies a documentation effort following HAER Level II Standards. Information for the written narrative was primarily gathered through informal interviews with current NASA and contractor personnel and research materials housed at the KSC Archives Department. A search for historic photographs was also conducted at the Kennedy Institutional Imaging Facility. Selected drawings were provided by KSC's Engineering Documentation Center, which serves as the repository for all facility drawings. It should also be noted that KSC does not periodically produce drawings of their facilities to show current existing conditions.

Besides the Haulover Canal Bridge, there are two additional bascule bridges within KSC that were determined eligible for the National Register: the Banana Creek Bridge and the Indian River Bridge. Because the bascule spans for all three bridges are nearly identical, in compliance with Stipulation V.A.2 of the Programmatic Agreement and at the suggestion of the KSC Historic Preservation Officer, only the Haulover Canal Bridge was fully documented as part of this effort. A brief history of the other two bridges, as well as a discussion of their physical differences, is included in Appendix B.

LIST OF ACRONYMS

ACI	Archaeological Consultants, Inc.
ACOE	U.S. Army Corps of Engineers
AMR	Atlantic Missile Range
AS	Apollo-Saturn
CCAFS	Cape Canaveral Air Force Station
IHA	InoMedic Health Applications
KSC	Kennedy Space Center
LC	Launch Complex
LOC	Launch Operations Center
LOD	Launch Operations Directorate
MILA	Merritt Island Launch Area
MR	Mercury-Redstone
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
SA	Saturn-Apollo
STS	Space Transportation System
U.S.	United States

Part I. Historical Information

A. Physical History:

1. **Date of construction:** October 7, 1964, through October 1, 1965.[2]

2. **Architect/Engineer:** U.S. Army Corps of Engineers (ACOE)-Canaveral District, Merritt Island, Florida.[3]

3. **Builder:** B. B. McCormick and Sons, Titusville, Florida.[4]

4. **Original plans and construction:** For the most part, the Haulover Canal Bridge at the time of documentation resembles the original. The alignment of the bridge has not changed, nor has a majority of its materials.

5. **Alterations and additions:** Circa 1991, the control mechanisms for the bridge were modified.[5] In addition, the original windows in the Control House were replaced at an unknown date.[6]

B. Historical Context:

Introduction

Following the launch of Sputnik I and Sputnik II, which placed Soviet satellites into Earth's orbit in 1957, the attention of the American public turned to space exploration. President Dwight D. Eisenhower initially assigned responsibility for the U.S. Space Program to the Department of Defense. The Development Operations Division of the Army Ballistic Missile Agency, led by Dr. Wernher von Braun, began to focus on the use of missiles to propel payloads, or even a man, into space. The United States successfully entered the space race with the launch of the Army's scientific satellite Explorer I on January 31, 1958, using a modified Jupiter missile named Juno I.[7]

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[2] NASA KSC, "Real Property Record, Haulover Canal Bridge," on file, KSC Real Property Office.
[3] U.S. Army Corps of Engineers, Merritt Island, "Plans of Proposed Road and Bridge Haulover Canal (to Volusia County Line)" (architectural drawings, NASA KSC, August 1964), on file, KSC Engineering Documentation Center, Florida.
[4] NASA KSC, "Haulover Canal Bridge."
[5] NASA KSC, "Haulover Canal Bridge."
[6] It is possible that the windows were replaced in 1972 when a tornado hit the area and knocked out two of the windows. "Photo Caption," *Spaceport News*, April 6, 1972: 8.
[7] Charles D. Benson and William B. Faherty, *Gateway to the Moon. Building the Kennedy Space Center Launch Complex* (Gainesville, FL: University Press of Florida, 2001), 1-2.

With the realization that the military's involvement in the space program could jeopardize the use of space for peaceful purposes, President Eisenhower formed NASA on October 1, 1958, as a civilian agency with the mission of carrying out scientific aeronautical and space exploration, both manned and unmanned. At this time, several Army facilities at CCAFS were given to NASA, including various offices and hangars, as well as launch complexes (LCs) 5, 6, and 26. Within one year of its establishment, NASA had formulated the basics for its first three Manned Space Programs: Project Mercury (ca. 1958-1963), Project Gemini (ca. 1959-1966), and the Apollo Program (ca. 1959-1975).

During NASA's formative years, the Agency worked with the Army Ballistic Missile Agency's Development Operations Division, as it provided the Redstone rockets for the early Project Mercury missions and was in the process of developing the Saturn rocket, which would be used for Apollo. The Development Operations Division had maintained its Missile Firing Laboratory, under the direction of Dr. Kurt H. Debus, at CCAFS since 1951 to supervise the experimental launches of the Redstone missile.[8] On March 15, 1960, President Eisenhower officially transferred the Development Operations Division to NASA, naming the new installation the George C. Marshall Space Flight Center (MSFC). Two months later, the Missile Firing Laboratory oversaw the first test flight of a Redstone modified for Project Mercury, which launched from LC 5 at CCAFS.[9]

On July 1, 1960, the Missile Firing Laboratory, along with the Atlantic Missile Range Operations Office, became the Launch Operations Directorate (LOD) and was absorbed by MSFC.[10] Over the next two years, the LOD assisted NASA in the launch of five additional Redstone rockets as part of Project Mercury. This included three test flights (Mercury-Redstone (MR)-1, MR-1A, and MR-2), and two manned launches (MR-3 and MR-4), which carried Alan B. Shepard, Jr., and Virgil I. "Gus" Grissom to space, respectively. The LOD also launched one test flight for the Apollo Program, Saturn-Apollo (SA)-1 from LC 34 on October 27, 1961, the first test flight of the Saturn I vehicle.[11]

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[8] Francis E. Jarrett, Jr. and Robert A. Lindemann, *Historical Origins of NASA's Launch Operations Center to July 1, 1962* (Cocoa Beach, FL: John F. Kennedy Space Center, 1964), http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19670031213_1967031213.pdf. The Redstone missile, which holds "the distinction of being the first operational US ballistic missile," was developed by von Braun's group in the early 1950s as an adaptation of the Navaho cruise missile. The first test of the Redstone occurred at LC 4 at CCAFS on August 20, 1953; the missile was declared operational in June 1958. Cliff Lethbridge, "Redstone Fact Sheet," 2000, http://www.spaceline.org/rocketsum/redstone.html.

[9] Kay Grinter, "Beach-Abort (7)," 2000, http://www-pao.ksc.nasa.gov/kscpao/history/mercury/beach-abort/beach-abort.htm.

[10] Benson and Faherty, *Gateway*, 15, 136; Jarrett and Lindemann, *Launch Operations Center,* 68. The Atlantic Missile Range Operations Office was a NASA liaison group established in 1958 to coordinate the scheduling and use of CCAFS facilities with the Atlantic Missile Range/CCAFS.

[11] E. Bell, II, "Saturn SA-1," 2012, http://nssdc.gsfc.nasa.gov/nmc/masterCatalog.do?sc=SATURNSA1. Because the rocket used to launch the Gemini spacecraft was the Air Force's Titan missile, the LOD's support of Project Gemini,

NASA's John F. Kennedy Space Center

On May 25, 1961, sixteen days after the flight of Alan Shepard, President John F. Kennedy charged NASA with putting a man on the Moon by the end of the decade. With the Agency's decision to use the powerful Saturn V launch vehicle, it was apparent that a new launch complex was required, and CCAFS, already with twenty-two launch complexes, did not have the space for new rocket facilities. After an evaluation of nine potential launch sites throughout the U.S. and nearby islands, NASA chose to acquire land on Merritt Island, an undeveloped area west and north of the existing CCAFS missile launching area. By September 1961, the initial master plan for what would initially be referred to as NASA's Merritt Island Launch Area (MILA) was completed. In late 1962, NASA began to gain title to the land, with the ACOE acting as purchasing agent. Over 83,903.9 acres were acquired by outright purchase, which included several small towns, such as Orsino, Wilson, Heath and Audubon, many farms, citrus groves, and several fish camps. Negotiations with the State of Florida provided submerged lands, resulting in the acquisition of property identified on the original Deed of Dedication. Much of the State-provided land was located south of the Old Haulover Canal and north of the barge canal/terminal facility.[12]

As work on the Apollo Program progressed, it became clear to NASA Headquarters that the LOD needed to be an independent center. On March 7, 1962, NASA announced the separation of the LOD from MSFC, and its establishment as an independent field installation, the Launch Operations Center (LOC), effective July 1, 1962; Dr. Debus was appointed the Center's first Director.[13] The LOC "would serve all NASA projects at Cape Canaveral, and would consolidate under a single official all of NASA's operating relationships with the Air Force Commander of AMR [Atlantic Missile Range]."[14] Because of the increase in responsibilities, the LOC acquired new personnel. While most offices, or directorates, remained at CCAFS, crammed in tiny spaces, some groups were forced to find space in buildings throughout the cities of Cape Canaveral and Cocoa Beach. The various directorates would remain in these facilities until the new buildings at MILA were completed.[15] Eventually, MILA incorporated the LOC as part of its jurisdiction; the

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NASA's second Manned Space Program, was limited to acting as NASA's point of contact with CCAFS and gathering/processing telemetry measurements.

[12] Benson and Faherty, *Gateway*, 96-107. The Old Haulover Canal, constructed circa 1854, is located roughly 0.9 miles southeast of the 'new' Haulover Canal, the latter of which is crossed by the Haulover Canal Bridge. The Old Haulover Canal, which is listed in the National Register of Historic Places, was constructed at the narrowest point of Merritt Island to link the Mosquito Lagoon with the Indian River for watercraft. This location historically had served as a crossover point between the Lagoon and River, where cargo was carried across the Island prior to the construction of the canal. The Old Haulover Canal was abandoned circa 1884 when the 'new' Haulover Canal was built to support larger watercraft. Robert G. Yoder, *National Register Nomination: Old Haulover Canal* (Washington, DC: National Park Service, 1973).

[13] Jarrett and Lindemann, *Launch Operations Center*, 79.

[14] Jarrett and Lindemann, *Launch Operations Center*, 80.

[15] Benson and Faherty, *Gateway*, 138-39.

entirety was renamed the John F. Kennedy Space Center in November 1963 following the death of the President.[16]

A Manned Lunar Landing Program Master Planning Board, which consisted of NASA and Air Force personnel, was established to oversee the development of the new center on Merritt Island. Pan American was hired to complete the master plan for the center; the ACOE served as the LOC's supervisory design and construction agent.[17] The master plan, mostly developed between 1961 and 1965, divided MILA into four functional zones: the launch zone, the launch support zone, the industrial zone, and the general support zone. The zones were arranged to maximize the protection of people and facilities from the four common types of launch hazards: blast, acoustic, toxic, and nuclear.[18]

The launch zone consisted of the launch pads and their direct support structures, such as fuel storage facilities, arming towers, and cable terminal buildings; this area was constructed along the shoreline between CCAFS and Playalinda Beach. The launch support zone, or Vehicle Assembly Building Area located roughly 3 miles southwest of the launch zone, included the assembly building, Launch Control Center, and other facilities that directly supported launch activities. The industrial zone, or Industrial Area, included assembly and checkout facilities, engineering and administrative facilities, such as the Headquarters Building, and employee/center support services. The general support zone contained support structures, such as instrumentation sites, security control buildings, and telemetry receiver areas; these are interspersed throughout the Center.[19]

Construction of KSC began in 1962, when the ACOE and hired contractors began to prepare the swampy land for the required facilities. Canals were dredged, with the sand used to compact and flatten the ground where the launch pads would be built. Surface water was then drained into the canals. Over the next four years, the majority of the Center's key facilities, such as the VAB, the Launch Control Center, LC 39, Pad A, the barge canal and terminal facility, ordnance storage and laboratory areas, the Crawlerway, the Operations & Checkout Building, the Central Instrumentation Facility, and the Headquarters Building, were completed.[20]

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[16] Benson and Faherty, *Gateway*, 65-68, 96-98, 105, 133-137, 146-48.
[17] Benson and Faherty, *Gateway*, 252-253; E.R. Bramlitt, *History of Canaveral District 1950-1971* (Cape Canaveral, FL: South Atlantic Division, U.S. Army Corps of Engineers, 1971).
[18] Pan American World Airways, Guided Missiles Range Division, *Analytical Report for NASA Merritt Island Launch Area Master Plan, Volume III* (Cape Canaveral, FL: Pan American World Airways, 1962), Sweetsir Collection, File No. ARCH00017252, KSC Archives Department, Florida; Pan American World Airways, Guided Missiles Range Division, *Analytical Report for NASA Merritt Island Launch Area Master Plan, Volume III* (Cape Canaveral, FL: Pan American World Airways, 1965), Sweetsir Collection, File No. ARCH00017254, KSC Archives Department, Florida.
[19] Pan American World Airways, *Merritt Island Launch Area Master Plan, Volume III*, 1965.
[20] Benson and Faherty, *Gateway*, 247-270.

The original master plan for MILA/KSC depicted the planned transportation routes that would provide automobile access to the Center. The plan showed that at the time of land acquisition, State Road 3/Merritt Island Road (presently called Kennedy Parkway North within the boundaries of KSC and North Courtenay Parkway outside the KSC boundaries) was the main north-south road, and State Road 401 was the main east-west road. These, along with numerous secondary roads that provided access to the former communities and individual properties, amounted to roughly 69 miles of paved road within KSC; however, none of the roads was suitable for the projected heavy use. NASA coordinated the rehabilitation of existing roads/construction of new roads with the Florida Department of Transportation (then, the Florida State Road Department); NASA primarily managed those roads within the Center (Figure No. A-1) while the Florida Department of Transportation focused on those outside the Center, although there was some overlap.[21]

The principle components of NASA's efforts were the construction of a new road, Orsino Causeway (presently known as NASA Causeway/NASA Parkway/State Road 405), between U.S. 1 and CCAFS and the renovation of State Road 3. The Orsino Road project included the construction of two bridges: the Indian River Bridge and the Banana River Bridge. The State Road 3 work involved the replacement of an existing wooden bridge over the Haulover Canal with a new bridge. All three bridges featured nearly identical double-leaf bascule main spans; their key difference was the number of approach spans due to the width of the body of water they crossed.[22]

During the initial planning phases, NASA considered many options for the Haulover Canal area based on ease of travel (both vehicular and watercraft), potential access restrictions, and cost effectiveness (construction and maintenance). Planners had discussed single- and double-leaf bascule bridges over the canal; maintaining the existing one-lane, hand-operated wood swing bridge; and relocating the Intracoastal Waterway passage. By July 1963, it was decided that a double-leaf bascule bridge would replace the existing bridge, a 5-mile section of roadway between the canal and Volusia County would be rebuilt, and there would be no relocation of the Waterway, because there was no space program that required the action.[23]

The drawings for the 5-mile segment of State Road 3 and the Haulover Canal Bridge were completed by the ACOE in August 1964; bids for their construction were opened on September

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[21] Pan American World Airways, *Merritt Island Launch Area Master Plan, Volume III*, 1962; "Merritt Island Master Plan," (architectural drawings, NASA KSC, March 1963).

[22] The written narrative of this report focuses on the Haulover Canal Bridge. The history and physical differences of the Indian River Bridge and Banana River Bridge are discussed in Appendix B.

[23] C. Bidgood, "Course of Action Relative to Area IV Improvements Programmed in FY 1963," memo to Lt. Col. R. A. Petrone, July 15, 1963, Box 14A.2, Folder No. 77, Land Management Collection, KSC Archives Department, Florida.

17, 1964.[24] The contractor, B. B. McCormick and Sons, commenced construction of the new Haulover Canal Bridge on October 7, 1964 (Figure Nos. A-2 through A-5). The existing bridge remained in operation during the construction.[25] On January 1, 1965, KSC formally assumed operational and maintenance responsibilities for the Old Haulover Canal bridge and the 5-mile segment of State Road 3 from the canal to the Volusia County line.[26] The new bridge was completed and turned over to KSC for occupancy on October 1, 1965; around the same time, the old bridge was demolished.[27]

Since its construction, the Haulover Canal Bridge has carried automobile traffic to and from KSC. At first, KSC stationed security guards at the Haulover Canal, requiring anyone who crossed the bridge in the southbound lane to have an access badge. This restriction was removed on January 3, 1965, when KSC moved the guard stations further south, at the intersection between Kennedy Parkway North and State Road 406.[28]

The Haulover Canal Bridge has remained as originally designed and constructed only undergoing minor cosmetic or technological modifications. On March 31, 1972, a tornado caused some damage to the bridge when it blew away the traffic control gates at the north end and knocked out two windows in the control tower.[29] Four years later, in 1976, a new generator was installed on the bridge.

In 1978, the Haulover Canal Bridge served as the test site for an experimental control system that would allow remote operation of the bridge, as well as the Indian River Bridge. Cameras mounted at the bridge sent images to a control console in the Launch Control Center, located more than 12 miles from the bridge. In addition, microphones and loudspeakers were mounted to the bridge fenders to allow the operator to speak with boaters.[30] Ultimately, KSC decided not to pursue remote operation of the bridge.

In the mid to late 1980s, the Haulover Canal Bridge underwent repair and refurbishment, but available sources did not provide details as to what this work entailed.[31] In 1989, the bridge's

[24] ACOE, "Plans of Proposed Road and Bridge Haulover Canal;" "Arming Tower Low Bidder Announced," *Spaceport News*, September 17, 1964: 6.
[25] Because of this, the road renovation work required a realignment of an approximate 1.3-mile segment in the vicinity of the Haulover Canal. The original road was left in place for the public to access the Canal.
[26] "Haulover Canal Bridge Harbors Rustic Memories," *Spaceport News*, December 31, 1964: 7.
[27] "New Haulover Bridge Eases Traffic Flow," *Spaceport News*, October 7, 1965: 3; KSC, "Haulover Canal Bridge."
[28] "Public Access Restrictions Relaxed," *Spaceport News*, December 31, 1964: 2.
[29] "Photo Caption." The windows in the Control House may have been replaced at this time, but available sources were not able to confirm this.
[30] "Remote Control of Bridge Being Tested," *Spaceport News*, March 3, 1978: 1 and 4.
[31] NASA KSC, "Haulover Canal Bridge."

north fender required two new timbers that were damaged by a barge.[32] In the mid-1990s, the Haulover Canal Bridge received modifications to its control and electrical systems.[33] In summer 2013, the bridge underwent preventative maintenance and a re-decking.[34]

NASA's Manned Space Programs

Initially, NASA's space program was organized into three phases: Projects Mercury, Gemini, and Apollo. Project Mercury, initiated in 1958, was executed in less than five years. Begun in 1964, Project Gemini was the intermediate step toward achieving a manned lunar landing, bridging the gap between the short-duration Mercury flights and the long-duration missions proposed for the Apollo Program. Apollo, the largest and most ambitious of the manned space programs, had as its goal the landing of astronauts on the Moon and their safe return to Earth. Providing the muscle to launch the spacecraft was the Saturn family of heavy vehicles. Saturn IB rockets were used to launch the early unmanned Apollo test flights and the first manned flight, Apollo 7, which carried astronauts on a ten-day Earth orbital mission.[35]

Three different launch vehicles were used for Apollo: Saturn I, Saturn IB and Saturn V; and three different launch complexes were involved: LC 34 and LC 37 on CCAFS, and LC 39 on KSC.[36] Altogether, thirty-two Saturn flights occurred (seven from LC 34, eight from LC 37, and seventeen from LC 39, Pad A [twelve] and Pad B [five], including Skylab and the Apollo-Soyuz Test Project) during the Apollo era. Of the total thirty-two, fifteen were manned, and of the seven attempted lunar landing missions, six were successful. No major launch vehicle failures of either Saturn IB or Saturn V occurred. There were two major command/service module failures, one on the ground (Apollo 1) and one on the way to the Moon (Apollo 13).[37]

The unmanned Apollo 4 mission, which lifted off on November 9, 1967, was the first Saturn V launch and the first launch from LC 39 (Pad A) at KSC. The next launch from LC 39 (Pad A) was Apollo 6, on July 14, 1967. Beginning with the launch of Apollo 8 on August 14, 1968, all manned missions have launched from LC 39.[38] On July 20, 1969, the goal of landing a man on

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[32] "Notes – Rice – 6/29/89," Box 57B.2, Folder No. 4, Executive Staff Notes 1989, KSC Archives Department, Florida.
[33] NASA KSC, "Haulover Canal Bridge."
[34] "Haulover Bridge Closed through mid-June," *The Daytona Beach-News Journal*, May 13, 2013, http://www.news-journalonline.com/article/20130513/news/305139997.
[35] Harry A. Butowsky, *Reconnaissance Survey: Man in Space* (Washington, DC: National Park Service, 1981), 5; Benson and Faherty, *Gateway*, 5.
[36] LC 39 is comprised of two launch pads, Pad A and Pad B. Unless otherwise noted, the term LC 39 refers to both launch pads.
[37] NASA, *Facts: John F. Kennedy Space Center* (1994), 82.
[38] Apollo 5 launched from CCAFS's LC 37B; Apollo 7 launched from LC 34 at KSC. Charles D. Benson and William B. Faherty, *Moon Launch! A History of the Saturn-Apollo Launch Operations* (Gainesville, FL: University Press of Florida, 2001), 532.

the Moon was achieved when Apollo 11 astronauts Neil A. Armstrong, Edwin E. "Buzz" Aldrin, Jr., and Michael Collins successfully executed history's first lunar landing. Armstrong and Aldrin walked on the surface of the Moon for two hours and thirty-one minutes, and collected 21 kilograms of lunar material. Apollo 17 served as the first night launch in December 1972. An estimated 500,000 people viewed the liftoff from LC 39 Pad A, which was the final launch of the Apollo Program.[39]

Skylab, an Earth-orbiting mission that was a follow-on to the Apollo Program, served as an early type of space station. With 12,700 cubic feet of work and living space, it was the largest habitable structure ever placed in orbit at the time. The station achieved several objectives: scientific investigations in Earth orbit (astronomical, space physics, and biological experiments); applications in Earth orbit (Earth resources surveys); and long-duration spaceflight. Skylab 1 orbital workshop was inhabited in succession by three crews launched in modified Apollo command/service modules (Skylab 2, 3 and 4). Actively used until February 1974, Skylab 1 remained in orbit until July 11, 1979, when it re-entered Earth's atmosphere over the Indian Ocean and Western Australia after completing 34,181 orbits.[40]

The Apollo-Soyuz Test Project of July 1975, the final application of the Apollo Program, marked the first international rendezvous and docking in space, and was the first major cooperation between the only two nations engaged in manned space flight, the U.S. and Russia. As the first meeting of two manned spacecraft of different nations in space, and the first docking and visits by astronauts and cosmonauts into the others' spacecraft, the event was highly significant. The Apollo-Soyuz Test Project established workable joint docking mechanisms, taking the first steps toward mutual rescue capability of both Russian and American manned missions in space.[41]

On January 5, 1972, President Richard M. Nixon delivered a speech in which he outlined the end of the Apollo era and the future of a reusable space flight vehicle, the Space Shuttle, which would provide "routine access to space."[42] During this speech, President Nixon instructed NASA to proceed with the design and building of a partially reusable Space Transportation System (STS; commonly referred to as the Space Shuttle) consisting of a reusable orbiter, three reusable main engines, two reusable solid rocket boosters, and one expendable external liquid fuel tank. NASA selected KSC as the primary launch and landing site for the Space Shuttle Program. KSC, responsible for designing the launch and recovery facilities, was to develop methods for shuttle assembly, checkout, and launch operations.[43]

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[39] NASA, *Facts*, 86-90.
[40] NASA, *Facts*, 91.
[41] NASA, *Facts*, 96.
[42] Marcus Lindroos, ed., "President Nixon's 1972 Announcement on the Space Shuttle," updated April 14, 2000, http://history.nasa.gov/stsnixon.htm.
[43] Linda Neuman Ezell, *NASA Historical Databook Volume III Programs and Projects 1969-1978*, The NASA History Series (Washington, DC: NASA History Office, 1988), 121-24, Table 2-57; Ray A. Williamson,

The first orbiter intended for spaceflight, *Columbia*, arrived at KSC from Air Force Plant 42, Palmdale, California, in March 1979. Originally scheduled for liftoff in late 1979, the launch date was delayed by problems with both the main engine components as well as the thermal protection system. *Columbia* spent 610 days in the Orbiter Processing Facility, another 35 days in the Vehicle Assembly Building and 105 days on LC 39, Pad A, before lifting off on April 12, 1981. STS-1, the first orbital test flight and first Space Shuttle mission, ended with a landing on April 14, 1981, at Edwards Air Force Base in California. This launch demonstrated *Columbia's* ability to fly into orbit, conduct on-orbit operations, and return safely.[44] *Columbia* flew three additional test flights in 1981 and 1982, all with a crew of two. The Orbital Test Flight Program ended in July 1982 with 95 percent of its objectives accomplished. After the end of the fourth mission, President Reagan declared that with the next flight the Shuttle would be "fully operational."

During the Space Shuttle Program, 135 missions were launched from KSC. The Space Shuttle carried a number of planetary and astronomy missions including the Hubble Space Telescope, the Galileo probe to Jupiter, Magellan to Venus, and the Upper Atmospheric Research Satellite. In addition, a series of Spacelab research missions were flown, which carried dozens of international experiments in disciplines ranging from materials science to plant biology. Between 1995 and 1998, NASA conducted a joint U.S./Russian Shuttle-*Mir* Program as a precursor to construction of the International Space Station. The Shuttle-*Mir* Program served to acclimate the astronauts to living and working in space. Many of the activities carried out were types they would perform on the International Space Station.[45] Construction of the station began in 1998; it was completed in 2011.

The Space Shuttle Program suffered two major setbacks with the tragic losses of the *Challenger* and *Columbia* on January 28, 1986, and February 1, 2003, respectively. *Challenger* was destroyed 73 seconds after launch due to a faulty O-ring seal in the right solid rocket booster; the crew of seven astronauts all perished. *Columbia* was lost because of a breach in the thermal protection system on the leading edge of the left wing, caused by a piece of insulating foam, which separated from the external tank after launch and struck the wing.[46] Sixteen minutes prior to its scheduled touchdown at KSC, the spacecraft broke apart during reentry over eastern Texas and all seven members of the crew perished.

"Developing the Space Shuttle," in *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program, Volume IV: Accessing Space*, ed. John M. Logsdon (Washington, DC: U.S. Printing Office, 1999), 172-174.

[44] Dennis R. Jenkins, *Space Shuttle, The History of the National Space Transportation System. The First 100 Missions* (Cape Canaveral, FL: Specialty Press, 2001), 99.

[45] Judy A. Rumerman, with Stephen J. Garber, *Chronology of Space Shuttle Flights 1981-2000* (Washington, DC: NASA History Division, 2000), 3.

[46] Columbia Accident Investigation Board, *Report, Volume I*, (Washington, DC: U.S. Government Printing Office, 2003), 25, http://history.nasa.gov/columbia/CAIB_reportindex.html.

Part II. Structural/Design Information

A. General Statement:

1. Character: The Haulover Canal Bridge (Photo Nos. 1, 2, 3) is a double-leaf, steel trunnion bascule bridge with concrete approaches, a concrete substructure, and a concrete control house on its northeast side. The bridge is oriented along a northwest-southeast axis and carries the two-lane, Kennedy Parkway North over the Haulover Canal.

2. Condition of fabric: The Haulover Canal Bridge is in good condition due to a rehabilitation effort May-September 2013.

B. Description: The Haulover Canal Bridge has approximate overall dimensions of 225'-3" in length, 54' in width, and 50' in height (above mean sea level); the roadway surface is roughly 32' above mean sea level. It is comprised of one main span, two piers, two approach spans (one to either side of the bascule), two abutments, and one Control House.

The main span consists of a double-leaf steel trunnion bascule, which has a width of 33' and measures 142'-9" in length at the road surface (Photo Nos. 3, 6). The two bascule leafs are identical, with a length of 84'-9" including the road deck portion of the leaf (54' in length), the trunnion section (roughly 16'-6" in length), and the counterweight mechanism (about 14'-3" in length).[47] The road deck portion of each leaf is supported by two main girders, six longitudinal stringers, and four lateral stringers. The main girders are positioned on the east and west sides and extend for the entire length of the bascule leaf; they range in depth from 3'-1", where the two leafs meet, to 6'-6", at the trunnion, to 4' at the end of the counterweight mechanism. The longitudinal stringers are between the main girders and are spaced roughly 3'-9" on center. The lateral stringers have a spacing of approximately 17'-7" on center. In the trunnion portion of the bascule leaf, the longitudinal stringers are spaced 3'-9" apart; there are no lateral stringers in this section. In the counterweight mechanism, the longitudinal stringers have a spacing of roughly 6'-8" on center, and the five lateral supports are spaced roughly 4'-3" on center. Each bascule leaf also has cross bracing, mounted to the underside of the longitudinal stringers, to provide further support for the bridge loads. The top surface of each bascule leaf is comprised of open steel grating in the deck area and a layer of concrete over steel plating in all other areas.

The bascule crosses a 90' channel, on either side of which is an approximately 179'-long arced fender comprised of two-, three-, and seven-bundle concrete piles faced with horizontal timber wales; the purpose of the fenders is to protect the bridge from boats passing through the channel.

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[47] The counterweight mechanism and trunnion for each bascule leaf rest below the road surface of the approach spans. Together, the two bascule leafs have a total length of 169'-6".

A catwalk extends for the entire length of each fender, and a red navigation light is located at both ends of each fender.

The Haulover Canal Bridge has two piers, Pier A and Pier B. Pier A is located to the northwest and supports the ‘north’ bascule leaf; Pier B is situated to the southeast, supporting the ‘south’ bascule leaf (Photo No. 8). Both piers are rectangular in plan, with approximate dimensions of 18’-6” in length, 42’ in width, and 34’ in height above mean sea level; each pier further extends to roughly 18’ below mean sea level, excluding the pilings. The piers are comprised of reinforced concrete and are fitted with niches and spaces (accessed by ladders or doors) for mechanical and electrical equipment. The bascule trunnion and operating machinery are located within one of the niches near the top of each pier. The centerline of the trunnion is situated approximately 10’-6” from the inner face of its supporting pier and roughly 4’-4.5” below the road surface (about 27’-5.5” above mean sea level). The bascule operating machinery is located below the trunnion, roughly 18’ above mean sea level (Photo No. 7).

The two approach spans are fixed steel girders, each of which measures 41’-3” in length and 33’ in width. Each span has a superstructure that consists of a reinforced concrete slab supported by steel girders. The four longitudinal girders are about 2’ in height and are spaced at 26’-5.5” on center. There are three latitudinal girders that are about 1’-9” in height and are spaced so there is one at each end of the approach span and one in the center. The approach spans are supported by the end abutments and main piers. Each of the two abutments is comprised of three reinforced concrete walls. One of the walls sits adjacent and parallel to the canal and supports the outer end of the approach span; the other two walls extend away from the canal at a 45-degree angle to the waterway. Each wall of the abutments measures 2’-9” thick at the bottom, which rests on a reinforced concrete base that is 2’-5” thick. The wall supporting the approach span tapers to roughly 1’-6” at the top. The other two walls taper to about 1’ at the top, and their overall height diminishes towards the outer end.

The bridge’s Control House, which has approximate overall dimensions of 18’-6” in length, 12’-9” in width, and 26’-8” in height, is cantilevered off the northeast side of Pier A (Photo Nos. 9, 10). It is constructed of reinforced concrete, features a flat roof, and contains three internal levels. A one-light metal swing door on the southwest elevation provides access to the middle level of the Control House. This level sits approximately 6” above the road surface, is in the form of a trapezium, and has an area of roughly 218 square feet. It is divided into two spaces: an electrical equipment room at the southeast end and a storage area at the northwest end. A ladder in the west corner provides access to the bottom level of the structure, while a ladder in the north corner leads to the top level. The 218 square foot bottom level, which sits roughly 7’ below the road surface and also is a trapezium in plan, contains the electrical generator and auxiliary power panel for the bridge. The rectangular, 168 square foot top level, roughly 9’-5” above the road surface, serves as the control room (Photo No. 11). The control panel for the bascules is located along the southeast wall (Photo No. 12); an L-shaped desk area extends along portions of the southwest and northwest walls. Beginning roughly 3'-8" above the finished floor of this level, the wall material changes to glass panels, which slant outward from the bottom to the top. The two center panels are one-over-one single hung sash windows,[48] and the two outer panels are one-light fixed windows. Above the windows, projecting from the exterior wall surface, are extruded aluminum louvers.

C. Mechanicals/Operation: The Haulover Canal Bridge's Control House is manned twenty-four hours a day, seven days a week; the tenders typically prefer to use the automatic controls, rather than the manual controls, to operate the bascule. Additionally, the bascule can be operated from the equipment room, if necessary.

When a boat nears the bascule, its captain radios the bridge tender; the call numbers are posted on metal signs attached to the railings. The bridge tender then presses the "begin raise sequence" button. At this point, the traffic signal for automobiles changes to red, the gate flashers start, and the roadway gongs sound. After checking for traffic, the tender lowers the oncoming traffic gates followed by the offgoing traffic gates, using their individual down buttons. Once these steps are completed, the tender proceeds with pressing the "raise" button on the control panel. This initializes the opening process, which includes pulling the lock bars, sounding the horn, and raising the bascule leafs, which take roughly ninety seconds to open to the full 76 degrees.[49]

Once the boat is past the bridge, the tender begins the lowering process by pressing the "begin lower sequence" button, and the warning horn sounds five times. After the horn has sounded, the tender presses the "lower" button, which brings the bascule leafs to their seated position and drives the lock bars. Afterwards, the roadway control gates are raised and the traffic signals are changed to green.[50]

D. Site Information: The Haulover Canal Bridge is oriented along a northwest-southeast axis. It carries Kennedy Parkway North over the Haulover Canal, which has a southwest-northeast orientation. The Haulover Canal and Bridge are located outside of the controlled access area of KSC, but within the boundaries of the Merritt Island National Wildlife Refuge. A manatee viewing area sits directly northeast of the bridge, and a boat ramp is located roughly 1,100' to the southwest of the bridge. Paved roads provide access to the manatee viewing area and boat ramp; dirt roads provide access to the northwest and southeast canal shores.

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[48] Originally, these windows were four-light awning.

[49] Paula Eri, *Haulover Canal Bridge, Operating Instructions* (Florida: Kennedy Space Center, 2009), 10-11. When operating the bridge manually from the Control House, the tender presses different buttons to pull the span locks, raise the bascule leafs, and sound the horn, in that order. Eri, *Haulover Canal Bridge,* 7. Similarly, when operating the bridge from the equipment room, each step of the process was initiated separately. In addition, the operator had to yell "all clear" from the room. Eri, *Haulover Canal Bridge,* 17.

[50] Eri, *Haulover Canal Bridge,* 11. As with the manual raising of the bridge, the manual operations to lower the bridge require separate buttons for each task. Eri, *Haulover Canal Bridge,* 7-8.

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APPENDIX A: Historic Photos of the Haulover Canal Bridge

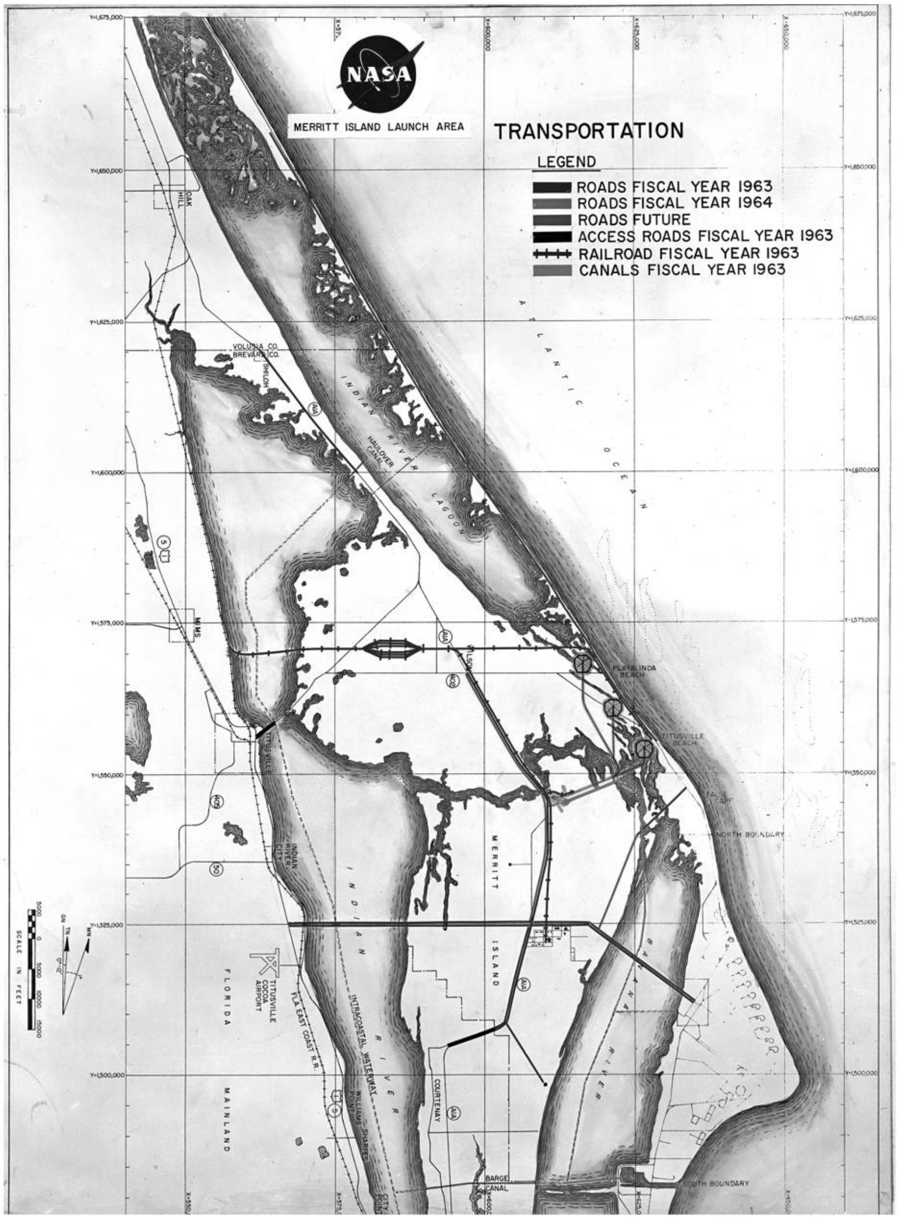


Figure A-1. Chart of KSC Roads, Highways, Railroads, and Causeways, May 7, 1963.
Source: Kennedy Institutional Imaging Facility, LOC-63C-1296.

Figure A-2. Construction of the Haulover Canal Bridge (old wooden bridge to right), camera facing southeast, March 11, 1965.
Source: Kennedy Institutional Imaging Facility, 100-KSC-65-5511.

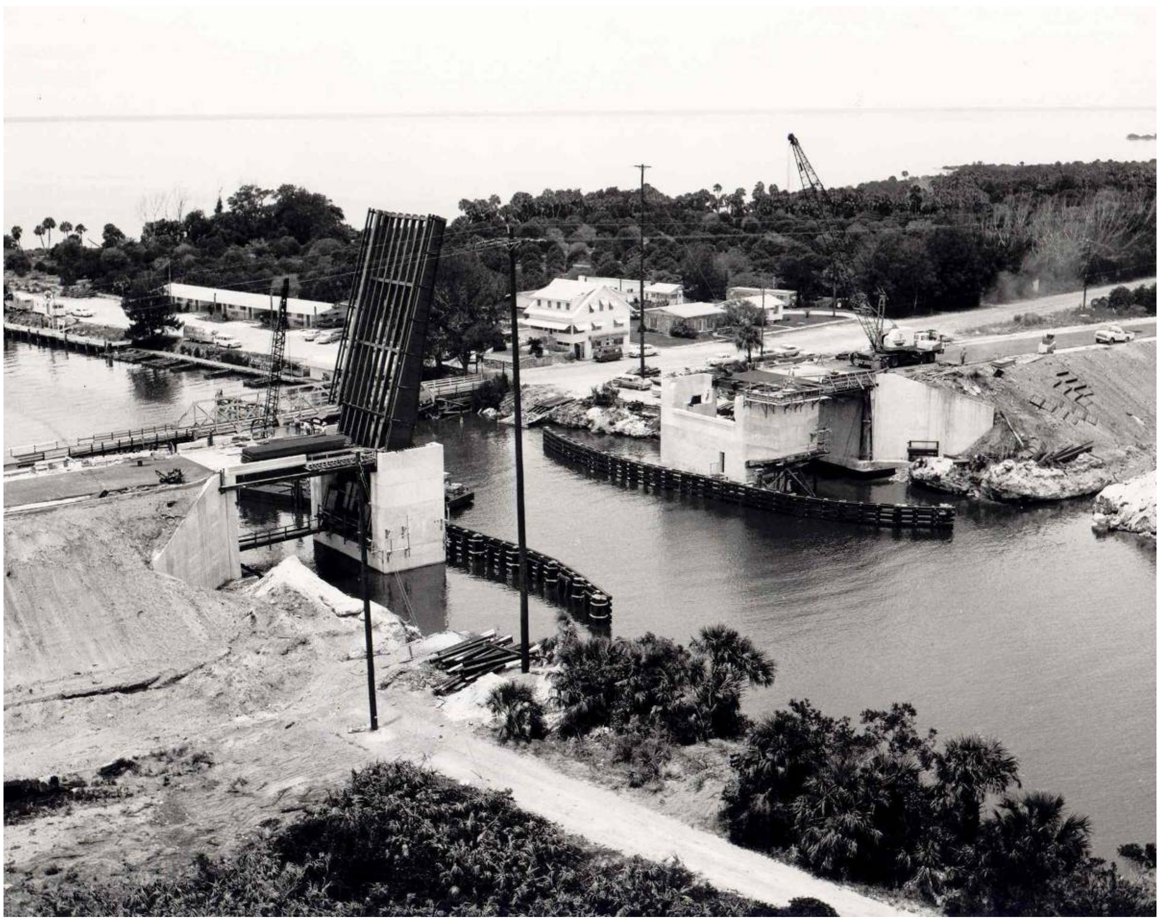


Figure A-3. Construction of the Haulover Canal Bridge, camera facing west, June 9, 1965.
Source: John F. Kennedy Space Center Archives, 100-KSC-65C-3822.

Figure A-4. Construction of the Haulover Canal Bridge, camera facing north, July 12, 1965.
Source: John F. Kennedy Space Center Archives, 100-KSC-65C-4468.

Figure A-5. Aerial of the completed Haulover Canal Bridge (following removal of old wooden bridge), camera facing north, October 5, 1965.
Source: Kennedy Institutional Imaging Facility, 100-KSC-65C-7032.

Figure A-6. Ground level view of the completed Haulover Canal Bridge, camera facing north, January 12, 1966.
Source: Kennedy Institutional Imaging Facility, 100-KSC-66C-0468.

APPENDIX B: Banana River Bridge and Indian River Bridge

Introduction:

Along with the Haulover Canal Bridge, the Banana River Bridge and the Indian River Bridge represent a cohesive set of transportation structures designed to allow employees, materials and supplies, and smaller spacecraft components to travel between mainland Florida and the new Kennedy Space Center on Merritt Island. Whereas the Haulover Canal Bridge was a replacement for an existing one-lane wooden bridge, the Banana River Bridge and Indian River Bridge were designed as part of the new roadway extending from U.S. 1 to CCAFS.[1]

All three structures feature double-leaf bascule bridges as their main span, with nearly identical lengths, railings, support piers, and control houses. Pursuant to the "Programmatic Agreement among the National Aeronautics and Space Administration John F. Kennedy Space Center, Advisory Council on Historic Preservation, and the Florida State Historic Preservation Officer regarding Management of Historic Properties at the Kennedy Space Center, Florida," Stipulation V.A.2, if there are multiple assets of a specific property type that are 95 percent identical, only one of the assets will be recorded. In this case, the KSC Historic Preservation Officer recommended that the Haulover Canal Bridge be the focus of the documentation efforts. This appendix has been included as part of the package to provide historical information regarding the Banana River Bridge and Indian River Bridge and to note any major physical differences of these two bridges.

Historical Information:

The Orsino Causeway (presently known as NASA Causeway/NASA Parkway/State Road 405) is one of the new roads constructed by NASA to provide automobile access to KSC. The road is approximately 13.3 miles long and extends between U.S. 1 and CCAFS. For design and construction, the Causeway was divided into two segments: a 7.2-mile, four-lane roadway between U.S. 1 and State Road 3 that crossed the Indian River (hereafter referred to as Segment 1) and a 6.1-mile, two-lane roadway from State Road 3 to CCAFS that crossed the Banana River (hereafter referred to as Segment 2). Although Segment 1 was scheduled for Fiscal Year 1964 and Segment 2 for Fiscal Year 1965, Segment 2 was the first to be designed and constructed.[2]

In November 1962, Ewin Engineering Corporation of Miami, Florida, completed the design work for Segment 2, including the Banana River Bridge.[3] The original bids for the construction of Segment 2 were opened on December 13, 1962, but the low bid was around 18 percent higher

[1] Price, "Architectural Survey and Evaluation of 45 Facilities," 81-84.
[2] Pan American World Airways, *Merritt Island Launch Area Master Plan, Volume III*, 1962; NASA KSC, "Real Property Record, Banana River Bridge," on file, KSC Real Property Office; NASA KSC, "Real Property Record, Indian River Bridge," on file, KSC Real Property Office.
[3] Ewin Engineering Corporation, Miami, "Banana River-Orsino Causeway" (architectural drawings, NASA KSC, November 1962), on file, KSC Engineering Documentation Center, Florida.

than ACOE/government estimates. An inquiry determined that the reason for the high bids was the tight construction schedule. NASA decided to have the ACOE readvertise the project and set a new bid opening date of January 15, 1963; the contract was awarded to Houdaille-Duval of Jacksonville, Florida. Work on the bridge began January 23, 1963 and ended on February 20, 1964.[4]

In July 1963, after work on Segment 2 had begun, Howard, Needles, Tammen & Bergendoff (or HNTB) of Orlando, Florida, finished the drawings for Segment 1, which included the Indian River Bridge.[5] Bids for the construction of Segment 1 were opened on August 8, 1963; this contract also was awarded to Houdaille-Duval. They began construction of the bridge on August 21, 1963 and finished it on December 5, 1964.[6]

Since its construction, the Banana River Bridge has carried KSC, NASA, Air Force, and contractor personnel between the KSC Industrial Area and the CCAFS Industrial Area. The Indian River Bridge is situated outside the controlled access area. It provides access not only to the controlled access area of KSC (through a gate), but also to the KSC Visitor Complex.

For the most part, both the Banana River Bridge and Indian River Bridge have remained as originally designed and constructed. Over their life, they have undergone minor repair and refurbishment work, which has kept them operational. Like the Haulover Canal Bridge, modifications were made to their respective control and electrical systems in the mid-1990s. Both are operated on demand, but the Indian River Bridge does not open for normal boat traffic during morning and afternoon rush hours.[7]

Physical Differences of the Banana River Bridge:

Similar to the Haulover Canal Bridge, the Banana River Bridge (renamed the Roy D. Bridges Jr. Bridge in August 2003) is oriented along a northwest-southeast axis, carrying the two-lane segment of NASA Parkway over the Banana River (Photo Nos. 14 through 17).[8] This bridge has a total length of approximately 782', which incorporates the main bascule span and twelve approach spans (six to either side of the main span). The length of its main bascule span, 137'-9", is a little shorter than the other two bridges, but its width is the same (54' with the Control

[4] J.F. Burke, "Memo for Record," December 26, 1962, Box 14A.2, Folder No. 77, Land Management Collection, KSC Archives Department, Florida; NASA KSC, "Banana River Bridge."
[5] HNTB, Orlando, "Indian River-Orsino Causeway" (architectural drawings, NASA KSC, July 1963), on file, KSC Engineering Documentation Center, Florida.
[6] H. Waag, "Memorandum for Record," August 9, 1963, Box 14A.2, Folder No. 77, Land Management Collection, KSC Archives Department, Florida; NASA KSC, "Indian River Bridge."
[7] NASA KSC, "Banana River Bridge;" NASA KSC, "Indian River Bridge;" "Bridge Hours to Change," *Spaceport News*, March 11, 1988, 8.
[8] Roy D. Bridges, Jr. was a former astronaut who served as Director of KSC from March 1997 to August 2003.

House, 33’ for the roadway). In addition, the main piers supporting the bascule leafs are shorter than those of the Haulover Canal Bridge and the Indian River Bridge, with the road surface at roughly 27’ above mean sea level.

The approach spans for the Banana River Bridge also are longer than those of the Haulover Canal Bridge. The two spans closest to the bascule are about 53’ in length, and those next to the abutments are roughly 51’ in length; the remaining eight approach spans (four per side) are 52’ in length. The Banana River Bridge also features support piers for the approach spans, five on each side (Photo No. 18). The supports closest to the main piers are double bents with ten piles, and the remaining supports are single bents with five piles.

The Control House for the Banana River Bridge is mounted to the south side of the west pier. It differs from those on the Haulover Canal Bridge and the Indian River Bridge in that all levels have pure rectangular plans. The control room also maintains its original awning windows.

Physical Differences of the Indian River Bridge:

The Indian River Bridge is oriented along a west-east axis and carries the four-lane segment of NASA Causeway over the Indian River/Atlantic Intracoastal Waterway (Photo Nos. 20 through 23). The most notable differences between this bridge and the other two is that it is comprised of two adjacent bridges, one to the south that carries two lanes of eastbound traffic and one to the north that carries two lanes of westbound traffic. Each bridge has a total length of approximately 2,993’, which includes the main bascule span and fifty-five approach spans (sixteen to the west of the main span and thirty-nine to the east of the main span). Each main bascule span has the same length and width as that of the Haulover Canal Bridge, and the main piers are roughly the same height as those of the Haulover Canal Bridge, about 32’ above mean sea level.

With the exception of the two spans closest to each bascule, the approach spans for each bridge are 52’ in length. For the north bridge (westbound traffic), the approach span directly west of the main bascule is around 41’ in length, whereas the approach span directly to the east of the main bascule is about 53’ in length. The south bridge (eastbound traffic) is the reverse of this; however, the approach span to the immediate west differs from all others in that it is roughly 43’ in width to accommodate two parking spots for the bridge tenders. Similar to the Banana River Bridge, the Indian River Bridge features two types of supports for the approach spans. The supports closest to the main piers, and fourteen others, are double bents with eight piles. The remaining eighty-eight supports are single bents with four piles (Photo No. 24).

The Control House for the Indian River Bridge is mounted to the north side of the south bridge’s west pier. It is identical to the one on the Haulover Canal Bridge, except that it maintains its original awning windows.

Figure B-1. Early construction of the Banana River Bridge, facing northwest, June 4, 1963.
Source: John F. Kennedy Space Center Archives, LOC-63-5649.

Figure B-2. Construction of the Banana River Bridge, facing northwest, June 30, 1963.
Source: John F. Kennedy Space Center Archives, LOC-63-7706.

Figure B-3. Construction of the Banana River Bridge, facing southwest, August 26, 1963.
Source: John F. Kennedy Space Center Archives, LOC-63-8418.

Figure B-4. Construction of the Banana River Bridge, facing northeast, September 5, 1963.
Source: John F. Kennedy Space Center Archives, LOC-63-8790.

Figure B-5. Construction of the Banana River Bridge, facing northwest, September 10, 1963.
Source: John F. Kennedy Space Center Archives, LOC-63-9113.

Figure B-6. Construction of the Banana River Bridge, facing northwest, January 8, 1964.
Source: John F. Kennedy Space Center Archives, KSC-64-400.

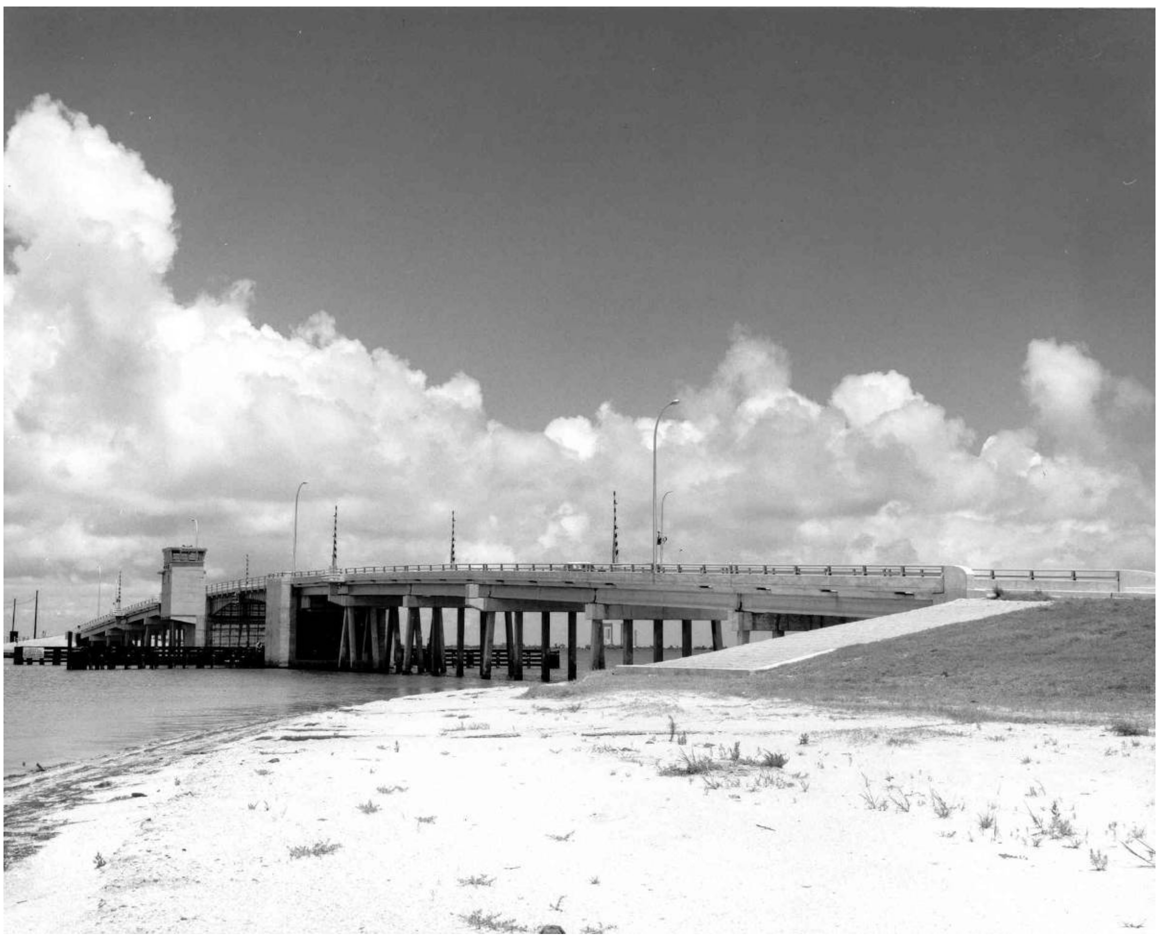


Figure B-7. Banana River Bridge, facing northwest, June 29, 1965.
Source: John F. Kennedy Space Center Archives, 100-KSC-65-12643.

Figure B-8. Hydraulic fill and early construction of the Indian River Bridge, facing east, October 30, 1963.
Source: Kennedy Institutional Imaging Facility, LOC-63-3259.

Figure B-9. Construction of the Indian River Bridge, facing northeast, April 7, 1964.
Source: John F. Kennedy Space Center Archives, KSC-64-3071.

Figure B-10. Construction of the Indian River Bridge, facing northwest, May 11, 1964.
Source: John F. Kennedy Space Center Archives, KSC-64-3714.

Figure B-11. Construction of the Indian River Bridge and Orsino Causeway, facing east, July 8, 1964.
Source: John F. Kennedy Space Center Archives, 100-KSC-64C-2639.

Figure B-12. Construction of the Indian River Bridge, facing northwest, October 13, 1964.
Source: John F. Kennedy Space Center Archives, 100-KSC-64-18836.

Figure B-13. Indian River Bridge, facing northwest, June 29, 1965.
Source: John F. Kennedy Space Center Archives, 100-KSC-65-12642.

APPENDIX C: Architectural Drawings of the Haulover Canal Bridge, Banana River Bridge, and Indian River Bridge

(PDF Scans of each Drawing at the original size are located within the Field Notes)

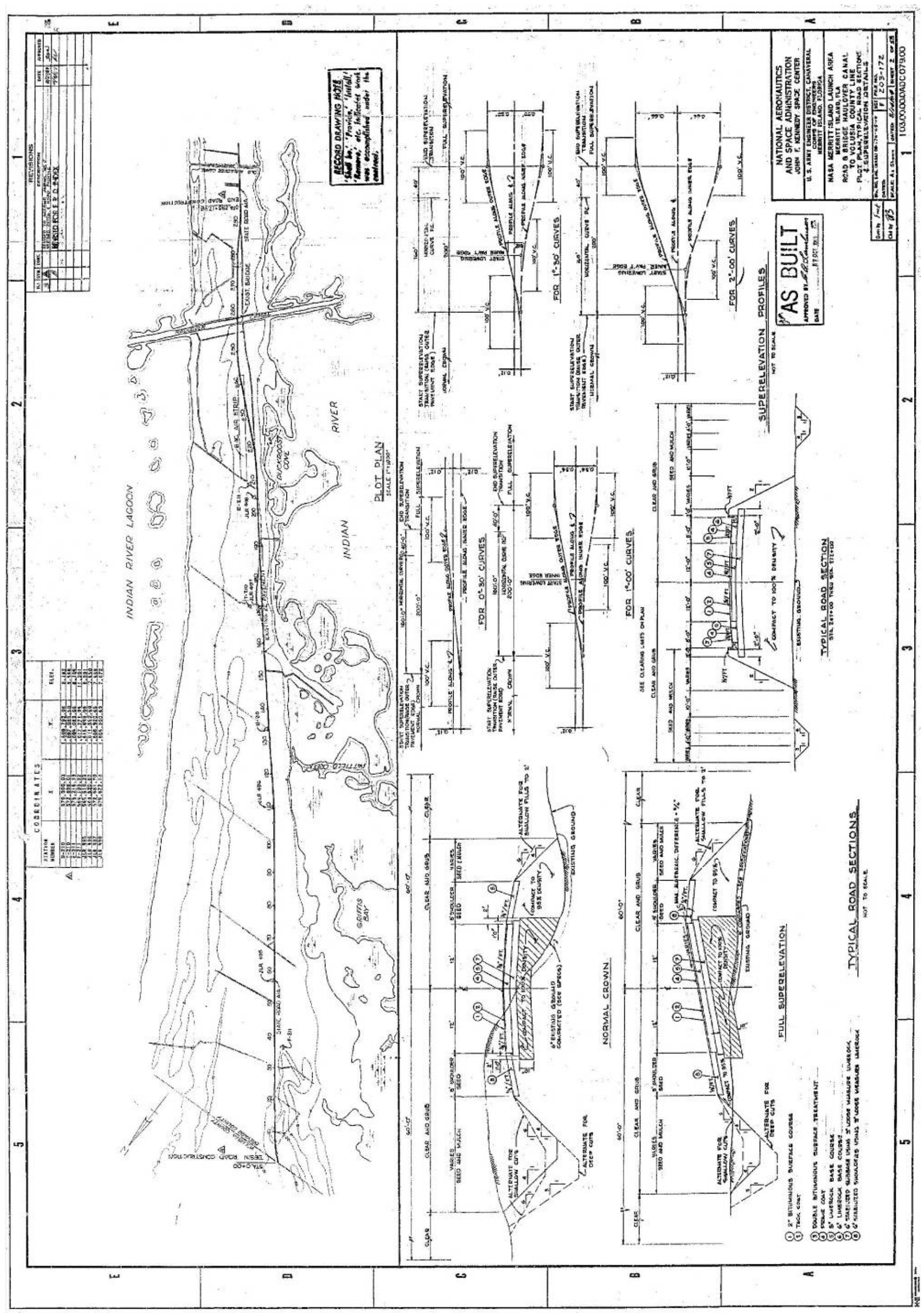


Figure C-1. U.S. ACOE, “Plans of Proposed Road and Bridge Haulover Canal (to Volusia County Line),” Plot Plan, Typical Sections & Superelevation Details, August 1964, Sheet 2.

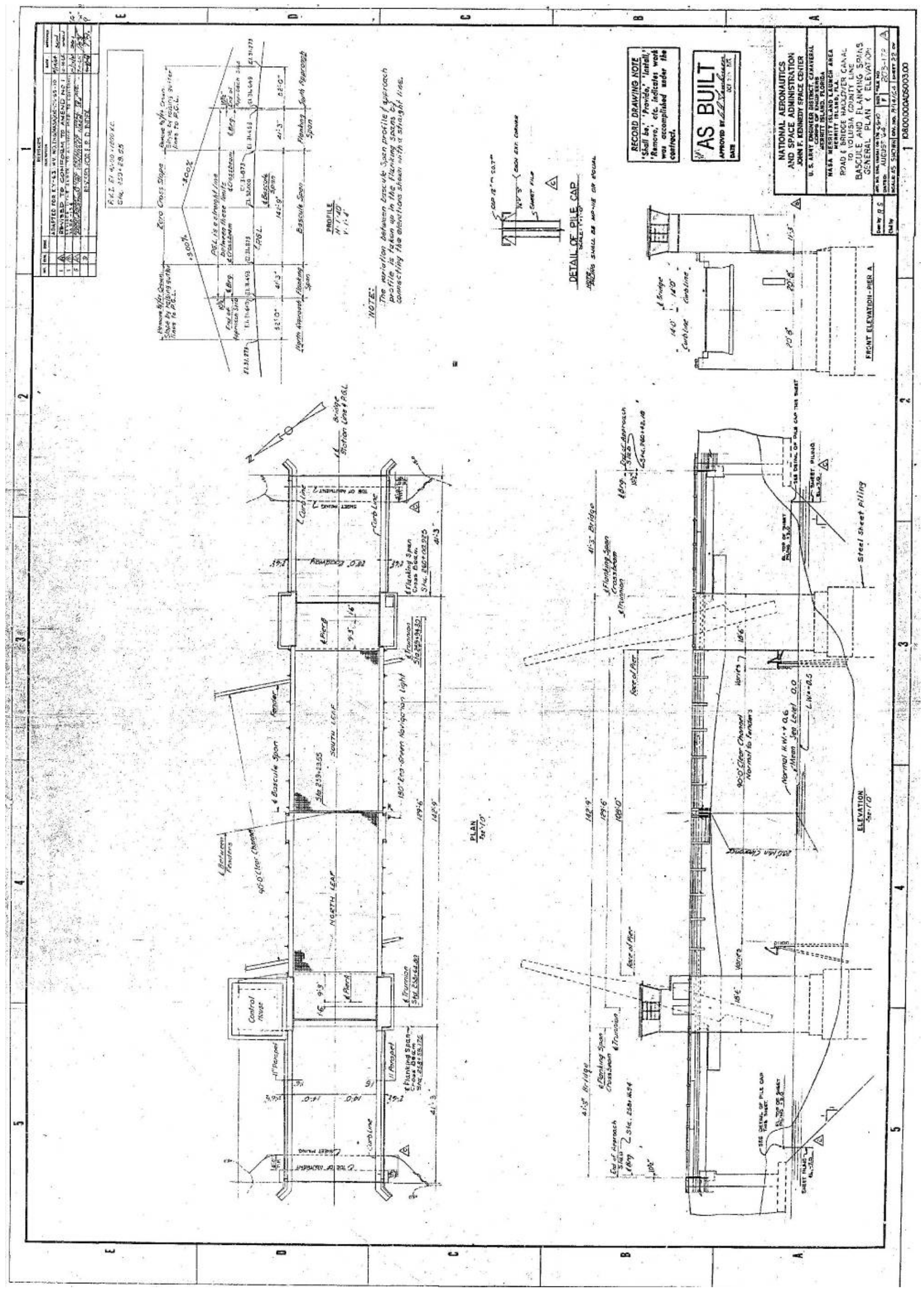


Figure C-2. U.S. ACOE, “Plans of Proposed Road and Bridge Haulover Canal (to Volusia County Line),” Bascule and Flanking Spans, General Plan & Elevation, August 1964, Sheet 22.

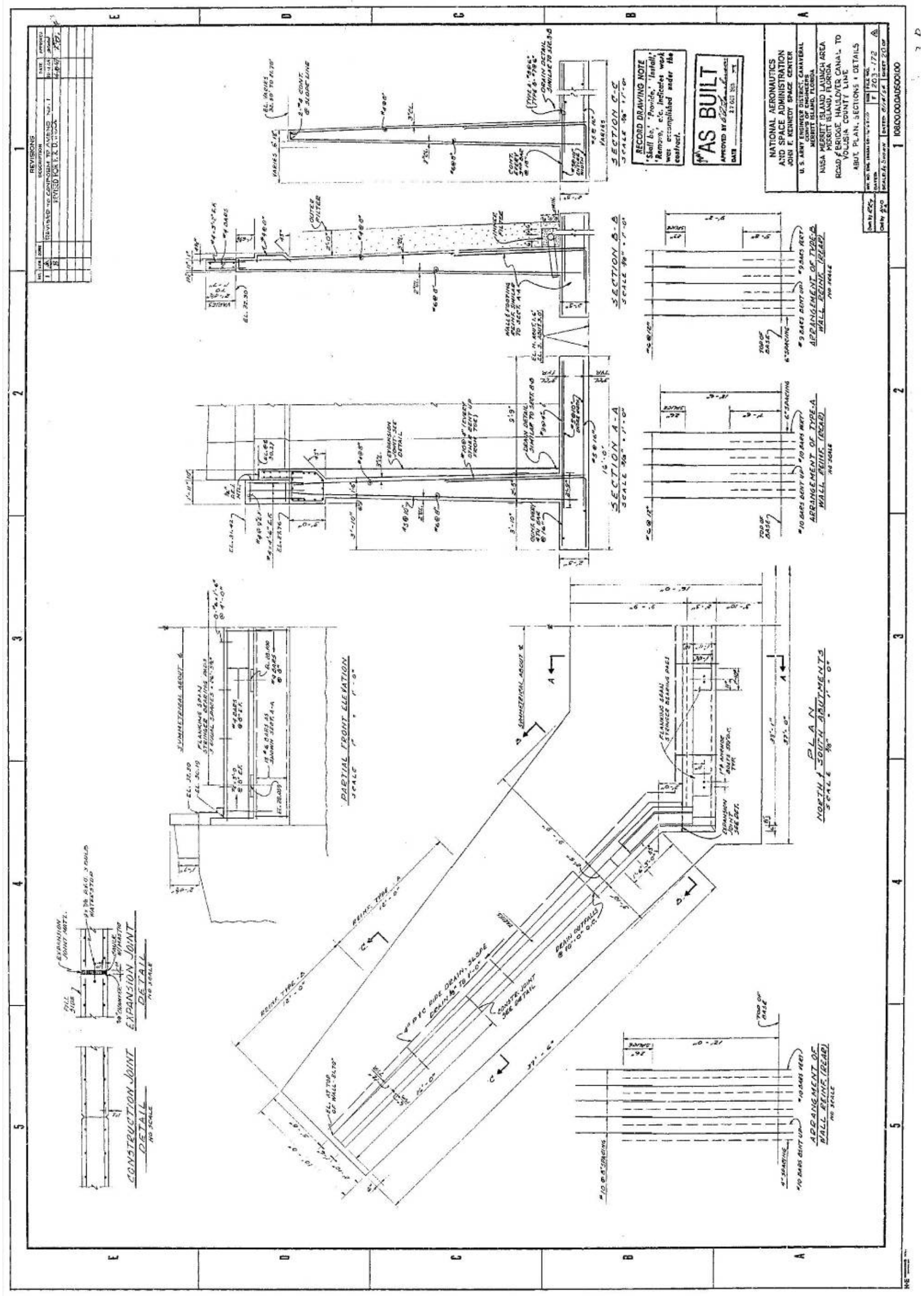


Figure C-3. U.S. ACOE, “Plans of Proposed Road and Bridge Haulover Canal (to Volusia County Line),” Abut. Plan, Sections & Details, August 1964, Sheet 20.

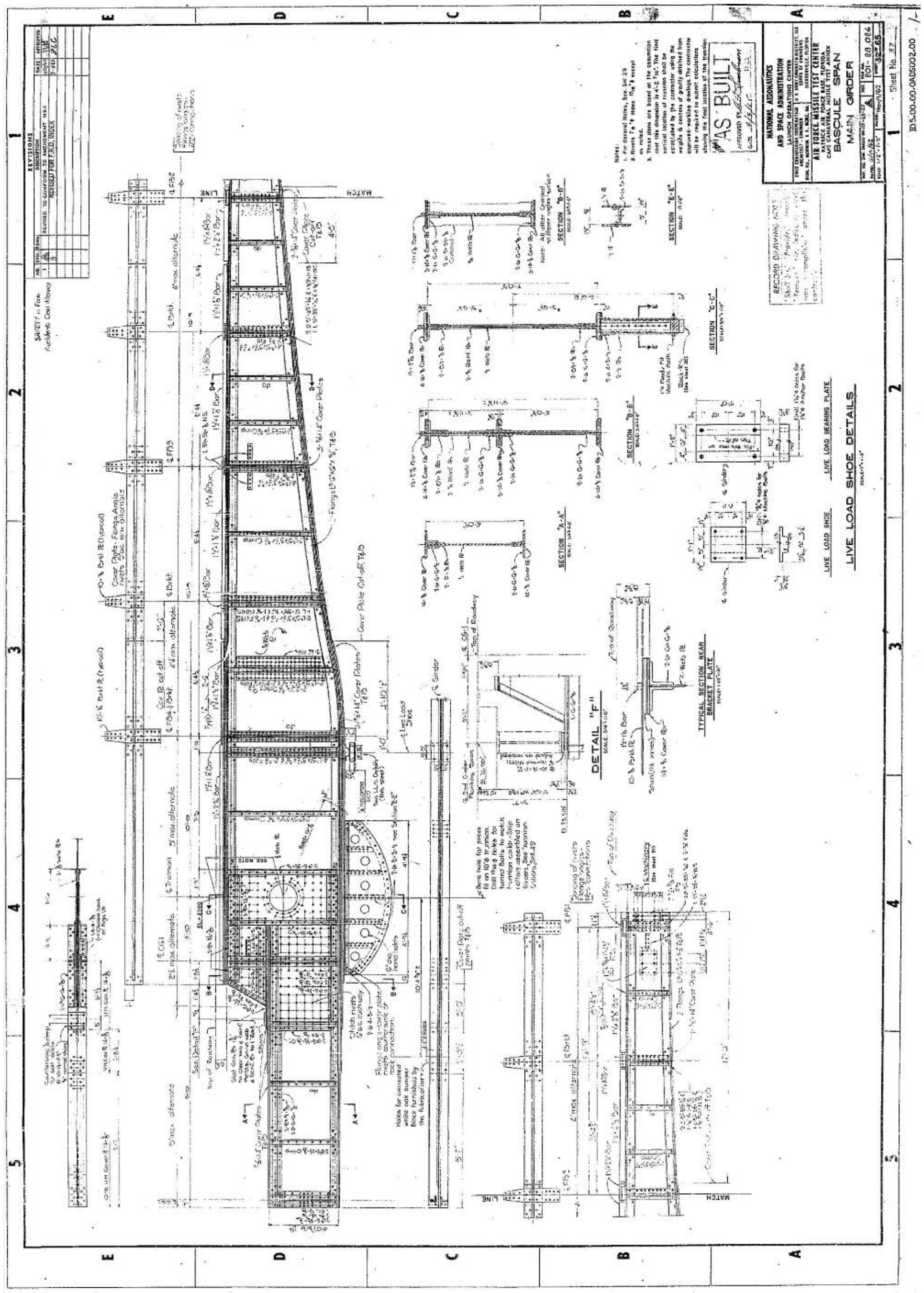


Figure C-4. Ewin Engineering Corporation, “Banana River-Orsino Causeway,” Bascule Span Main Girder,” November 1962, Sheet 32.

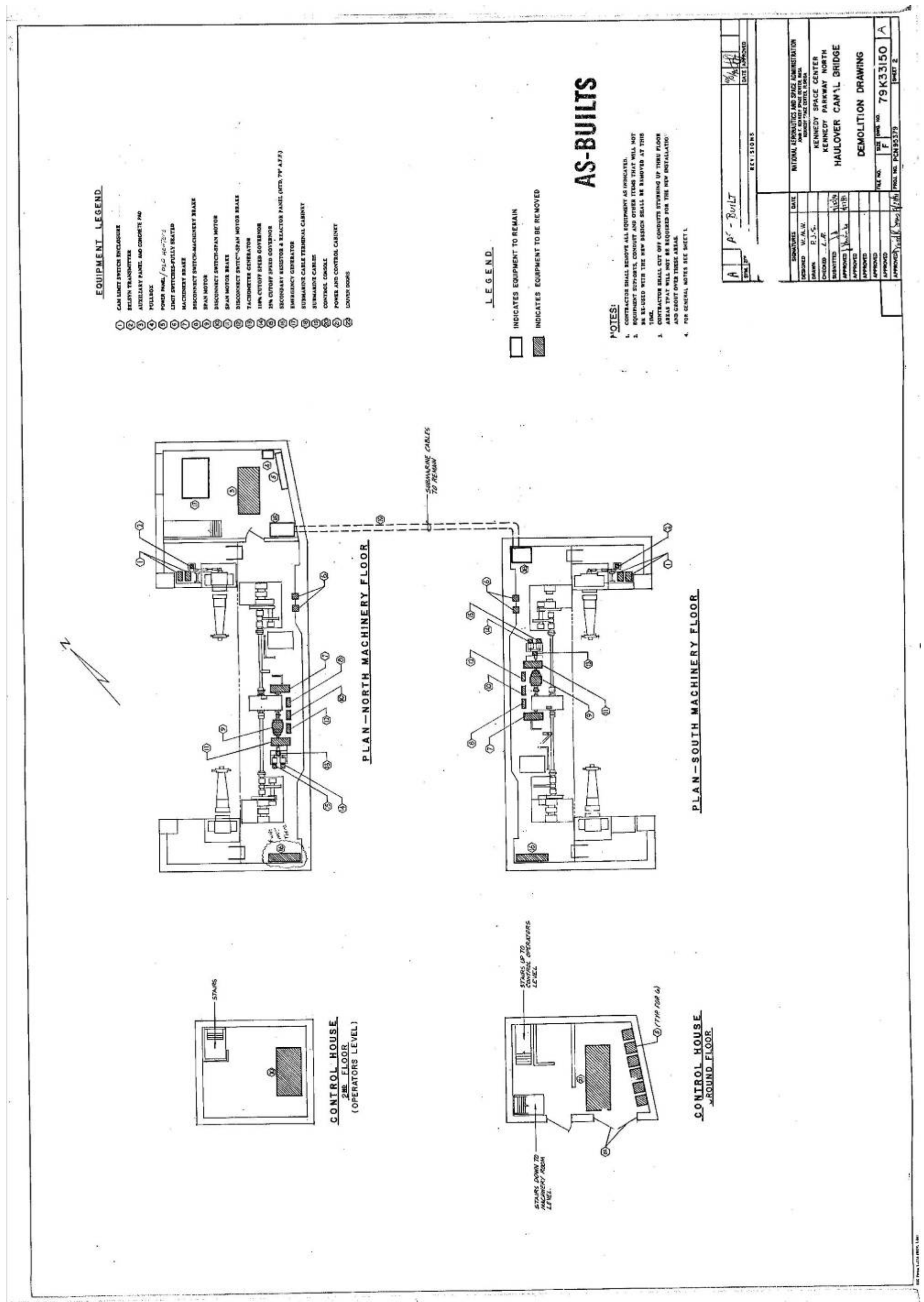


Figure C-5. NASA KSC, "Haulover Canal Bridge," Demolition Drawing, September 1991, Sheet 2.

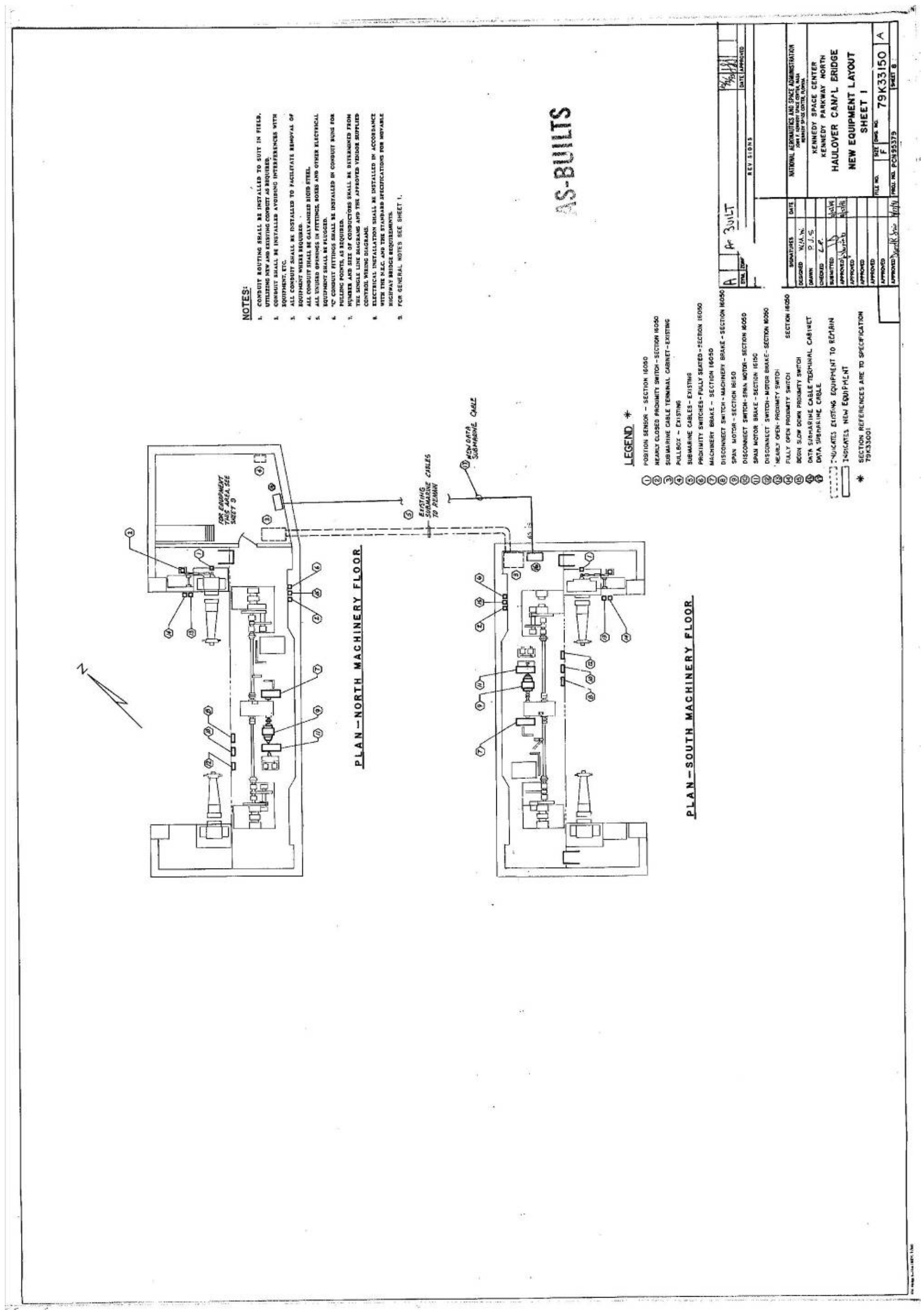


Figure C-6. NASA KSC, "Haulover Canal Bridge," New Equipment Layout, Sheet 1, September 1991, Sheet 8.

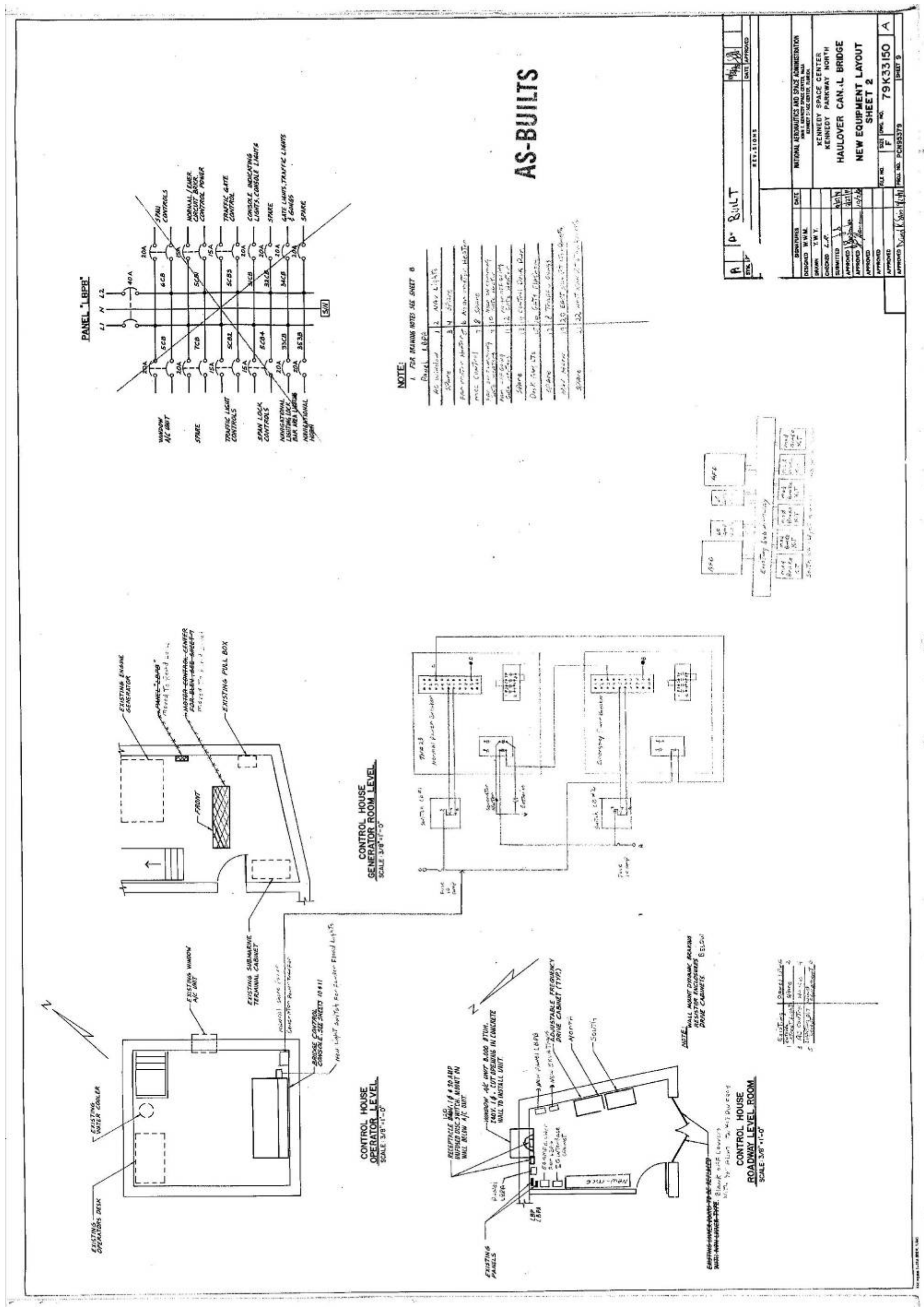


Figure C-7. NASA KSC, “Haulover Canal Bridge,” New Equipment Layout, Sheet 2, September 1991, Sheet 9.

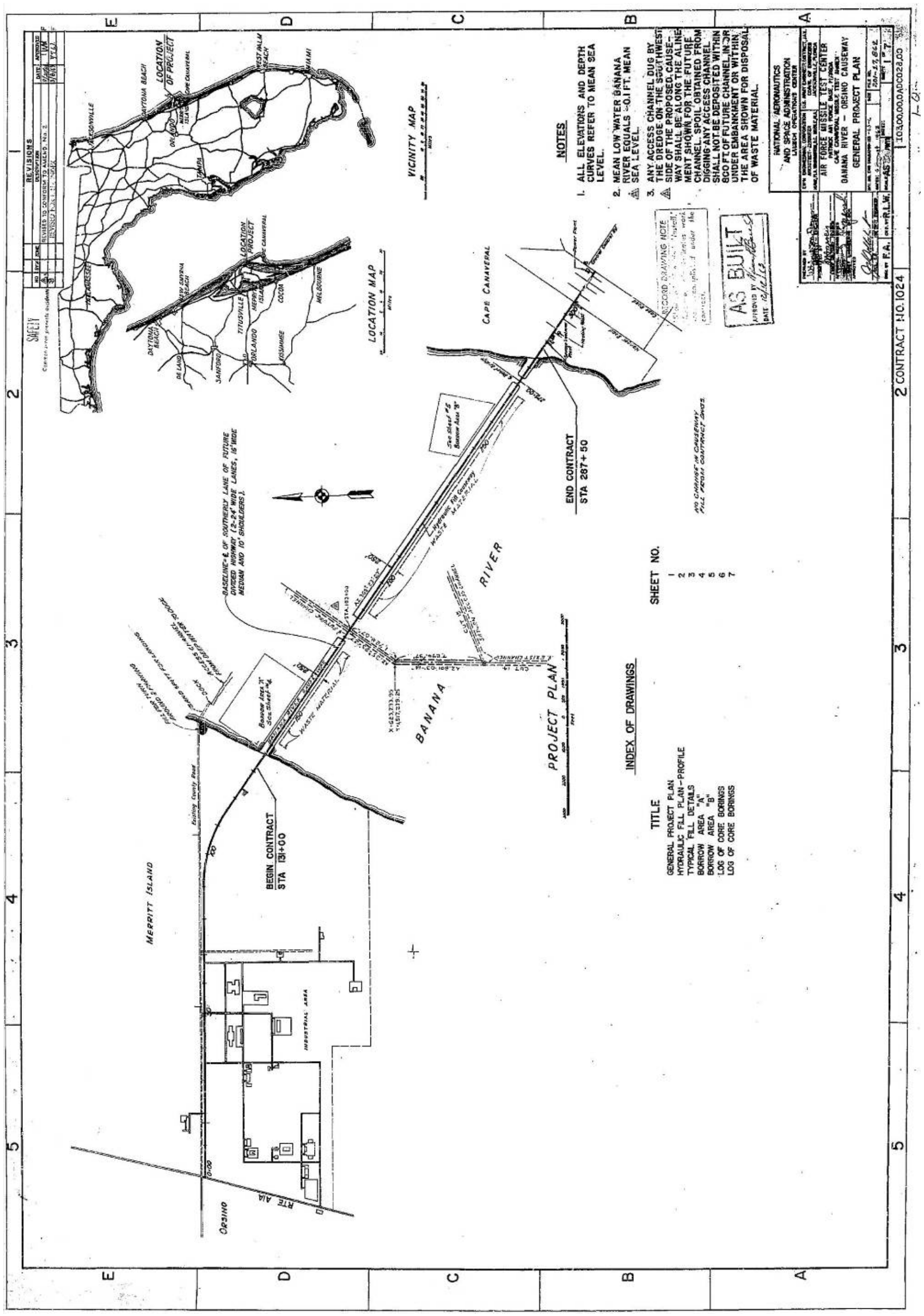


Figure C-8. Ewin Engineering Corporation, "Banana River-Orsino Causeway," General Project Plan, November 1962, Sheet 1.

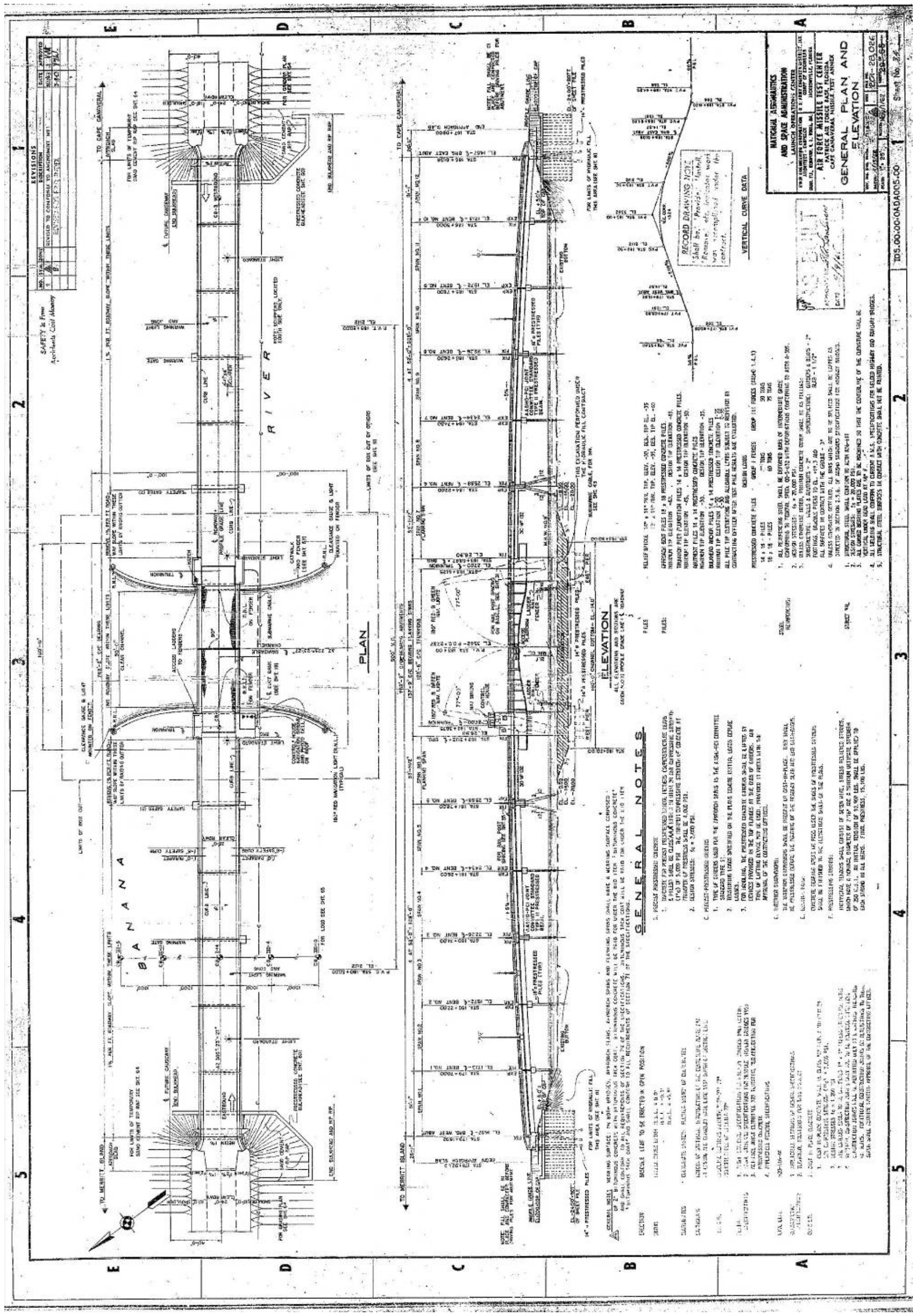


Figure C-9. Ewin Engineering Corporation, "Banana River-Orsino Causeway," General Plan and Elevation, November 1962, Sheet 34.

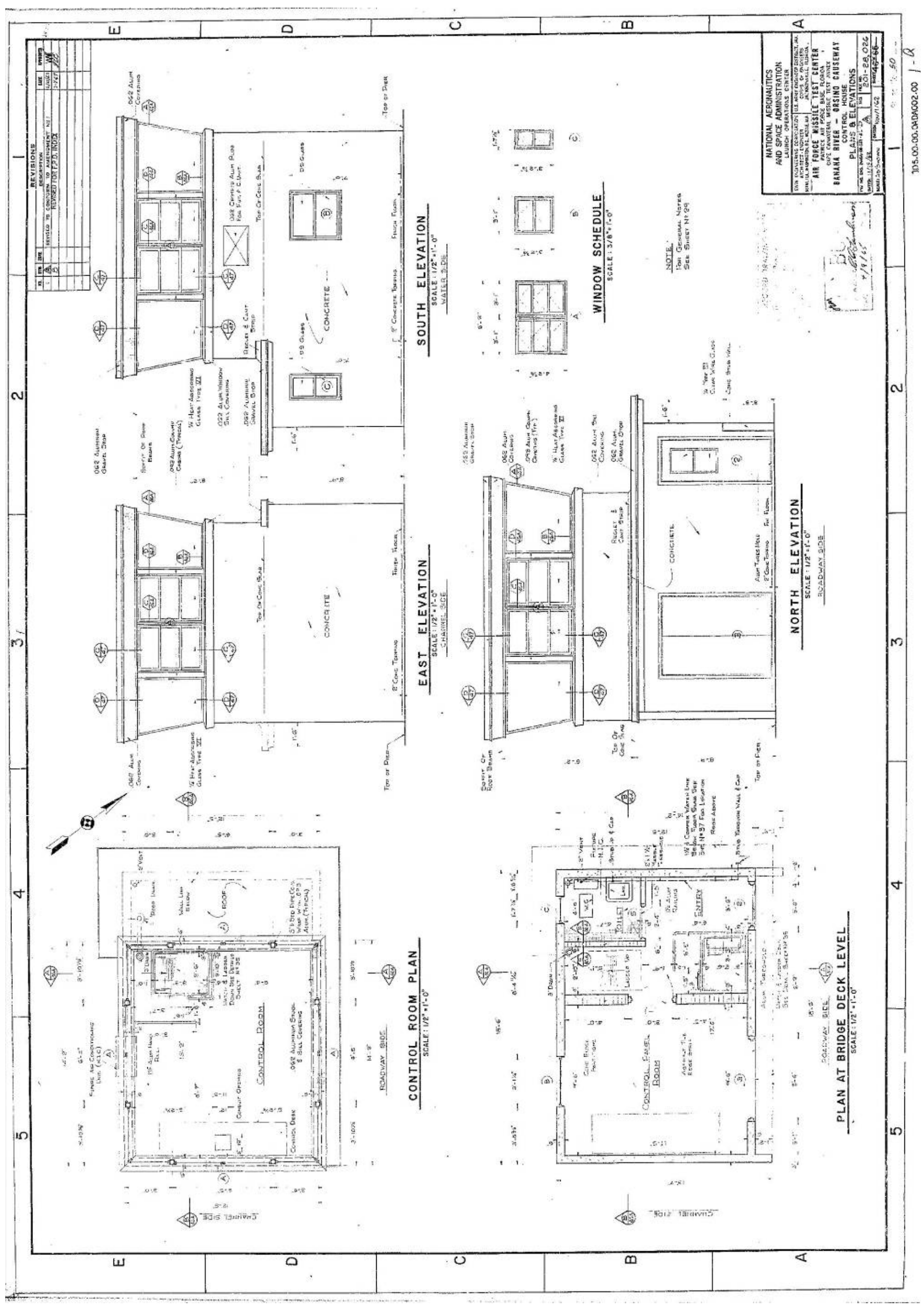
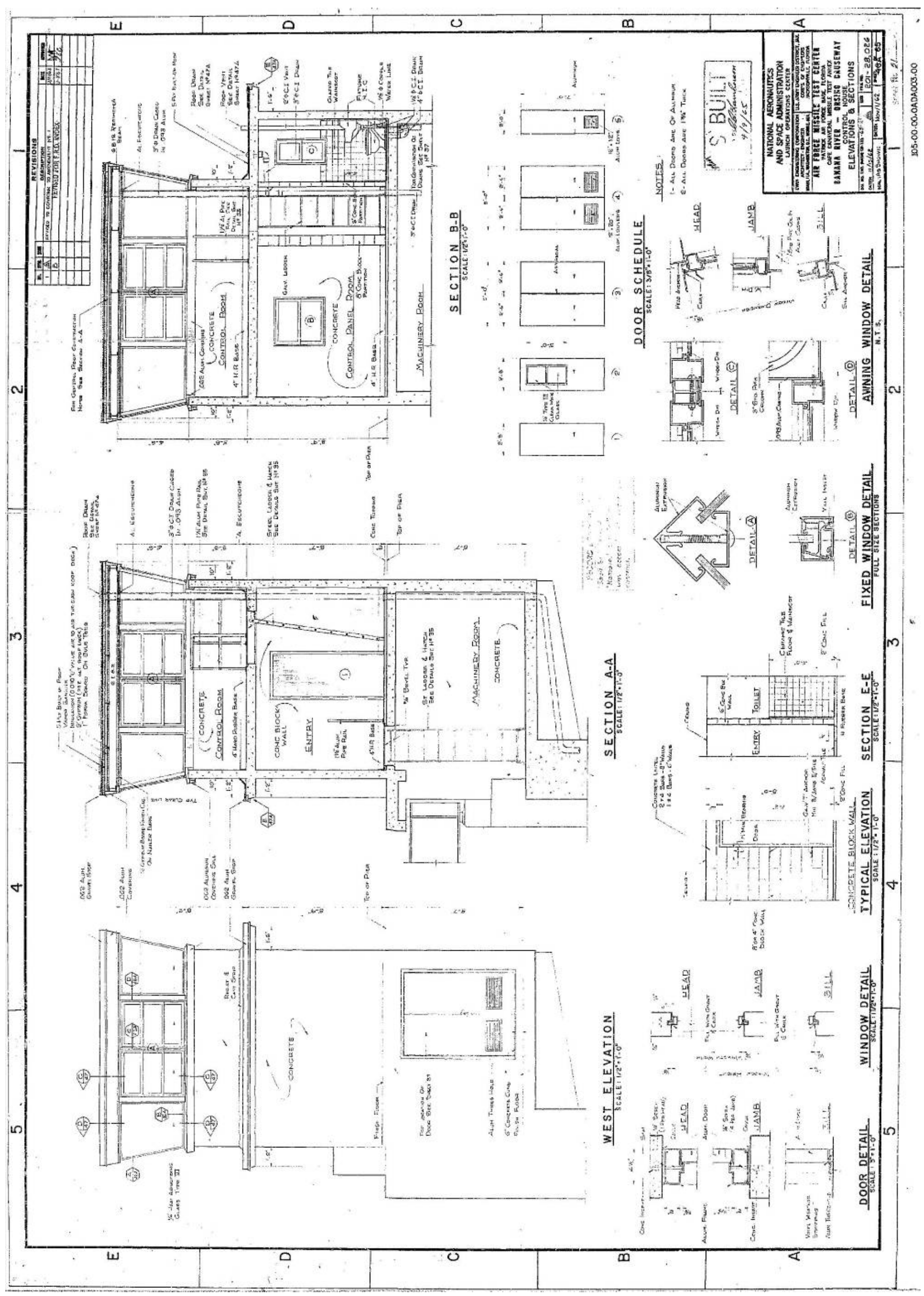


Figure C-10. Ewin Engineering Corporation, "Banana River-Orsino Causeway," Control House Plans & Elevations, November 1962, Sheet 50.



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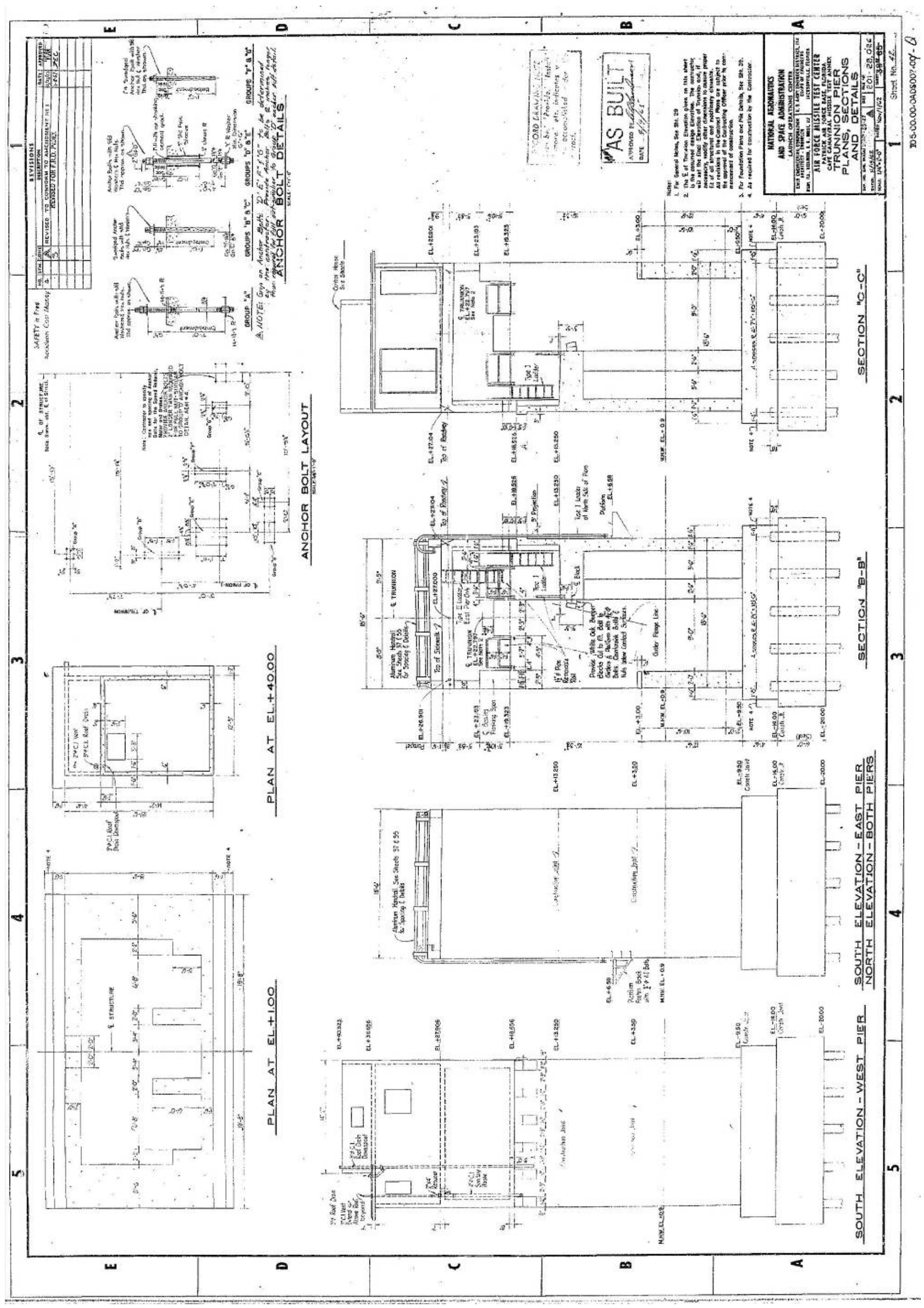

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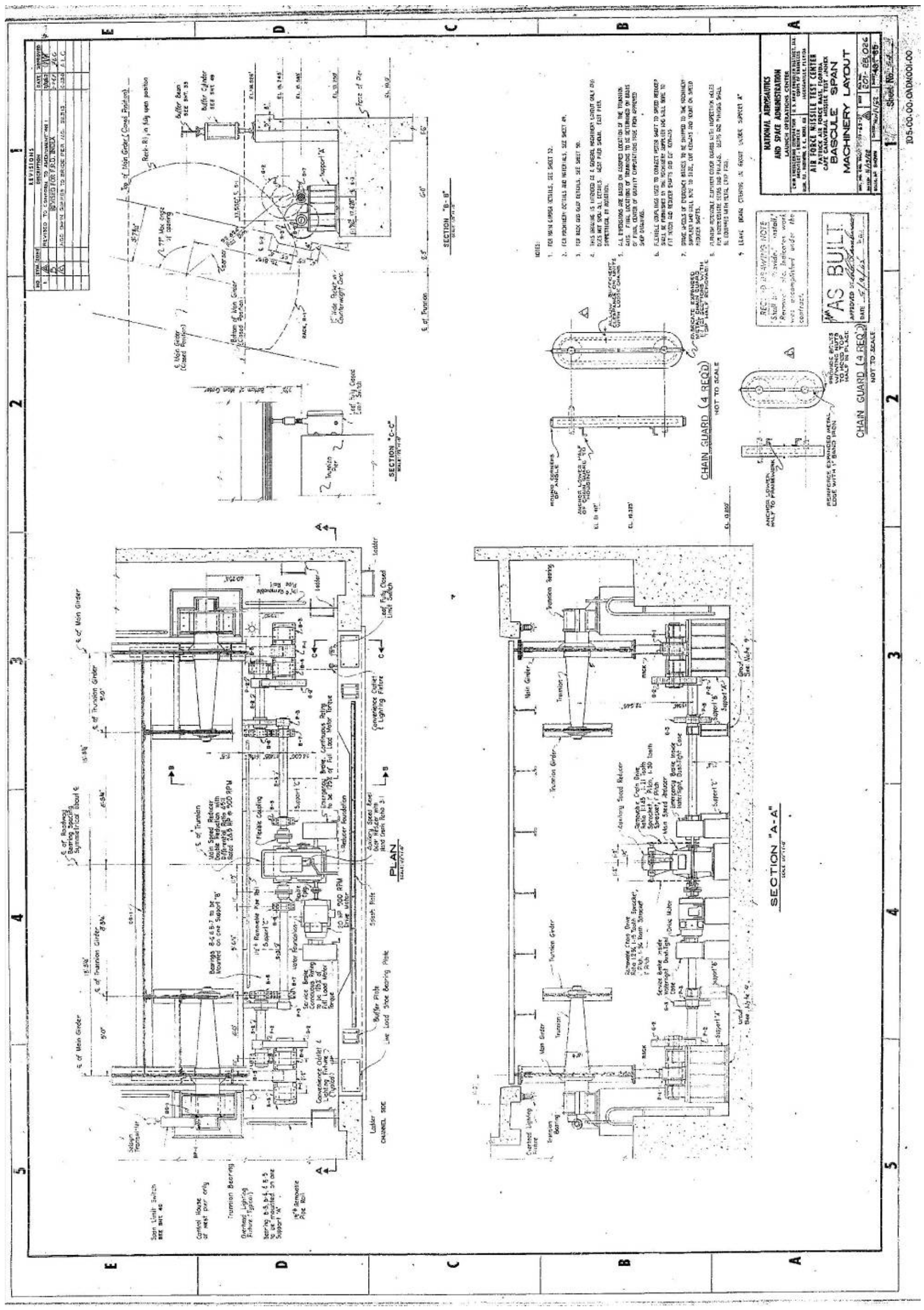
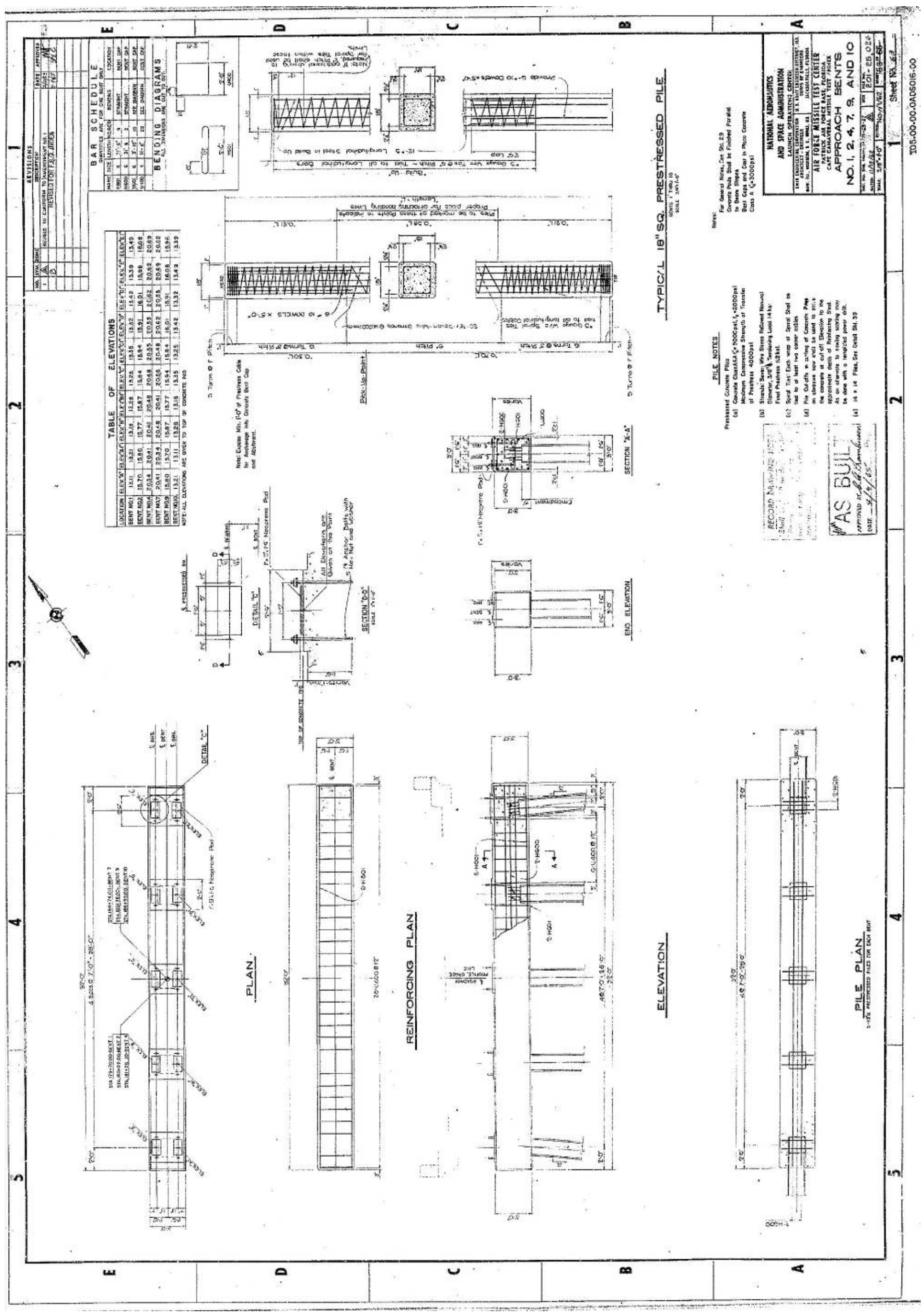


Figure C-13. Ewin Engineering Corporation, "Banana River-Orsino Causeway," Bascule Span Machinery Layout, November 1962, Sheet 54.



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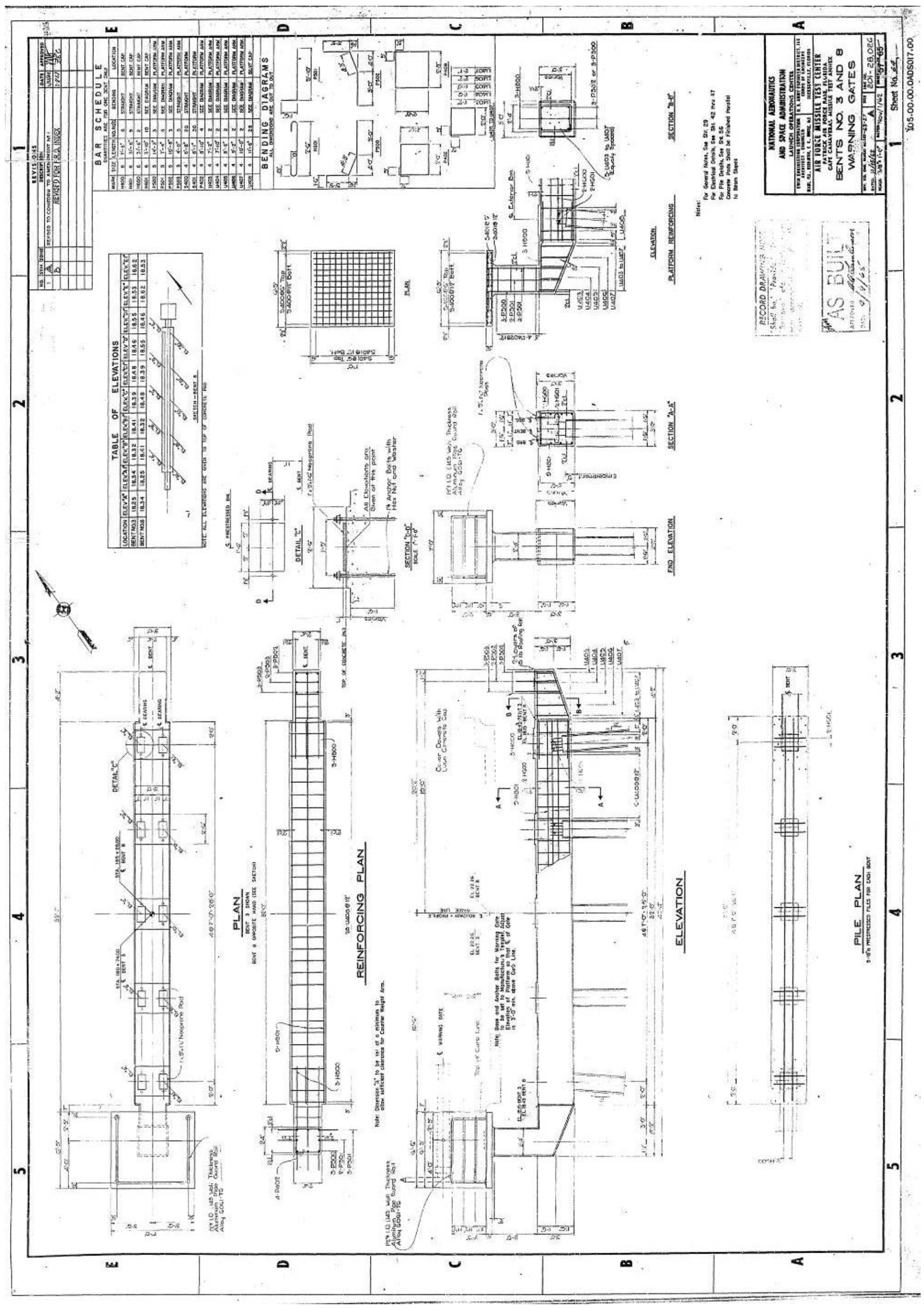
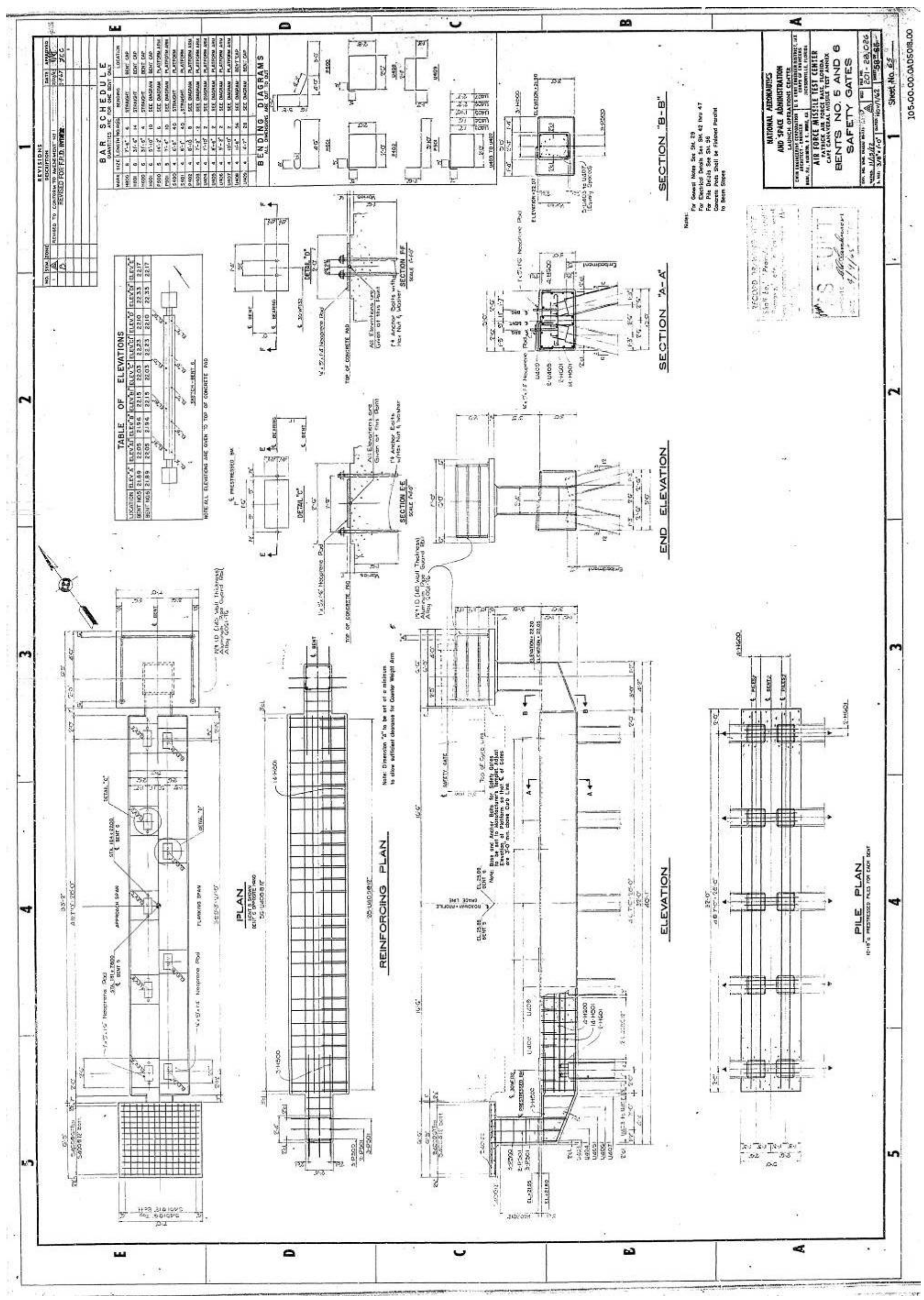


Figure C-15. Ewin Engineering Corporation, "Banana River-Orsino Causeway," Bents No. 3 and 8, Warning Gates, November 1962, Sheet 64.



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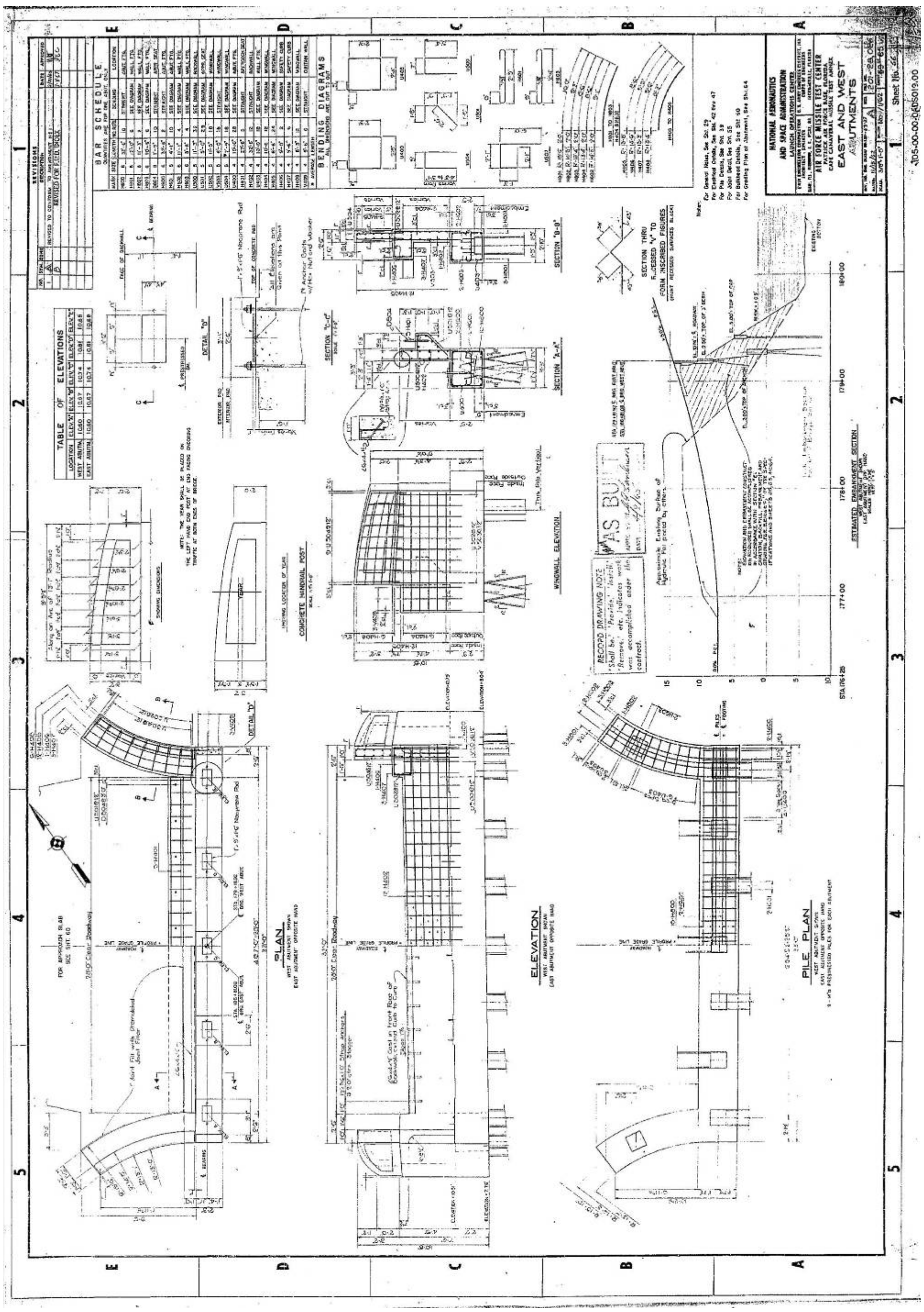

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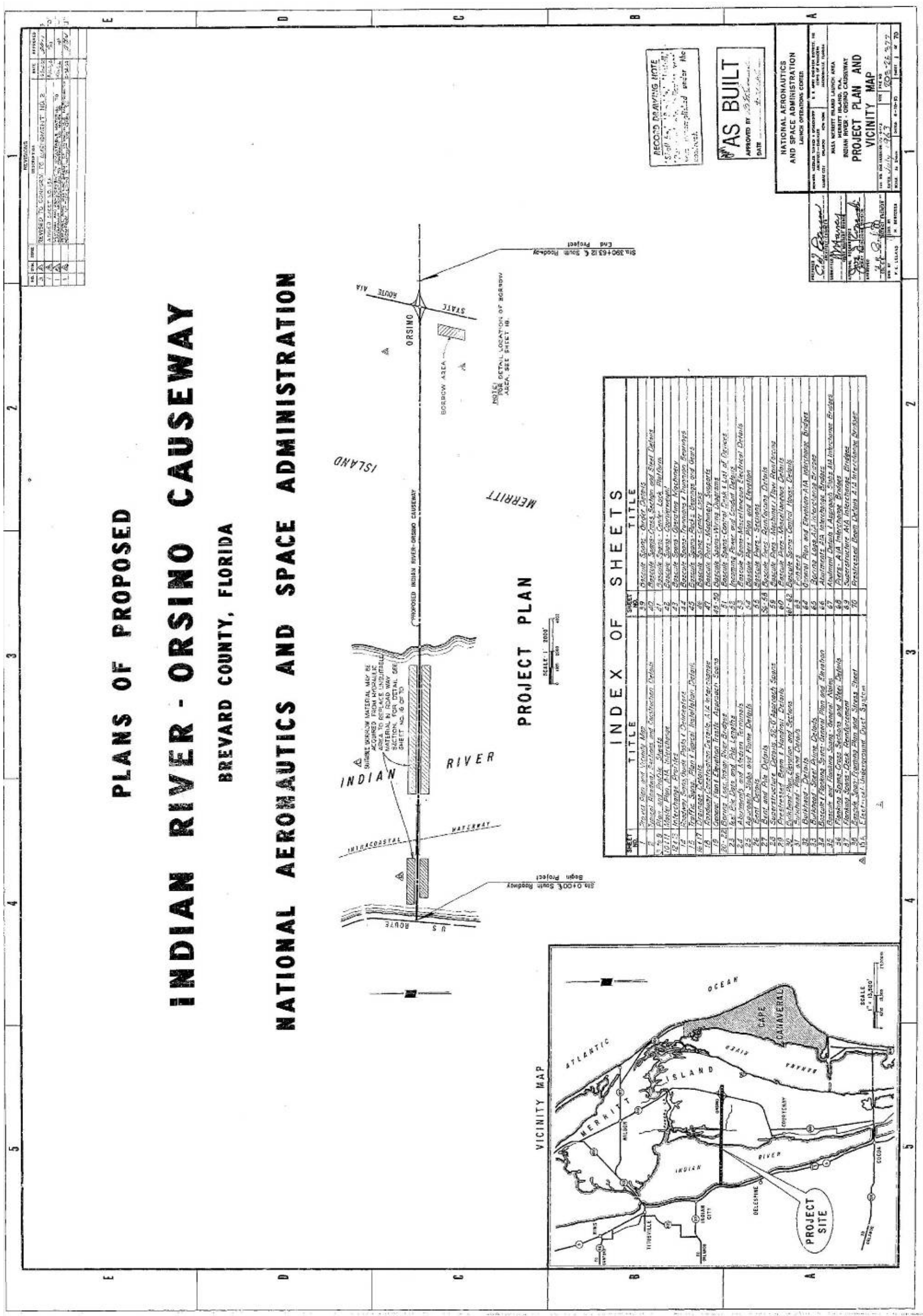

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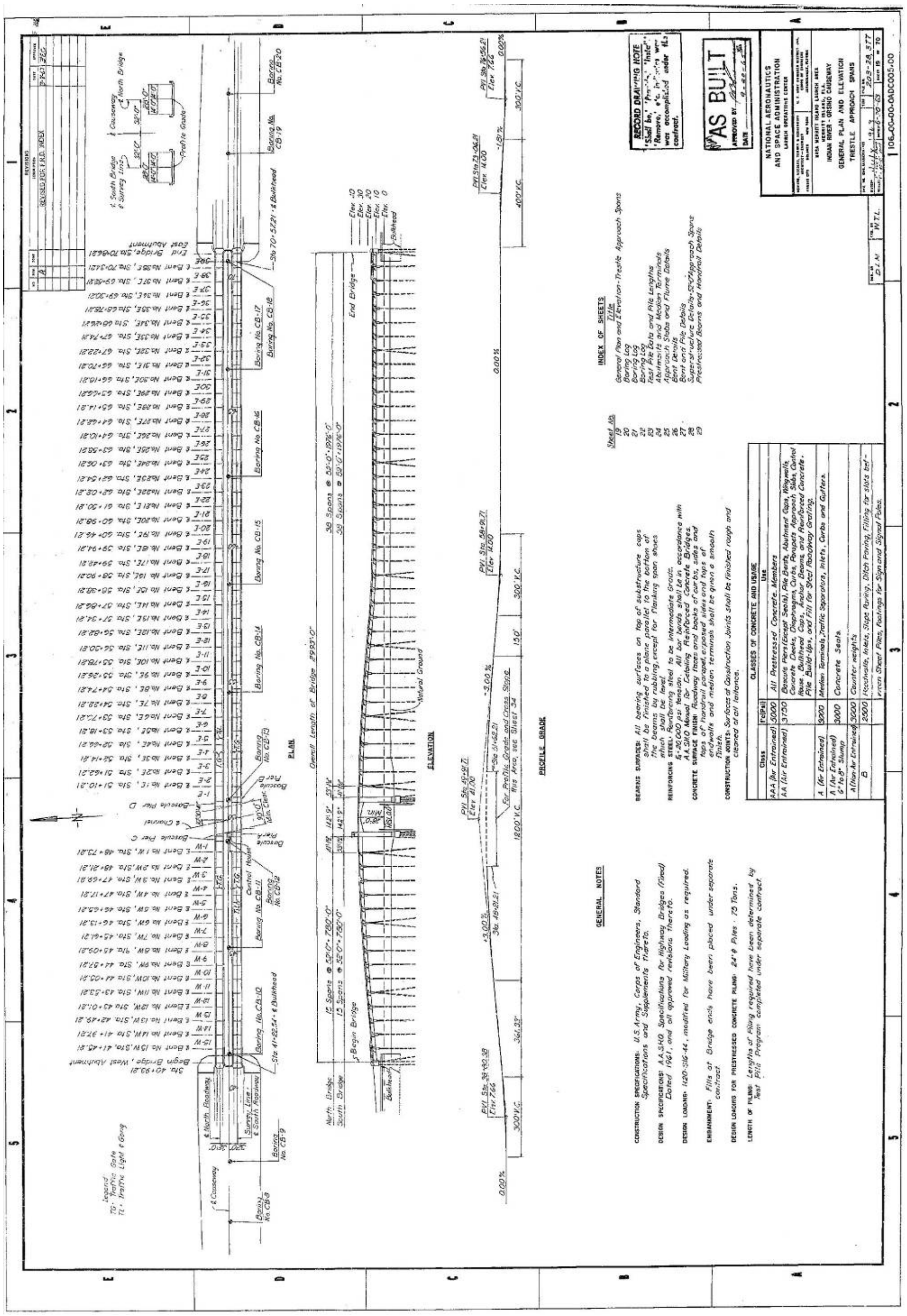

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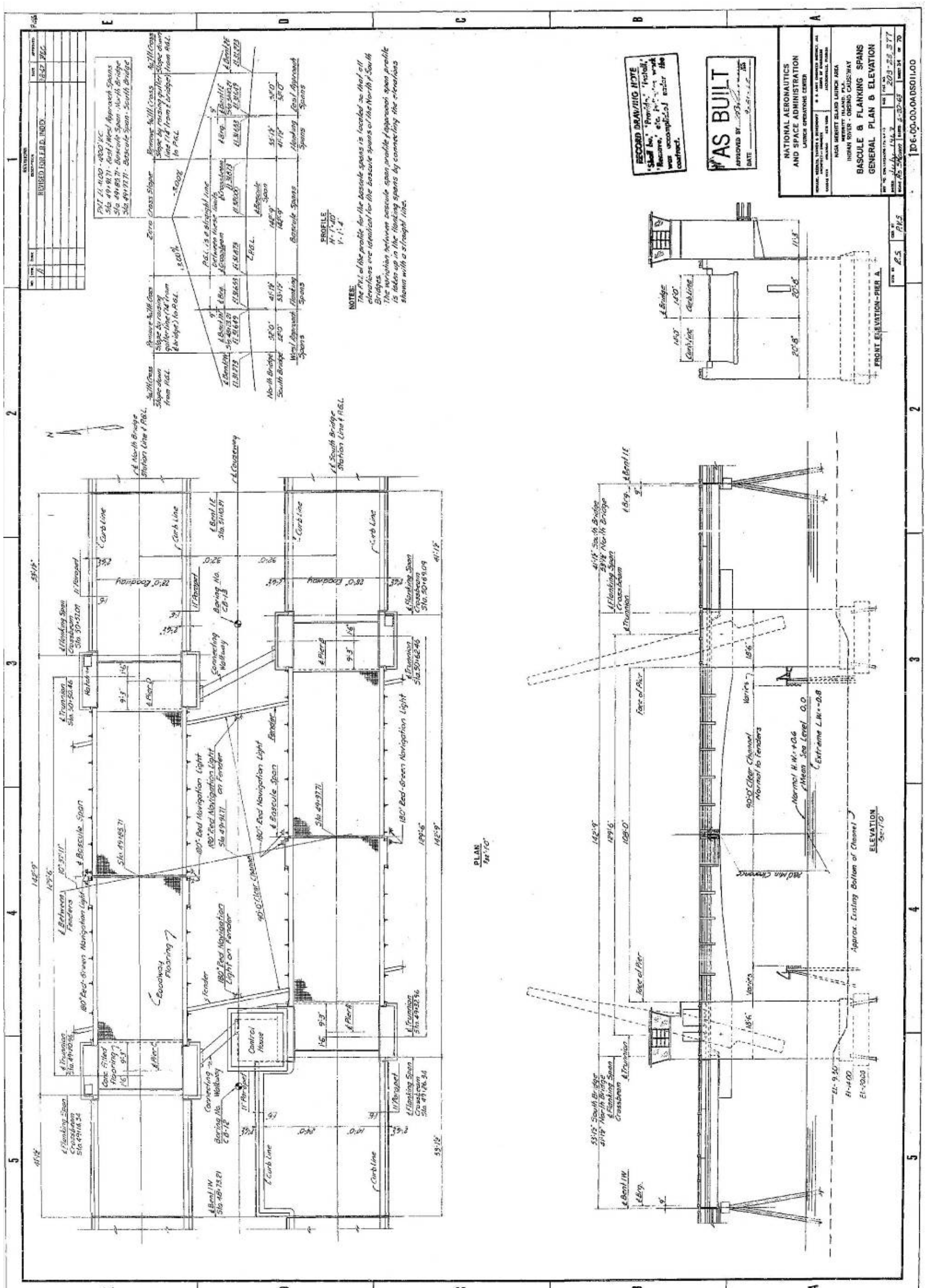

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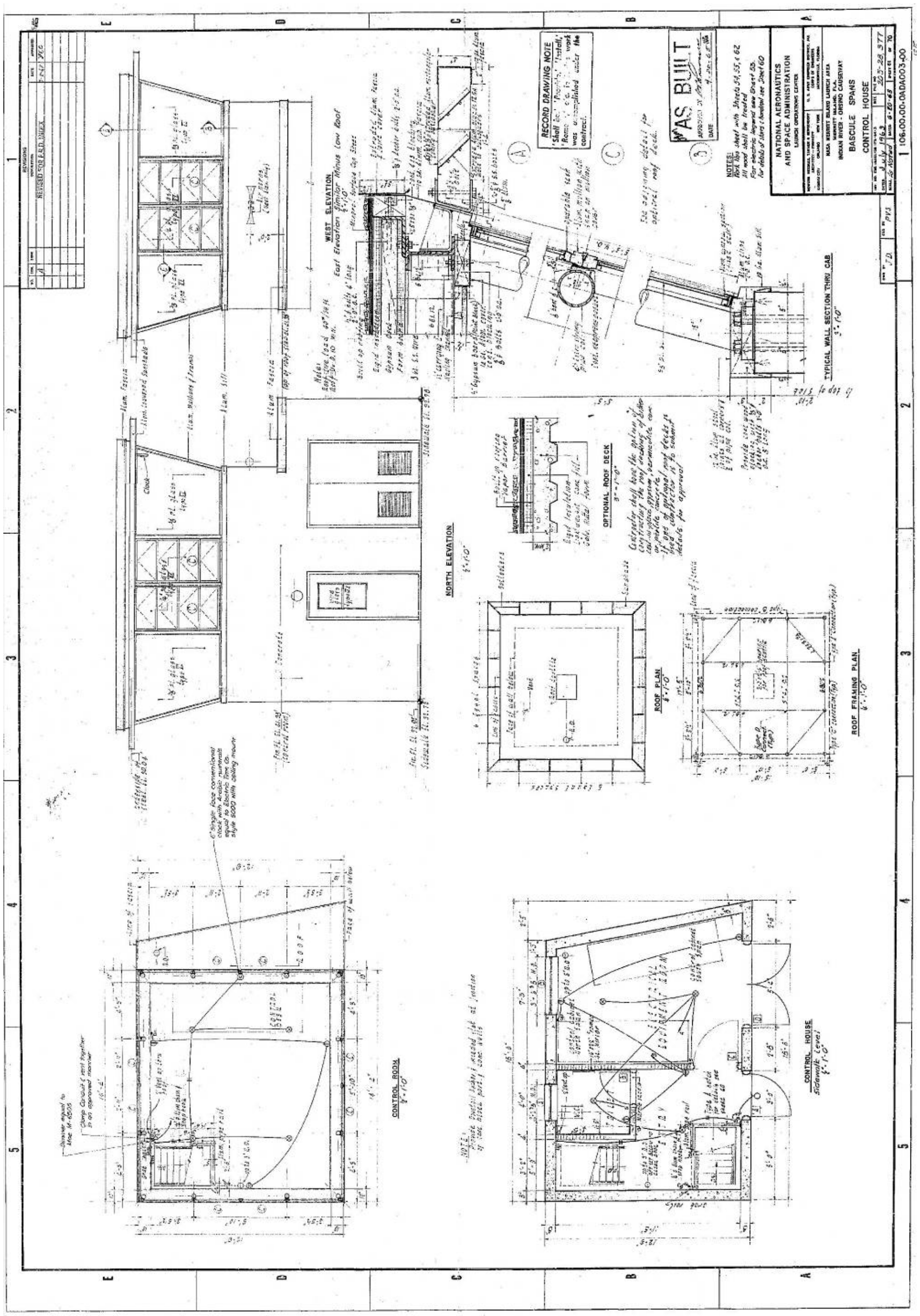

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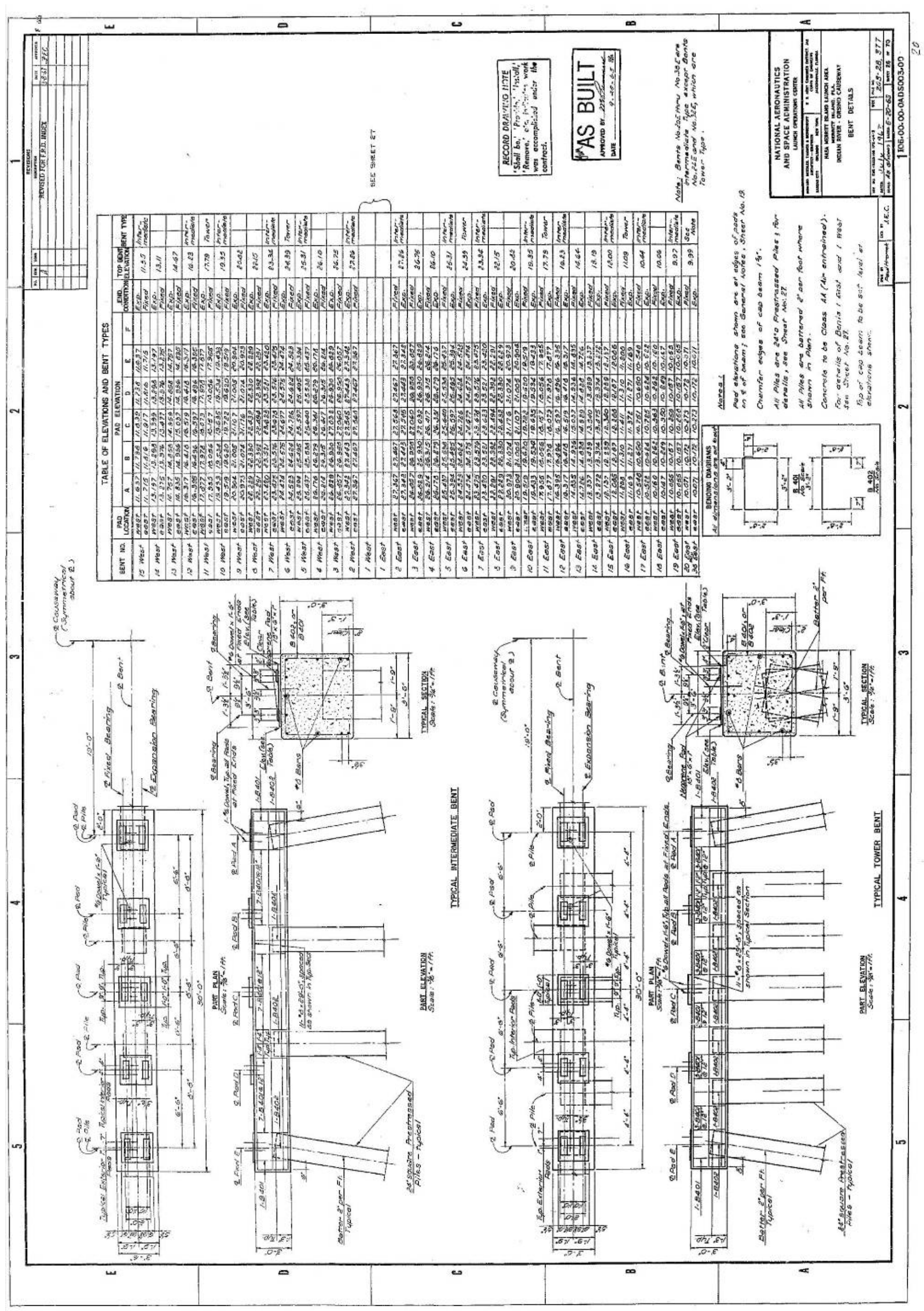

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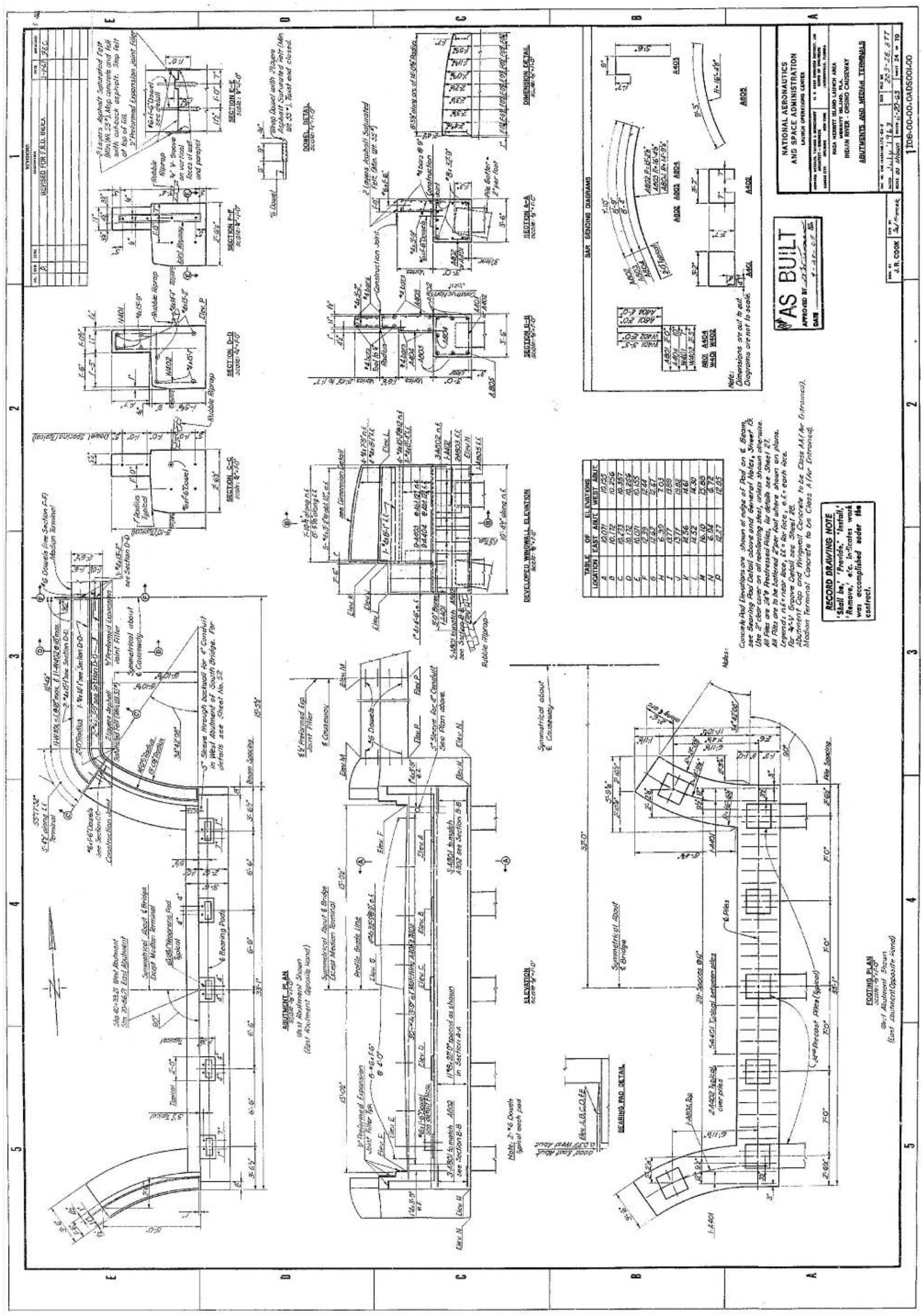

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Cape Canaveral
Brevard County
Florida

Penny Rogo, Photographer; January 2013
(FL-8-C-1 through FL-8-C-25)

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FL-8-C-2	OVERALL VIEW OF THE HAULOVER CANAL BRIDGE WITH BASCULE SPAN LOWERED, FACING NORTHWEST.
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