HAER NO. CO-101

TWIN TUNNELS

I-70 mile posts 242.163 and 242.164
Idaho Springs vicinity
Clear Creek County
Colorado

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Intermountain Support Office - Denver
National Park Service
P.O. Box 25287
Denver, Colorado 80225-0287

HISTORIC AMERICAN ENGINEERING RECORD

TWIN TUNNELS

HAER No. CO-101

Location:	Interstate 70 (I-70) Mileposts 242.163 (eastbound tunnel) and 242.164 (westbound tunnel) in the Idaho Springs vicinity, Clear Creek County, Colorado. The Twin Tunnels are located at latitude: 39.745077, longitude: -105.47369. The coordinate represents the center of the east entrance of the westbound tunnel, and was obtained on September 4, 2012, using 1″ USGS High Resolution Orthoimagery for the Denver, Colorado, Urban Area that adheres to the National Standard for Spatial Data Accuracy. This coordinate is accurate to ± 4 U.S. survey feet. The coordinate's datum is North American Datum 1983. The location of the Twin Tunnels has no restriction on its release to the public.
Present Owner:	Colorado Department of Transportation (CDOT), formerly Colorado Department of Highways (CDOH), Denver, Colorado
Present Use:	Tunnels allowing vehicular traffic on I-70 to maintain speed while passing through a rocky projection in Clear Creek Canyon
Significance:	The Twin Tunnels represent the first successful tunneling operation associated with the construction of I-70, which is a major transportation corridor and the only east-west interstate highway spanning Colorado. The tunnels constitute a milestone in the advancement of the interstate system through the Rocky Mountains. Furthermore, the construction of the Twin Tunnels was the first project conducted by CDOH to use rock bolts.
Historian:	Kristin A. Gensmer, Centennial Archaeology, Inc., 2012
Project Information:	Centennial Archaeology, Inc. produced this report at the request of the Cultural Resource Section of CDOT. Christian J. Zier, PhD., acted as Principle Investigator for the project. Kristin A. Gensmer was the Project Supervisor and Historian, compiled this report, and prepared the photographs. Travis R. Bugg produced the graphics and acted as GIS Specialist and Draftsperson. Gary Huibregtse, Professor of Photography at Colorado State University, was the photographer. Denise Fallon Zier served as Technical Editor. The archival research was conducted by Robert Autobee and Jennifer Olander of CDOT's Environmental Programs Branch History Unit,

and is derived from Level II Documentation prepared by CDOT for the Colorado Office of Archaeology and Historic Preservation.[1]

Part I. Historical Information

A. Physical History:

1. **Date of Construction:** March 14, 1960 – July 7, 1961

2. **Architect/Engineer:** Colorado Department of Highways (CDOH) / U.S. Bureau of Public Roads

3. **Contractor:** Colorado Constructors, Inc. of Denver, Colorado

4. **Original Plans and Construction:** The 1961 as-built plans for the Twin Tunnels (Appendix A) are reposited at the CDOT Central Files in Denver, Colorado. The plans show two parallel bores designed to accommodate two lanes of vehicular traffic at high speed.[2] The plans for the tunnel openings suggest the Art Deco movement, and consist of a poured concrete keystone arch flanked by fluted concrete pilasters. The 25' of rock separating the tunnels is covered by a concrete retaining wall. Originally half of each tunnel was to be lined by pneumatically-placed mortar. The other half was intended to be lined with poured concrete that was reinforced with embedded steel ribs.[3] As a result of unforeseen weaknesses in the rock, the plans were altered during construction: Rock bolts were used in addition to the ribs, and both tunnels were lined in their entireties with concrete.[4] The plans show that electrical conduits and control panels were installed, and depict a corrugated metal pipe underdrain to be installed.[5] However, in order to conserve funds, the drainage system was not completed during the original construction episode.[6] Otherwise, the tunnels were built largely as proposed.

5. **Alterations and Additions:** The Twin Tunnels appear to have undergone few modifications since their original construction.[7] In 1965 CDOH added the drainage system in an effort to prevent accidents caused by water and ice in the tunnels.[8] The

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[1] Colorado Department of Transportation (CDOT), *Twin Tunnels (5CC.1189.3): SHPO Level II Documentation, I-70, Clear Creek County*, March 2008, Prepared by the Colorado Department of Transportation for the Colorado Office of Archaeology and Historic Preservation.
[2] CDOT, *Twin Tunnels*, 6.
[3] Colorado Department of Highways, "Plan and Profile of Proposed Federal Aid Project No. I-70-3(2)251-Unit 2, State Highway No. 2, Clear Creek County," revised December 15, 1960, Located at the Colorado Department of Transportation, Central Files, Denver, CO.
[4] CDOT, *Twin Tunnels*, 4-5.
[5] Colorado Department of Highways, "Plan and Profile"
[6] Charles E. Shumate, "Transfer of Funds." August 3, 1965. Microfilm Roll C71-14, CR82-21, Located at the CDOT, Central Files, Denver, CO.
[7] CDOT, *Twin Tunnels*, 6.
[8] Charles E. Shumate, "Transfer of Funds."

drainage system consists of 8" corrugated metal pipes that were installed on the lower side of each tunnel.[9]

New lighting was installed by CDOT between 2007 and 2008 in order to reduce congestion and soften the approach to the tunnels by creating a smooth transition into the tunnels for drivers.[10] Continuous lighting was placed inside the tunnels near the top of the crown, and high mast lighting was installed outside the tunnels near each portal opening.[11]

B. Historical Context[12]

Clear Creek County

One of the original seventeen counties in Colorado, Clear Creek County has a history rich in mining. George Jackson discovered gold in Chicago Creek in January 1859, sparking a migration to the area by miners and those wishing to capitalize on the industry. Still maintaining its original county boundaries, Clear Creek County was created on November 1, 1861, and "…Idahoe was named the county seat in the legislative act of establishment."[13] The town remained the seat until 1867 when Georgetown became the new county seat.[14] The county is named for the creek that spans most of its length. It initially bore the name Vasquez Fork after a Spaniard who had a trading post and fort named after him as well.[15] The creek was renamed Clear Creek in the 1860s.[16] The first settlement in the county was an area named Spanish Bar after evidence of early Spanish mining activity was discovered.[17] Other communities in the area sprang up to support mining activities. One of these would eventually become Idaho Springs. The Idahoe Town Company was organized on June 22, 1860, and surveyed the initial layout for the town.[18] Several subsequent surveys were completed, but by the third survey "…in April 1873 an entirely new town site consisting of 1057 acres of land was preempted" and finally decided upon.[19] In addition to surveys, the town held many names including "Idaho City, Idahoe and finally Idaho Springs," which was finalized on April 7, 1876.[20] The town of Idaho Springs was incorporated on November 15, 1885.[21]

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[9] Parsons Transportation Group, "Existing Conditions Report of the Interstate 70 Twin Tunnels: Portals, Roadway Space, Liners, and Traffic Barriers (Draft)," 2012, Prepared for the Colorado Department of Transportation by Parsons Transportation Group, Denver, Colorado, 6.
[10] CDOT, *Twin Tunnels*, 6.
[11] Daniel Jepson, CDOT Senior Staff Archaeologist and Cultural Resource Section Manager, e-mail message to Christian J. Zier, June 27, 2012.
[12] The Historical Context is derived largely from the CDOT *Twin Tunnels* report.
[13] Jim Wright, "Chapter 1," In, *The History of Clear Creek County*, ed. by the Historical Society of Idaho Springs (Denver: Specialty Publishing, Inc., 1986), 1.
[14] Pioneer Association, *Pioneer History, Clear Creek County, CO* (1918; reprint, Lakewood, CO: Foothills Genealogical Society of Colorado, Inc.,1994), 10.
[15] Ibid., 6.
[16] Jim Wright, *The History of Clear Creek County*, 1.
[17] Ibid.
[18] Ibid.
[19] Pioneer Association., *Pioneer History, Clear Creek County*, 10.
[20] Jim Wright, *The History of Clear Creek County*, 1.
[21] Ibid.

Clear Creek County continued to flourish as a result of mining and tourism. In April 1941, however, the U.S. Government passed order L-202, which labeled the gold mining industry as non-essential. Because of this, miners in the area were unable to obtain proper materials, and the mining era came to an end. To fill the void, the county turned to tourism and outdoor recreation.[22] Tourism had long been a major draw, with early wagon roads taking travelers in and out of the area. These early wagon roads, which included the Idaho and Fall River Wagon Road, the South Clear Creek Wagon Road, the Chicago Creek Wagon Road and the Virginia Canyon Wagon Road, began in the 1860s and served not only the mines but stage coaches as well. The Concord Coach was the Standard Stagecoach that carried express mail and passengers.[23]

While wagon roads and stagecoaches filled a transportation need, the introduction of "…railroads played a key role in the growth and development of Clear Creek County."[24] The Colorado Central Railroad, which ran through Clear Creek County, transported ore, merchandise and passengers. Building a railroad in the area, particularly up Clear Creek Canyon, was a notable accomplishment that required high levels of engineering skill. The railroad up Clear Creek Canyon took many years to construct, making it to Floyd Hill by 1873 and eventually to Idaho Springs in June 1877, after a stall in construction due to an economic slow-down.[25] This and other railroads in the area, including the Georgetown Loop, brought tourists into Clear Creek County in droves. The tourists came to see the natural environment as well as the railroad accomplishments. This influx of visitors continued for years, but transferred from the rail to the automobile. As a result, many of the rails were torn down and sold for scrap in the 1930s, while new roads were constructed to accommodate the automobile.[26] The time following World War II saw a great rise in the number of high country tourists. U.S. Highways 6 and 40, which were the major highways in the county, became congested with weekend travelers going to and returning from the mountains. Along the fourteen-mile stretch from Floyd Hill to Empire Junction, Sunday night travelers would frequently sit in traffic for up to two hours.[27]

Interstate 70 and the Twin Tunnels

Relief for the tourist congestion was seen in the Federal Interstate Highways Act, which was signed into law by President Dwight D. Eisenhower in spring 1956, and authorized construction of a national highway system. Colorado's Department of Highways soon launched a $7 million, five-year plan to build the interstate from Floyd Hill through Idaho Springs, an effort they hoped would alleviate some of the heavy congestion. The project faced many challenges, including constructing a new four-lane highway through the narrow Clear Creek Canyon, building nine

[22] Ibid.,4.
[23] "Transportation," In, *The History of Clear Creek County*, ed. by the Historical Society of Idaho Springs (Denver: Specialty Publishing, Inc., 1986), 95.
[24] Ibid., 96.
[25] Ibid.
[26] Ibid., 97.
[27] Thurlow C. Reseigh, "Design Problems on Interstate Route 70 Denver to Utah Line" (paper presented at Committee on Design Meeting of American Association of State Highway Officials Annual Convention, Denver, CO., October 11, 1961).

concrete bridges and drilling twin two-lane tunnels through a promontory east of Idaho Springs.[28]

Prior to proceeding with the work, a rocky projection jutting into the existing U.S. Highways 6 and 40 alignment presented CDOH with a choice – bore two tunnels through the projection or cut an open two-lane highway through the outcrop. Ultimately, money was the deciding factor. A CDOH construction analysis determined that construction and acquisition of right-of-way for a 4,000' tunnel alignment, including 700' twin tunnels, was more economical in the long run than cutting 150' deep into the projection and constructing the road with a twelve-degree curve.[29] The tunnel option, in addition to providing a long-term cost benefits ratio of 3.5 over the open-cut option, also afforded a higher speed limit of 70 miles per hour. The open-cut option only allowed for a speed of approximately 40 miles per hour. This reduction in speed would create further congestion, as the stretch through Idaho Springs was designed to withstand a 60-mile-per-hour speed limit while the Floyd Hill interchange could handle a 50-mile-per-hour speed limit.[30] The factors of long-term cost effectiveness and potential speed limits resulted in the selection of the tunnel option.

Representatives from the Colorado Department of Highways and the Bureau of Public Roads inspected the tunnel's proposed location in 1957-58.[31] They drilled an 800' long, 7' x 8' bore into the ridge. This pioneer bore indicated a number of faults that could potentially lead to falling rock. In addition, the group discussed the necessity to maintain a 25' width for the pillar between the initial bore and a secondary bore that was to be drilled. Because of this, the bore drilling needed to be sufficiently controlled in order to maintain the integrity of the pillar.[32] Subsequent studies of the rock indicated that the stone was not as strong as initially thought and a wider pillar, close consultation with a mining engineer, and additional support for the interior lining of the tunnels were recommended.[33]

The project continued, with Colorado Constructors, Inc. (CCI) of Denver winning out over two other competitors with a low bid of $1,744,186.05 to construct the tunnels. The other bids, which came from the Z.H. Lowdermilk Inc. & Gardner Construction Company and H.E. Lowdermilk Co., were within five thousand dollars of the accepted bid.[34] The minimum wage for skilled laborers on the project was $1.10 an hour, with a construction schedule of three hundred days.[35] CCI initiated work on March 14, 1960, by beginning the process of clearing the eastbound tunnel. Blasting and an eight drill jumbo were utilized in the rock removal process.

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[28] Ibid.
[29] Ibid.
[30] Ibid.
[31] Colorado Department of Highways, "Colorado I-70-3(2)251 Idaho Springs-East (Tunnels)," December 14, 1959, Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.
[32] Ibid.
[33] "Geology of Pioneer Bore," December 21, 1959, Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.
[34] "Bids Received February 25, 1960, 11:00 A.M.," February 25, 1960, Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.
[35] State Highway Commission of Colorado, "Contract," February 25, 1960. Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.

Between blasts, mechanized equipment excavated and cleared loose rock. Explosions related to blasting snapped transmission lines and removed power to parts of the Clear Creek Canyon during much of the summer 1960. Telephone wires which ran through the proposed location of the tunnels needed to be moved early in the job process.[36]

By August 30, 1960, approximately 85' had been excavated from the western portal of the north and south tunnels, while about 145' had been excavated from the east portal of the south tunnel (eastbound). The north tunnel (westbound) had roughly 80' excavated from the eastern portal.[37] On October 15, 1960, the south tunnel was bored completely. The project proceeded, with a minor setback in November 1960. The CDOH found the concrete work at the west end of the north tunnel to be unacceptable. CCI agreed to salvage materials and manpower to produce an acceptable product both in terms of utility and aesthetics.[38] On December 4, 1960, severe winter weather forced CCI to suspend operations.[39] Operations resumed and the work within the tunnel that was previously documented as unacceptable was on its way to being repaired in February 1961. Unfortunately, "concrete exposed at the outside of the portal arch still… [left] much to be desired in that finish… [was] rough and very porous, indicating improper placement methods and poor form and finish work".[40] In addition, it had been determined that the entire length of the tunnels needed to be lined due to the "unstable condition of the rock encountered" during the boring process.[41] This required additional time, expense and the use of steel bolts, known as rock bolts, a first for CDOH. Engineers and crews paid special attention to weak spots, fault lines, and water seeping from the rock and inserted the bolts into the firm strata.[42] Additional reinforcing steel supports were concealed by the concrete facades at each entrance.

Rock bolts are long, anchoring, steel rods that provide stability in tunnels by holding loose or unstable rock in place by distributing the load. Although rock bolts were initially developed in Germany in 1913, they did not become widely used until they were adapted by the American mining industry in 1940. Systematic rock bolting, like that employed in the construction of the Twin Tunnels, was first used in 1950 during the construction of a diversion tunnel for the Keyhole Dam in Wyoming. Rock bolts are considered superior to the wood and steel supports that they replaced because they do not obstruct the cross-sectional profile of a tunnel, are

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[36] The Mountain States Telephone and Telegraph Company, "FAP I-70-3(4) 250 Idaho Springs East #6 and #40," April 5, 1960. Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.
[37] I.J. Ratliff, "United States Department of the Interior Bureau of Mines Memo Subject: Rock bolting, vehicular tunnels, Interstate Route 70, east of Idaho Springs, Colorado, Project I-70-3(2)251 Unit 2," September 2, 1960. Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.
[38] Colorado Constructors, Inc., "Mr. F.G. Sterns, Construction Engineer District No. 1," November 29, 1960. Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.
[39] Robert Autobee, *Architectural Inventory Form Resource Number 5CC1189.3*, November 15, 2005.
[40] A.R. Abelard, "09-05 Colorado I-70-3(2)251 Idaho Springs Tunnels," February 13, 1961. Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.
[41] State Highway Department of Colorado "Supplemental Agreement and/or Work Order," December 2, 1960. Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.
[42] Robert Autobee, *Architectural Inventory Form.*

generally less expensive because they use fewer raw materials, and are safer because they are less likely to rot or become dislodged.[43]

Construction work on the Twin Tunnels was completed July 7, 1961.[44] The project was finished in 386 days, eighty-six days over the allotted three hundred days determined in the contract with CCI in 1960.[45] Various aspects of the project held up the completion date. In addition to unacceptable concrete work, higher prices of steel, the cost of tunnel lining and the use of rock bolts resulted in a total project cost of $2.7 million – almost a million dollars more than CCI's original bid.[46] The issue of structural steel costs and money owed to CCI was brought to court. The courts found in favor of CCI, and they were awarded $5,881.89.[47]

In 1965, unused funds from a different portion of the I-70 project were transferred to the Twin Tunnels for the installation of a drainage system in the westbound bore. When the tunnels were originally constructed, "there was no indication of moisture or water and drains were eliminated as an economy measure."[48] For a sixteen-month period during 1964-65, it was found, however, that water and icing in the tunnel were partly responsible for eleven accidents, five of which resulted in injuries.[49]

With the exception of the drainage project, the Twin Tunnels have undergone very few modifications since their construction. In 2007, CDOT concluded that the concrete facades at the west portals contributed to a visual phenomenon known as the "black hole effect," which led to traffic slowing in that area of the interstate. In addition, the angle of the existing wall left little room for deflection of the guardrail in the event that it was struck by a vehicle. As a result, CDOT planned the removal of the original wall and its reconstruction at a safer angle.[50] However, this modification was not made, and the original façade and retaining wall remain in place.[51] In 2007-08, new lighting was installed inside the tunnels to help soften the approach and reduce congestion in the area by providing a smooth lighting transition for drivers.[52]

Although the Twin Tunnels have only just reached fifty years of age, their exceptional importance in the completion of I-70 through the mountains makes them eligible for the National Register of Historic Places (NRHP) under Criterion C and Criterion Consideration G. The tunnels were determined to be officially eligible for the NRHP on November 11, 2005. This

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[43] Kalman Kovari, "History of the sprayed concrete lining method – Part II: milestones up to the 1960s," *Tunnelling and Underground Space Technology*, No. 18 (2003): 71-83.
[44] Colorado Department of Highways, "Construction Progress Report," August 1961. Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.
[45] W.C. Stearns, "Time Count Report," July 10, 1961, Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.
[46] Robert Autobee, *Architectural Inventory Form.*
[47] George L. Zoellner, "Colorado Constructors, Inc. vs. Colorado Department of Highways, District Court, City and County of Denver No. B-46026; Project I-7—2(2)251, Unit 2," October 17, 1961. Microfilm Roll C71-14, CR82-21, located at the Colorado Department of Transportation, Central Files, Denver.
[48] Charles E. Shumate, "Transfer of Funds."
[49] Ibid.
[50] CDOT, *Twin Tunnels*, 1
[51] Lisa Schoch, CDOT Senior Staff Historian, personal communication to Kristin Gensmer, 9/13/2012.
[52] Ibid., 7

determination was officially reaffirmed on January 11, 2012. They are also included on the Federal Highway Administration's *Final List of Nationally and Exceptionally Significant Features of the Federal Interstate Highway System*,[53] and on the Advisory Council on Historic Preservation's list of resources that must be evaluated prior to any undertakings that may cause adverse impacts to the structures.[54]

Part II. Structural/Design Information

A. General Statement:

1. **Character:** The Twin Tunnels represent the first tunnels bored through hard rock during the construction of I-70 in Colorado as well as the first use of rock bolt technology by the CDOH. These structures are typical of concrete-lined vehicular tunnels constructed during the 1960s.

2. **Condition of Fabric:** The tunnels remain in active use and are generally in good, functional condition. However, some weaknesses have developed due to the age of the structure, exposure to the elements, and high levels of use. Small amounts of cracking, including one large void covered by a thin layer of concrete, are present in the liner. The corrugated metal pipes used in the drainage system are corroded as are the steel reinforcements near the void in the liner.[55]

B. Description: The Twin Tunnels consist of the arched portal structures present at each opening as well as the concrete-lined bores that allow two lanes of vehicular traffic on I-70 to pass through a rocky projection (Figure 1). The eastbound (south) bore measures 696' in length and the westbound (north) bore is 741' in length. The tunnels have a horseshoe-shaped cross section, are 32' wide from face-of-wall to face-of-wall, and 24' in height from the roadway surface to the top of the crown. Measuring from the centerlines, the westbound and eastbound bores are approximately 59' apart. The tunnels are separated by a 25' pillar of rock. The westbound bore is about 6' higher in elevation than the eastbound bore.[56]

Each of the tunnel openings consists of nearly-identical gray-painted poured concrete facades. The facades have a segmental (circular) arch design formed by low-relief fluted pilasters flanking concrete panels poured to resemble keystones surrounded by voussoirs.[57] The top of the arch is stepped. The smooth walls of the concrete and the geometric shapes of the pilasters and arch give the portal openings an appearance suggestive of Art Deco style architecture that was popular during the Modernistic Movement of the 1920s through the 1940s. Poured concrete walls that feature a stepped top and are painted the same gray as the façade both visually tie the

[53] Federal Highway Administration, "Final List of Nationally and exceptionally Significant Features of the Federal Interstate Highway System," *U.S. Department of Transportation: Federal Highway Administration*, 2006. Accessed August 9, 2012, www.environment.fhwa.dot.gov/histpres/highways_list.asp.
[54] CDOT, *Twin Tunnels,* 1
[55] Parsons Transportation Group, "Existing Conditions Report"(Draft), 2
[56] Ibid., 4-5
[57] CDOT, *Twin Tunnels*, 6

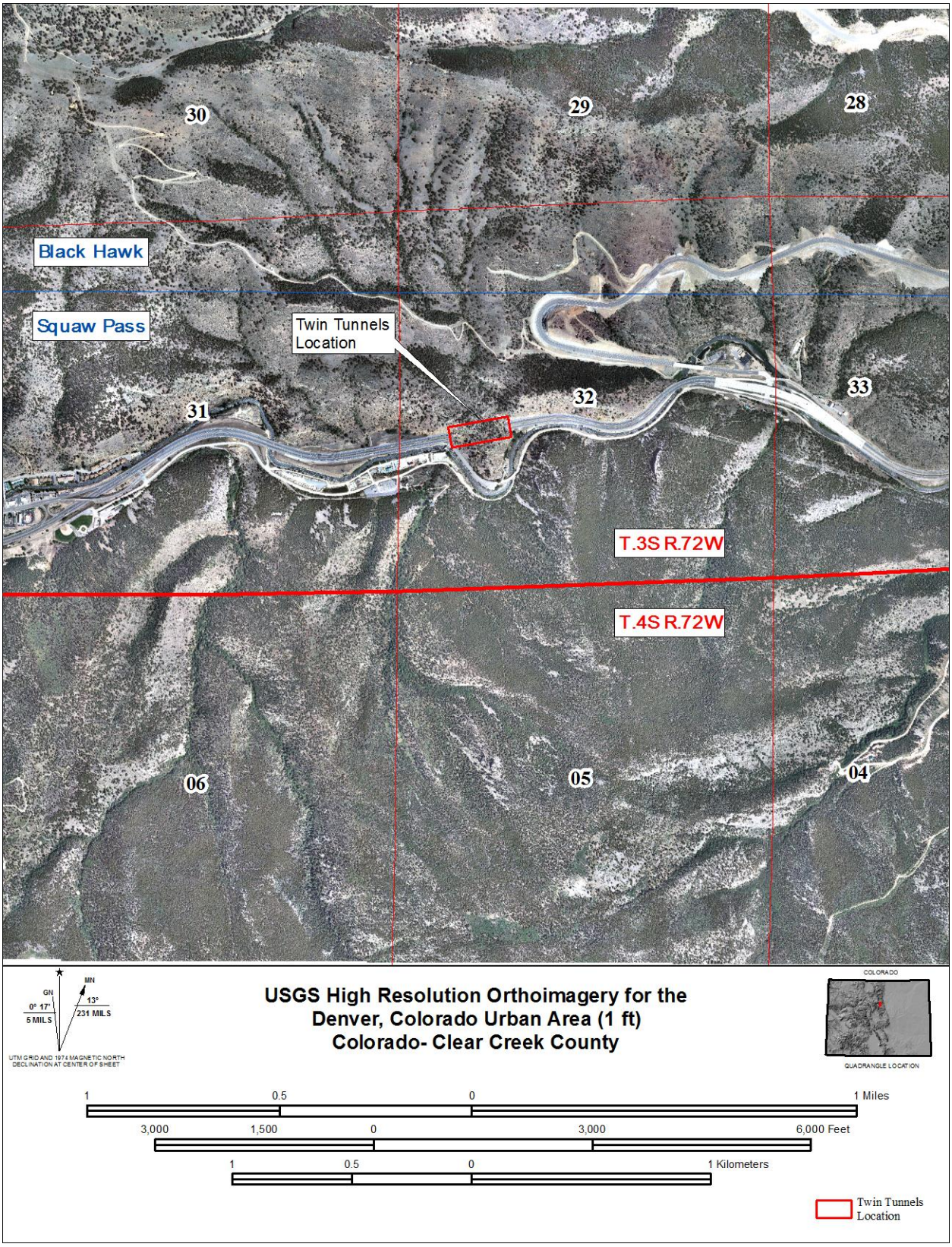

Figure 1. USGS map at 1:24,000 scale showing the location of the Twin Tunnels.

higher tunnel to the lower tunnel and stabilize the pillar of rock separating them. The north (westbound) tunnel extends farther west than the eastbound tunnel. On the west side of the tunnels stabilizing concrete walls run parallel to the north side of the interstate on both bores. A galvanized metal chain-link fence reinforced by wire cables is present on the top of the concrete walls, and prevents falling rock from causing traffic hazards. Metal piping that runs electrical wiring into the tunnels, and electrical boxes, have been affixed to the concrete facades.[58]

The interior of the tunnels is lined with concrete reinforced by steel ribs and rock bolts. The tunnels were blasted out of the rocky projection, and are separated by an intact central pillar of bedrock. The rock bolts were installed to lend additional support to the pillar, and the steel ribs reinforce the walls. The bolts are set on 4'-0" x 4'-0" centers placed in rows three bolts high in the eastbound tunnel and two bolts high in the westbound tunnel.[59] The steel bolts have a diameter of 1.25", are 18" long, and have a 7" threaded screw segment. Basic bearing plates that measure 6" x 6" were used to support the rock and to prevent the head of the rock bolts from sinking into the bolt holes. The steel ribs were also set at approximately 4' centers, and were blocked and wedged tightly against the rock before being imbedded in the concrete lining.[60] The concrete lining is reinforced by longitudinal No. 5 steel bars on 18" centers and transverse No. 6 bars on 8" centers. A skeleton of 3" x 6" timber was used as a support for the liner, and was left in place when the liner was installed. The lining consists of smooth concrete with a flat finish. The liner was cast in place over the stabilizing ribs and rock bolts, and was installed in segments that are approximately 40' long and 1'-6" thick. Construction joints were used to connect each longitudinal segment. Approximately eighteen segments form the eastbound bore and nineteen segments form the westbound bore.[61] The interior surfaces of the tunnels are covered with a mortar finish and are painted with a flat, white paint to a height of approximately 14' above the roadway. The crowns of the tunnels are not coated and remain gray concrete.[62]

The road surface consists of concrete pavement over a leveling course of concrete. The leveling course is 6" thick and the poured concrete pavement is 8" thick.[63] The effective roadway has been further reduced to approximately 29' by the later addition of New Jersey-type concrete barriers that run along the full length of the shoulder edges of each of the tunnels.[64]

No ventilation systems are present in the Twin Tunnels. Instead, air movement in the bores is a factor of the "piston effect" in which moving vehicles push air through the tunnels. Meteorological conditions also contribute to the movement of air in the tunnels. Air quality is not monitored.[65]

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[58] CDOT, *Twin Tunnels*, 6
[59] Parsons Transportation Group, "Existing Conditions Report"(Draft), 5
[60] CDOT, "As Built Plans: Typical Tunnel Sections," Sheet No. 2, located at the Colorado Department of Transportation, Central Files, Denver.
[61] Parsons Transportation Group, "Existing Conditions Report" (Draft), 5
[62] Daniel Jepson, e-mail message to Christian J. Zier, June 27, 2012.
[63] CDOT, "As Built Plans: Typical Tunnel Sections," Sheet No. 2
[64] Parsons Transportation Group, "Existing Conditions Report" (Draft), 6
[65] Ibid.

The Twin Tunnels are currently illuminated by a continuous lighting system that was installed in 2008. At that time high mast lighting was installed outside the tunnels near the entrances of each of the portals.[66] The current interior lighting system is positioned near the crown of each of the tunnels, and is oriented north of center in the eastbound tunnel and south of center in the westbound tunnel. This system is a replacement of the original lights, which were placed at the exact top of each tunnel.[67]

The drainage system consists of a corrugated metal pipe (CMP) underdrain that is situated along the north edge of the road in both tunnels. The CMP has a diameter of 8". The drain is located below the paved area and discharges through an 8'-0" x 8'-0" concrete box culvert near the east portal of the tunnels.[68] No waterproofing membrane or drainage system is present underneath the concrete liner.[69]

C. Mechanicals/Operation: The Twin Tunnels are open, reinforced bores that allow vehicular traffic to maintain high speeds while passing through a rocky projection. The drainage and lighting systems discussed above are the only operational features present in the tunnels.

D. Site Information: The Twin Tunnels are situated in Clear Creek Canyon in the Front Range of the Rocky Mountains. The bedrock through which bores pass largely consists of gneiss and schist.[70] The canyon is fairly narrow at this point, and is constrained by the same rocky projection that necessitated the creation of the bores. Clear Creek is located approximately 200' south of the eastbound tunnel.[71]

Part III. Sources of Information

A. Primary Sources

Abelard, A.R. "09-05 Colorado I-70-3(2)251 Idaho Springs Tunnels," February 13, 1961. Microfilm Roll C71-14, CR82-21. Located at Colorado Department of Transportation, Central Files, Denver.

Autobee, Robert. *Architectural Inventory Form Resource Number 5CC1189,* November 15, 2005. Located at Office of Archaeology and Historic Preservation, Denver, Colorado.

"Bids Received February 25, 1960, 11:00 A.M.," February 25, 1960. Microfilm Roll C71-14, CR82-21. Located at Colorado Department of Transportation, Central Files, Denver.

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[66] Daniel Jepson, e-mail message to Christian J. Zier, June 27, 2012.
[67] Parsons Transportation Group, "Existing Conditions Report" (Draft), 6.
[68] Ibid; "As Built Plans," Sheet No. 6.
[69] Daniel Jepson, e-mail message to Christian J. Zier June 27, 2012.
[70] Halka Chronic, *Roadside Geology of Colorado* (Missoula, Montana, Mountain Press Publishing Company, 1980), 87.
[71] Erik M. Gantt., Christian J. Zier and Kristin A. Gensmer, "A Class III Cultural Resource Inventory Report for the Colorado Department of Transportation Environmental Programs Branch, Denver, Colorado," 2011, by Centennial Archaeology, Inc., Fort Collins, Colorado.

Colorado Constructors, Inc. "Mr. F.G. Sterns, Construction Engineer District No. 1," November 29, 1960. Microfilm Roll C71-14, CR82-21. Located at Colorado Department of Transportation, Central Files, Denver.

Colorado Department of Highways. "Colorado I-70-3(2)251 Idaho Springs-East (Tunnels)," December 14, 1959. Microfilm Roll C71-14, CR82-21. Located at Colorado Department of Transportation, Central Files, Denver.

_____. "Construction Progress Report," August 1961. Microfilm Roll C71-14, CR82-21. Located at Colorado Department of Transportation, Central Files, Denver.

_____. "Plan and Profile of Proposed Federal Aid Project No. I-70-3(2)251-Unit 2, State Highway No. 2, Clear Creek County," revised December 15, 1960. Located at Colorado Department of Transportation, Central Files, Denver.

Colorado Department of Transportation. *Twin Tunnels (5CC.1189.3): SHPO Level II Documentation, I-70, Clear Creek County*, 2012. Prepared by Colorado Department of Transportation for Office of Archaeology and Historic Preservation, Denver, Colorado.

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Appendix A: Selection of the Twin Tunnels As Built Plans, courtesy of Colorado Department of Transportation, Denver.

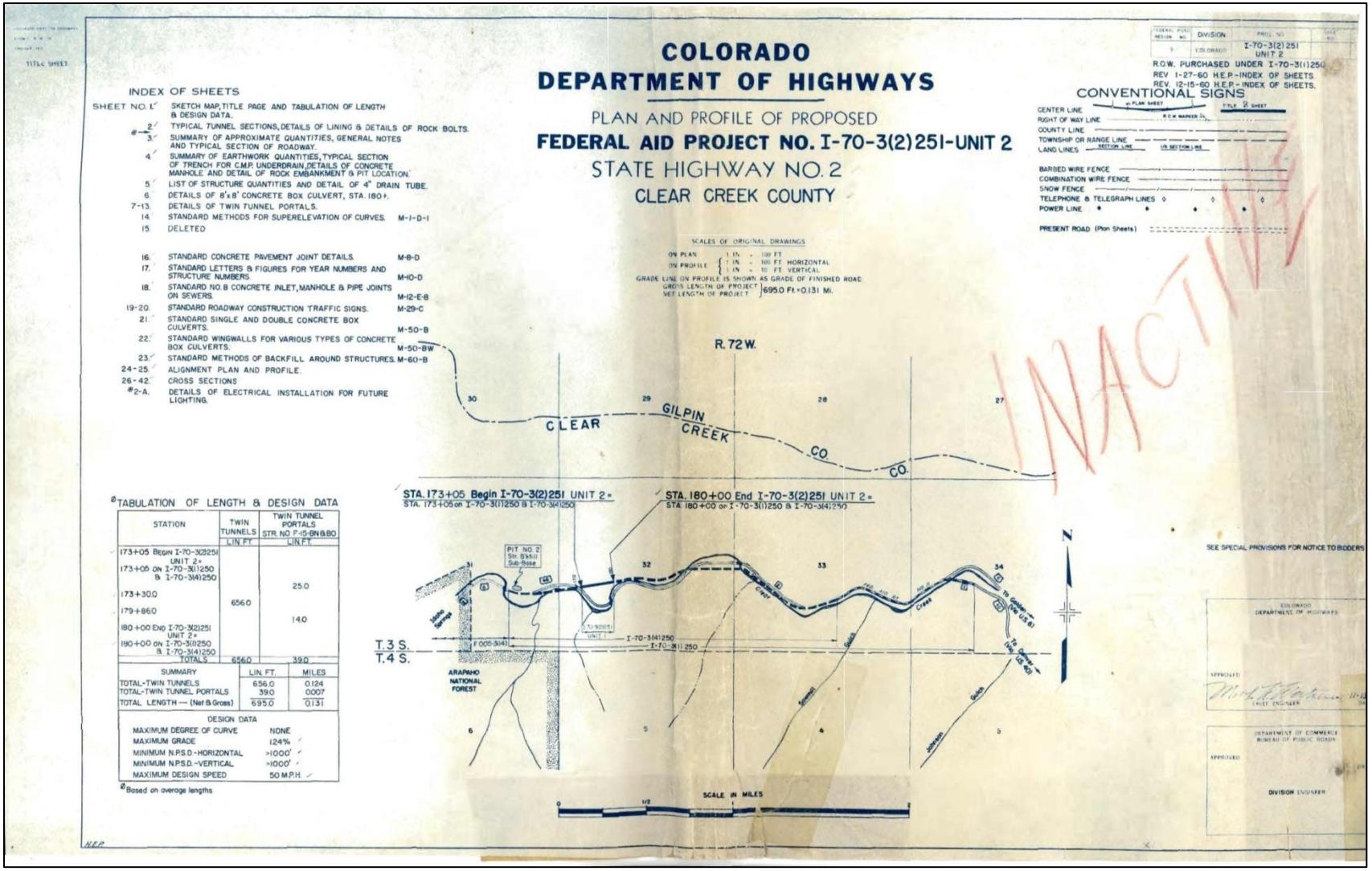


Figure A-1. Twin Tunnel As Built Plans. Index of sheets and location map, 1961.

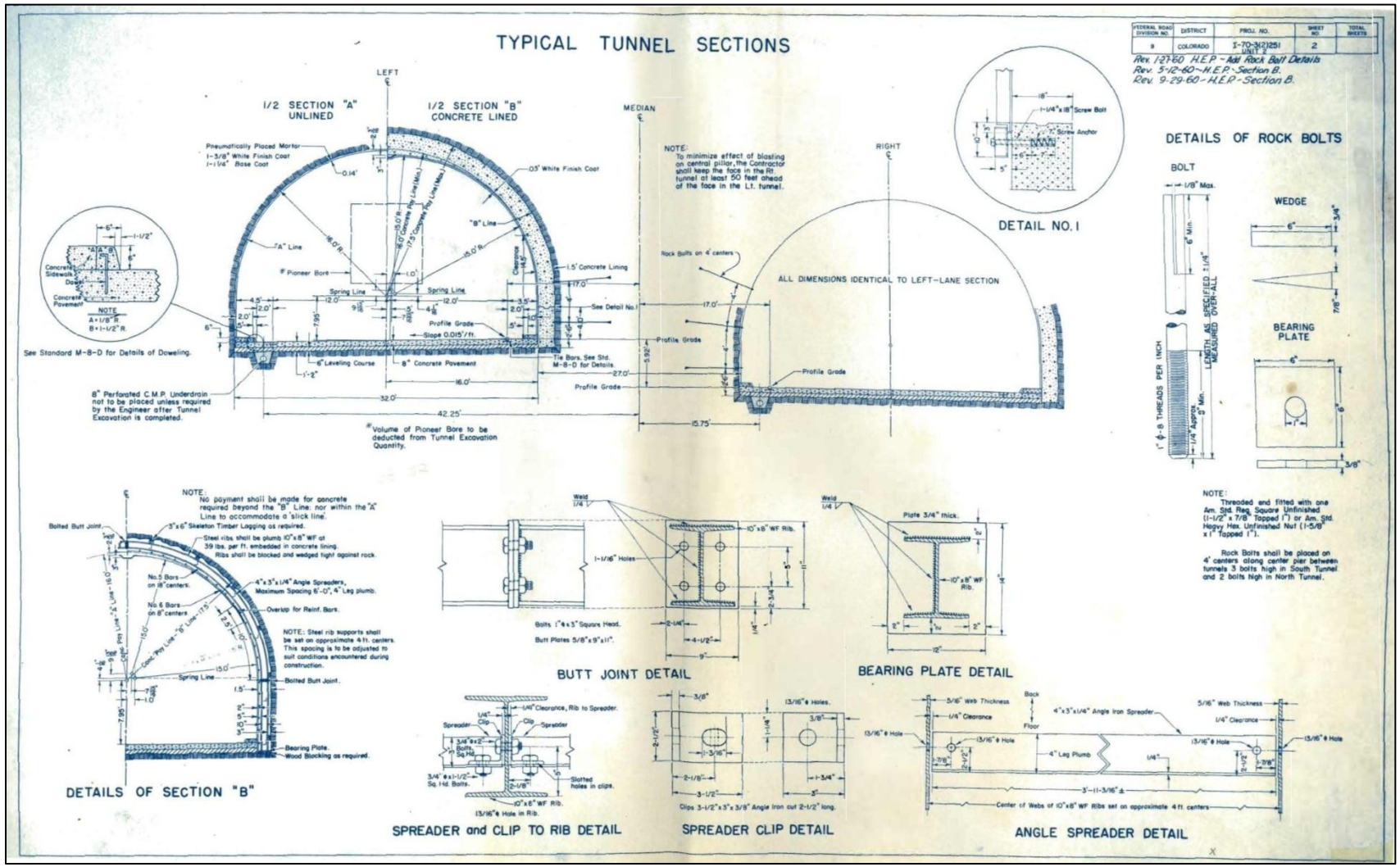


Figure A-2. Twin Tunnels As Built Plans (Sheet 2). Typical tunnel sections and rock-bolt details.

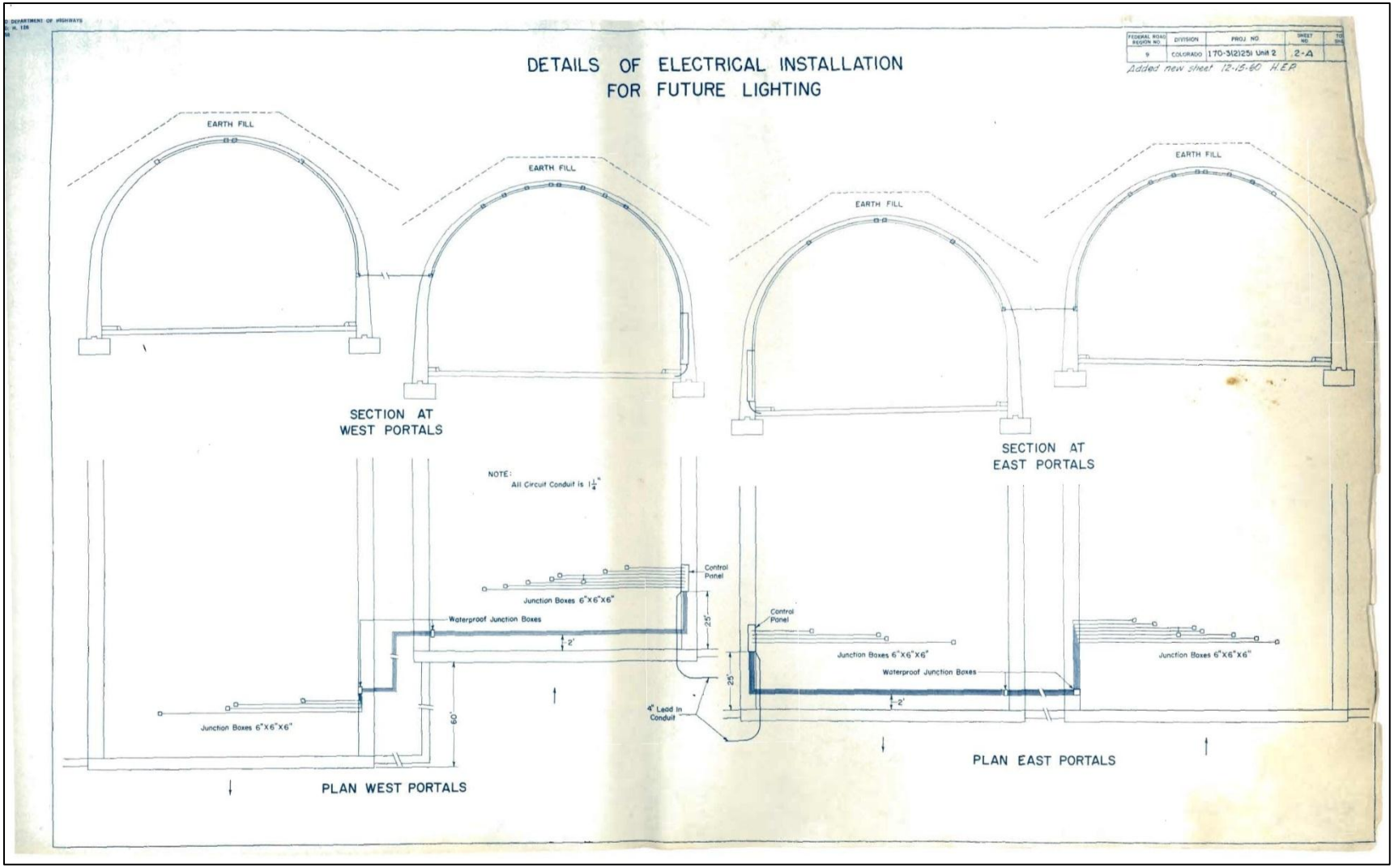


Figure A-3. Twin Tunnels As Built Plans (Sheet 2-A). Electrical installation details at portal entrances.

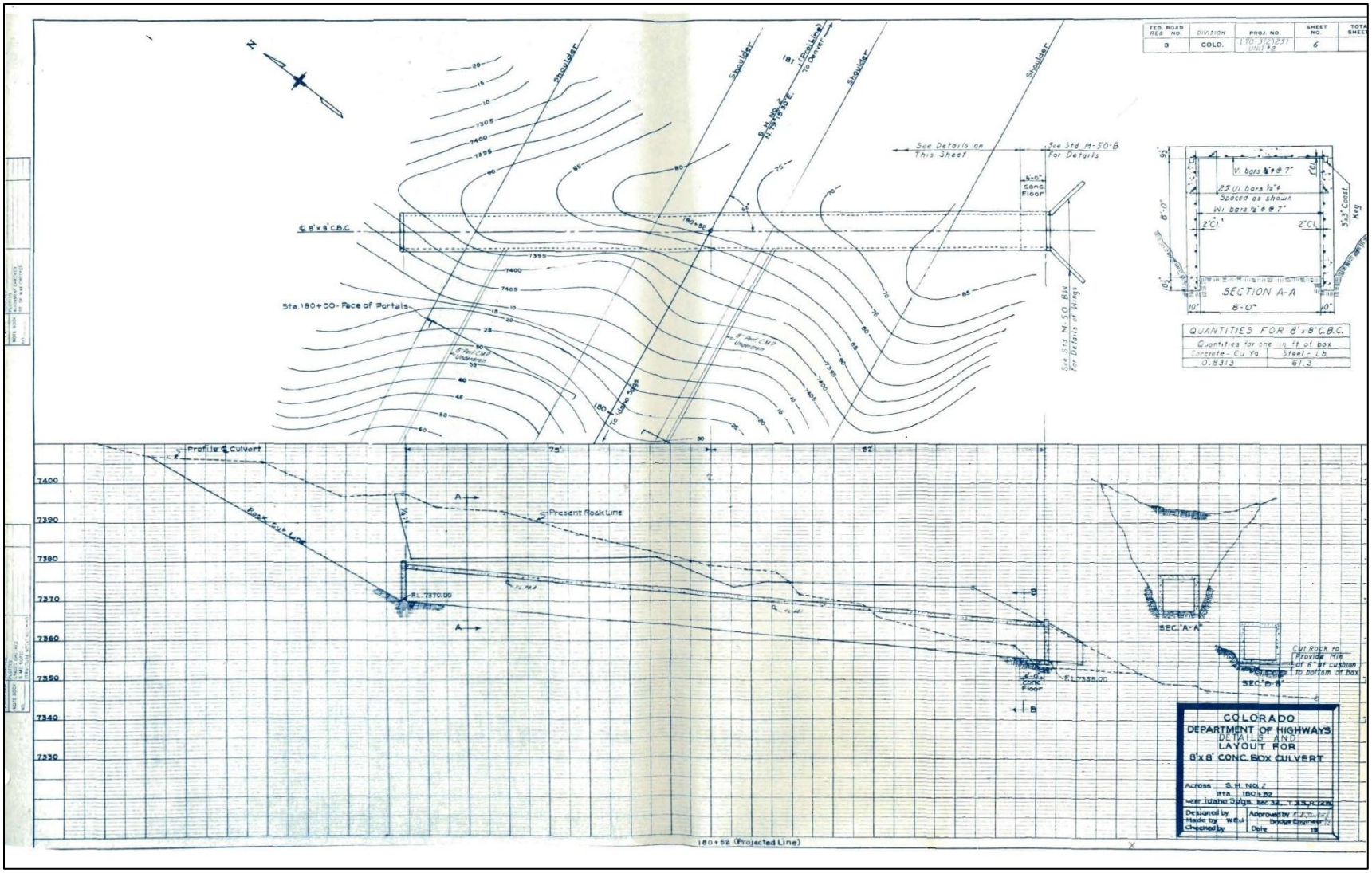
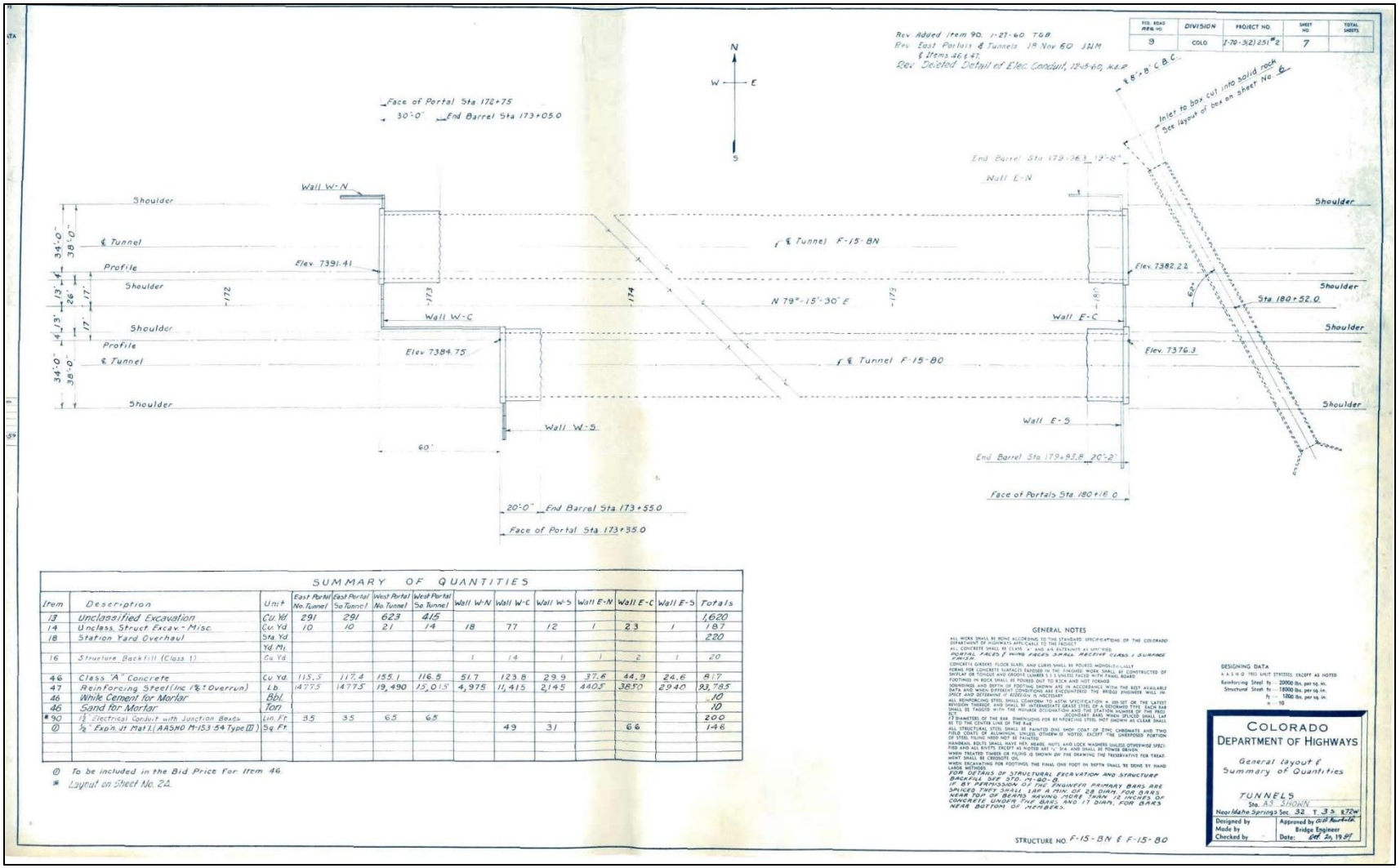


Figure A-4. Twin Tunnels As Built Plans (Sheet 6). Details and layout for concrete box culvert.



SUMMARY OF QUANTITIES

Item	Description	Unit	East Portal No. Tunnel	East Portal So. Tunnel	West Portal No. Tunnel	West Portal So. Tunnel	Wall W-N	Wall W-C	Wall W-S	Wall E-N	Wall E-C	Wall E-S	Totals
13	Unclassified Excavation	Cu. Yd.	291	291	623	415							1,620
14	Unclass. Struct Excav. - Misc.	Cu. Yd.	10	10	21	14	18	77	12	1	23	1	187
18	Station Yard Overhaul	Sta. Yd.											220
		Yd. Mi.											
16	Structure Backfill (Class 1)	Cu. Yd.					1	14	1	1	2	1	20
46	Class "A" Concrete	Cu. Yd.	115.3	117.4	155.1	116.5	51.7	123.8	29.9	37.6	44.9	24.6	817
47	Reinforcing Steel (Inc 1% ± Overrun)	Lb.	14775	14775	19,490	15,015	4,975	11,415	2,145	4405	3850	2940	93,785
46	White Cement for Mortar	Bbl.											10
46	Sand for Mortar	Ton											10
*90	½ Electrical Conduit with Junction Boxes	Lin. Ft.	35	35	65	65							200
⓪	½" Expn. Jt Mat'l. (AASHO M-153-54 Type III)	Sq. Ft.						49	31		66		146

⓪ To be included in the Bid Price For Item 46.
* Layout on Sheet No. 2A.

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO DEPARTMENT OF HIGHWAYS APPLICABLE TO THIS PROJECT.
ALL CONCRETE SHALL BE CLASS "A" AND AIR ENTRAINED AS SPECIFIED.
PORTAL FACES & WING FACES SHALL RECEIVE CURED & SURFACE FINISH.
CONCRETE GUIDERS, FLOOR SLABS, AND CURBS SHALL BE FINISHED MONOLITHICALLY.
FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF DRESSED OR TONGUE AND GROOVE LUMBER OR PLYWOOD FACED WITH FINISH BOARD.
FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK LINES SHOWN.
SOUNDINGS AND DEPTH OF FOOTING SHOWN ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA AND WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.
ALL REINFORCING STEEL SHALL CONFORM TO ASTM SPECIFICATION A 305 OR THE LATEST REVISION THEREOF, AND SHALL BE INTERMEDIATE GRADE STEEL OF A DEFORMED TYPE. EACH BAR SHALL BE TAGGED WITH THE MARKED DESIGNATION AND THE STATION NUMBER OF THE FACE SHOWN.
12 DIAMETERS OF THE BAR DIMENSIONS FOR BENDING STEEL NOT SHOWN AS CLEAR SHALL BE TO THE CENTER LINE OF THE BAR.
ALL STRUCTURAL STEEL SHALL BE PAINTED ONE SHOP COAT OF ZINC CHROMATE AND TWO COATS OF RED OXIDE, UNLESS OTHERWISE NOTED, EXCEPT THE UNEXPOSED PORTION OF STEEL FILLING NEED NOT BE PAINTED.
HANDRAIL BOLTS SHALL HAVE HEX. HEADS, NUTS, AND LOCK WASHERS UNLESS OTHERWISE SPECIFIED AND ALL RIVETS EXCEPT AS NOTED ARE ¾" DIA. AND SHALL BE POWER DRIVEN.
WHEN TREATED TIMBER OR FILLING IS SHOWN ON THE DRAWING THE PRESERVATIVE FOR TREATMENT SHALL BE CREOSOTE OIL.
WHEN EXCAVATING FOR FOOTINGS, THE FINAL ONE FOOT OF DEPTH SHALL BE DONE BY HAND LABOR METHODS.
FOR DETAILS OF STRUCTURAL EXCAVATION AND STRUCTURE BACKFILL SEE STD. 7-60-8.
IN THE PERMISSION OF THE ENGINEER PRIMARY BARS ARE SPLICED THEY SHALL LAP A MIN. OF 28 DIAM. FOR BARS NEAR TOP OF BEAMS HAVING MORE THAN 12 INCHES OF CONCRETE UNDER THE BARS AND 17 DIAM. FOR BARS NEAR BOTTOM OF MEMBERS.

DESIGNING DATA
A.A.S.H.O. 1953 UNIT STRESSES, EXCEPT AS NOTED
Reinforcing Steel f_s — 20000 lbs. per sq. in.
Structural Steel f_s — 18000 lbs. per sq. in.
f_c — 1200 lbs. per sq. in.
n — 10

COLORADO
DEPARTMENT OF HIGHWAYS
General layout & Summary of Quantities
TUNNELS
Sta. AS SHOWN
Near Idaho Springs Sec. 32 T. 3 S R. 72 W
Designed by
Made by
Checked by
Approved by Bridge Engineer
Date: Oct 25, 1960

STRUCTURE NO. F-15-BN & F-15-80

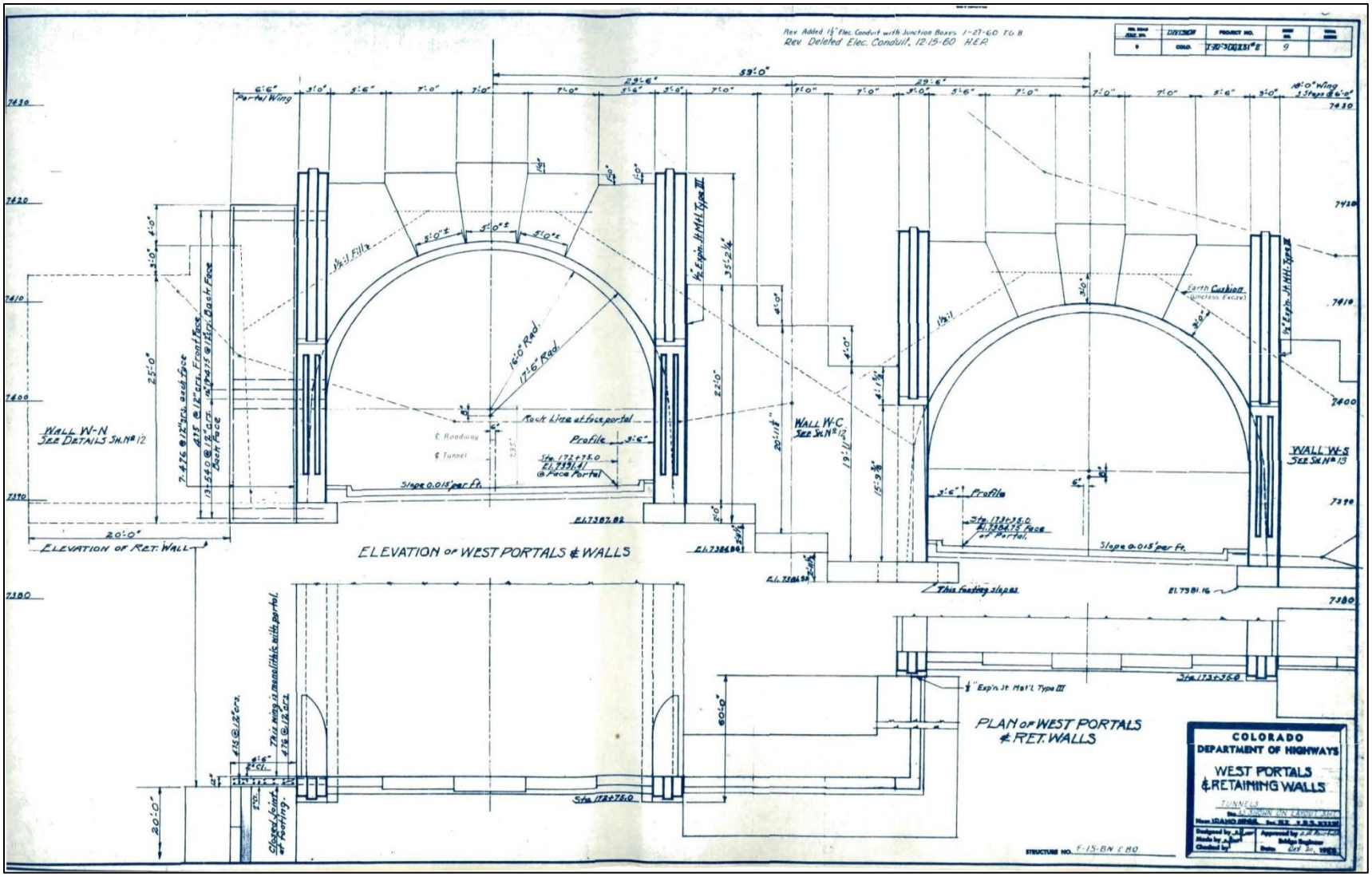


Figure A-6. Twin Tunnels As Built Plans (Sheet 9). Details of west portals and retaining walls.

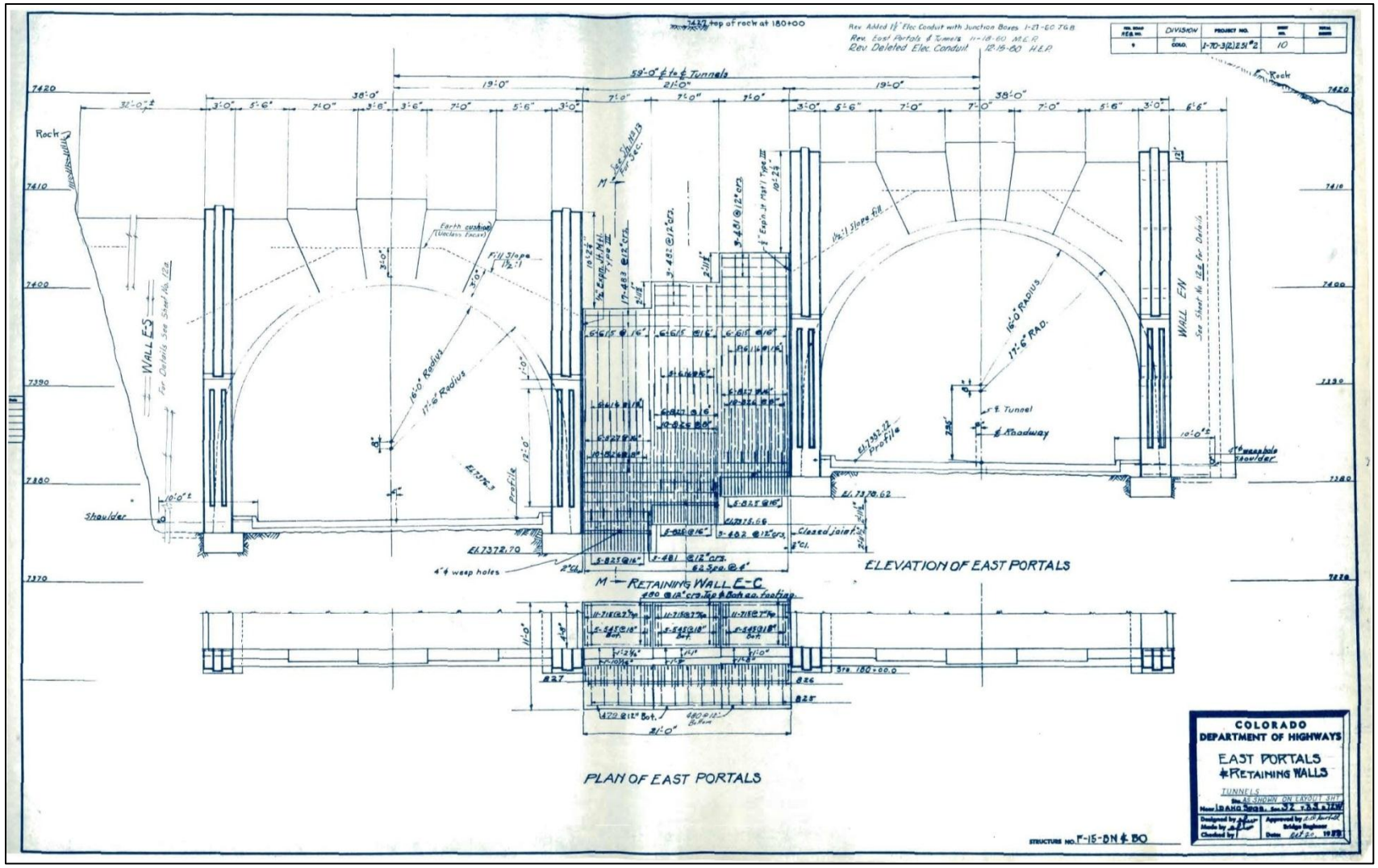


Figure A-7. Twin Tunnels As Built Plans (Sheet 10). Details of east portals and retaining walls.

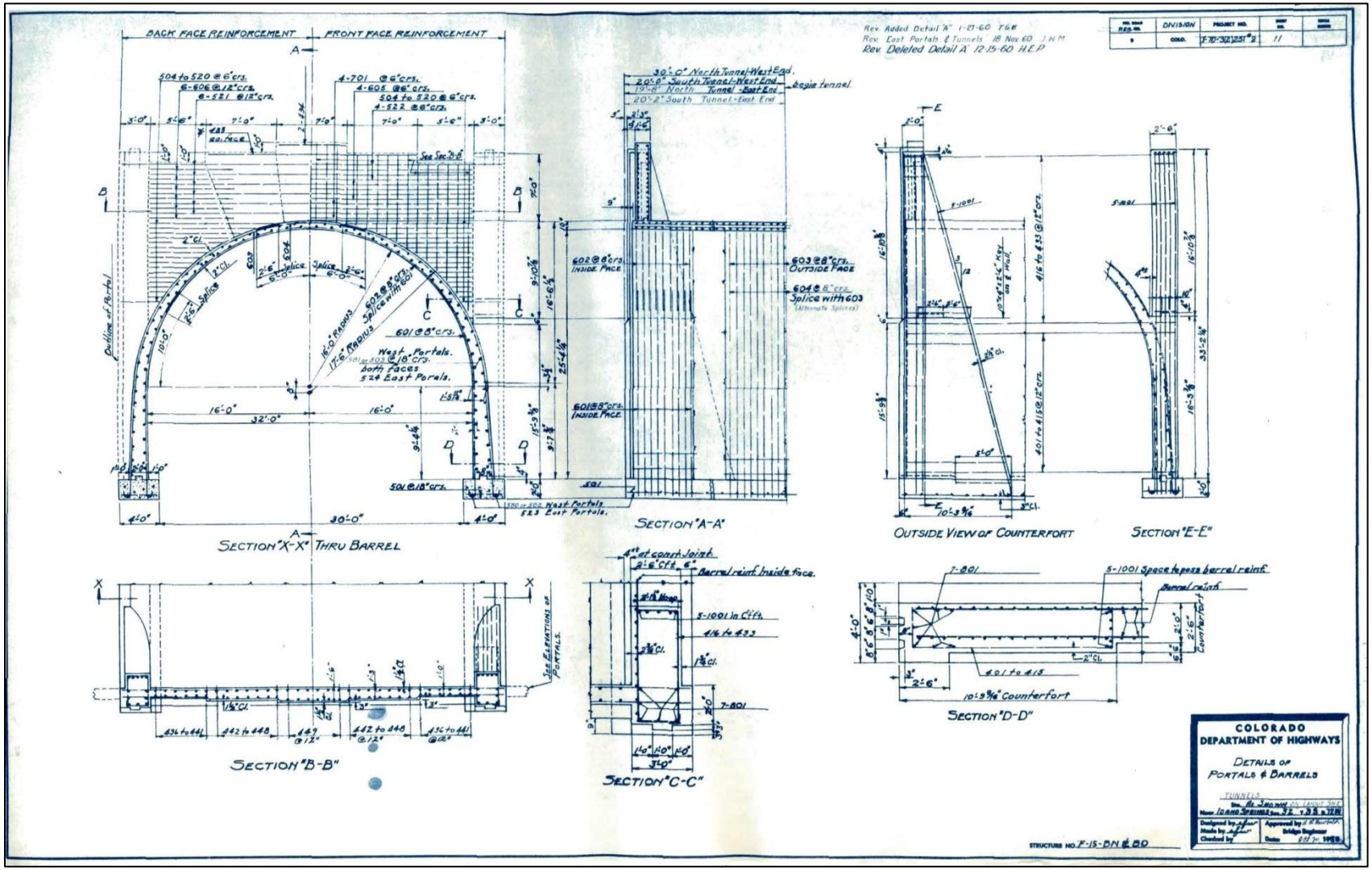


Figure A-8. Twin Tunnels As Built Plans (Sheet 11). Details of portals and barrels.

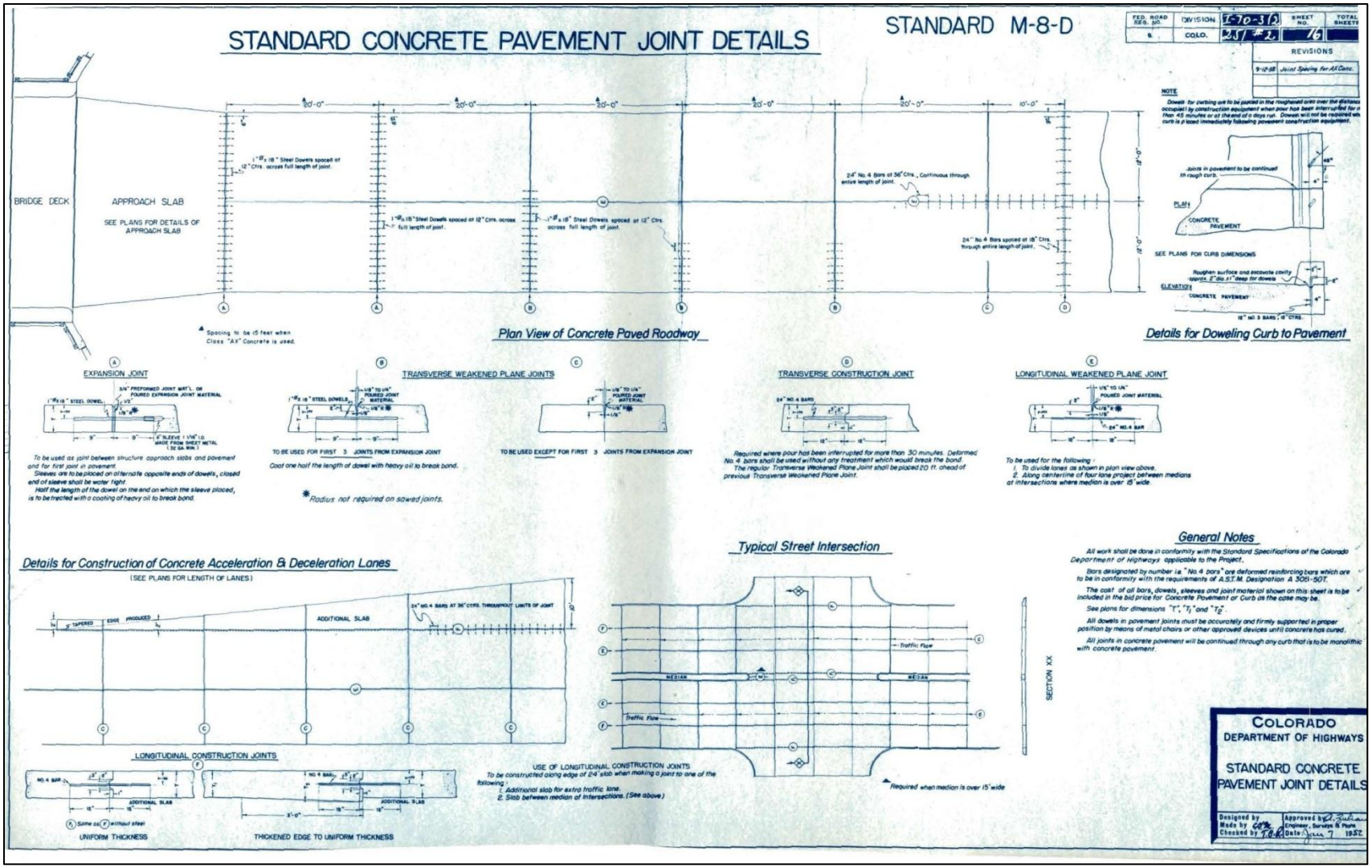


Figure A-9. Twin Tunnels As Built Plans (Sheet 16). Details of concrete pavement joints.

Appendix B: Selection of Twin Tunnels Lighting Upgrade As Built Plans, courtesy of Colorado Department of Transportation, Denver.

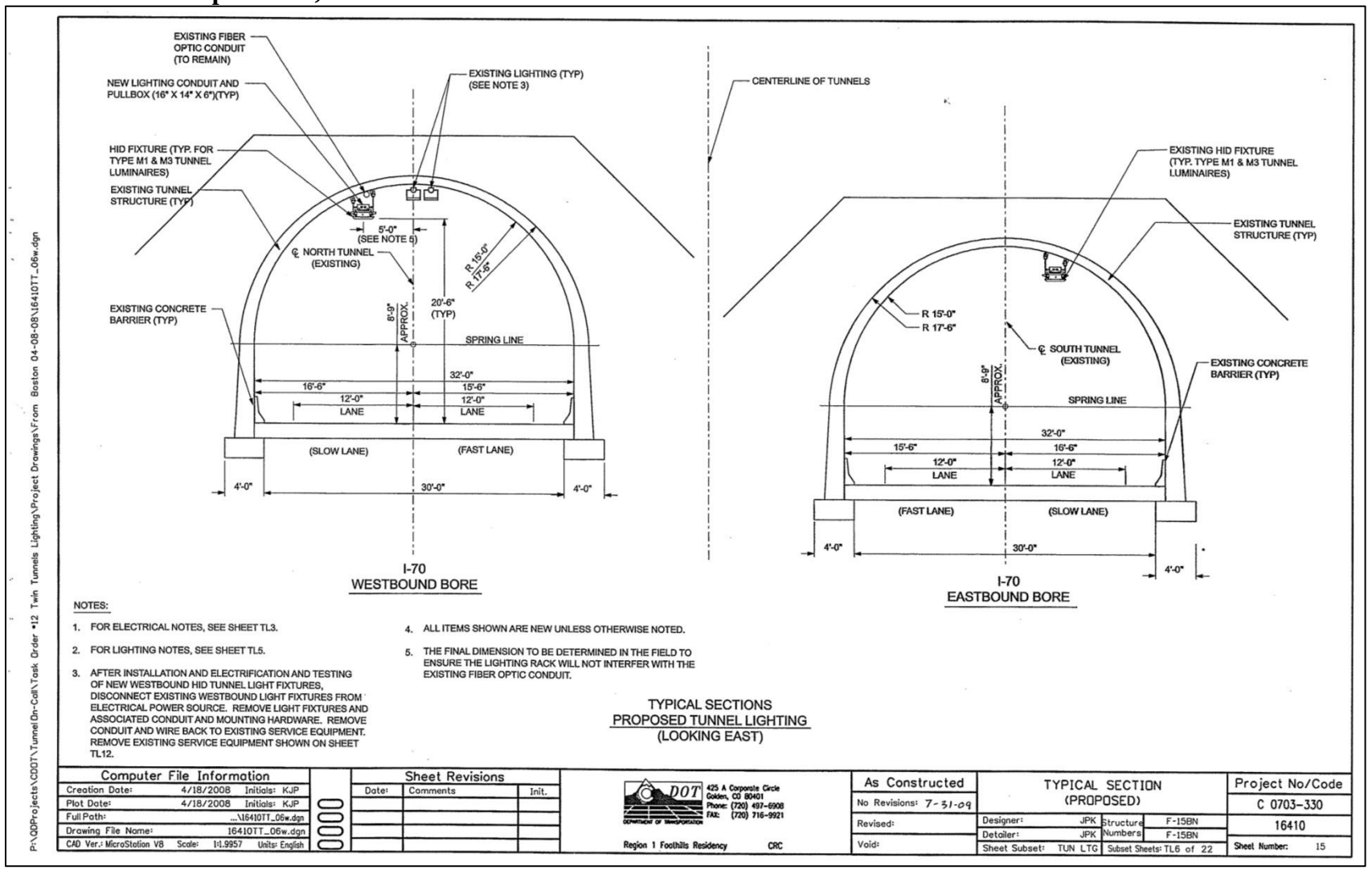


Figure B-1. Twin Tunnels Lighting Upgrade As Built Plans (Sheet 15). Typical tunnel sections and proposed lighting, 2008.

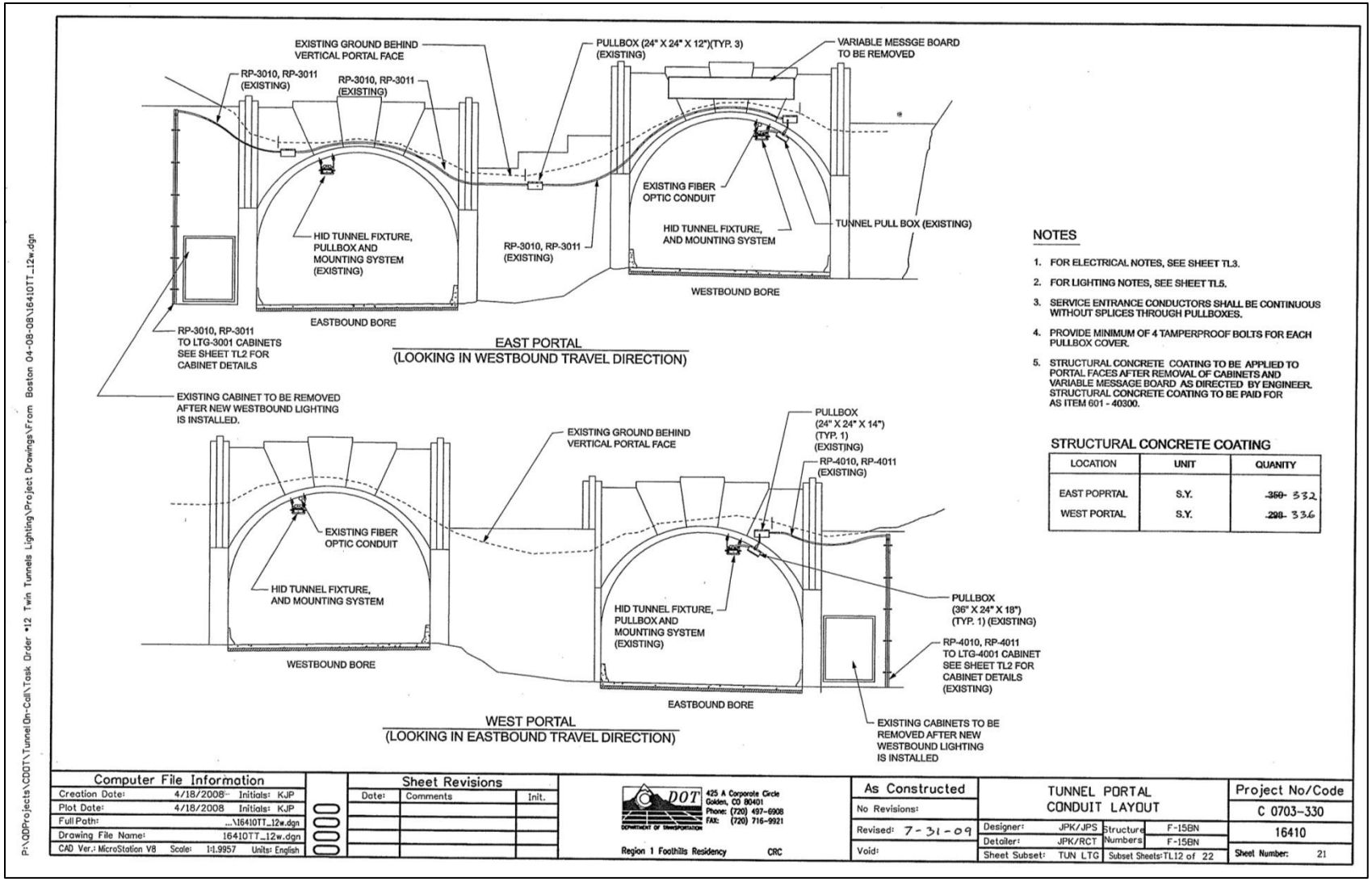


Figure B-2. Twin Tunnels Lighting Upgrade As Built Plans (Sheet 21). Typical tunnel sections and proposed lighting.

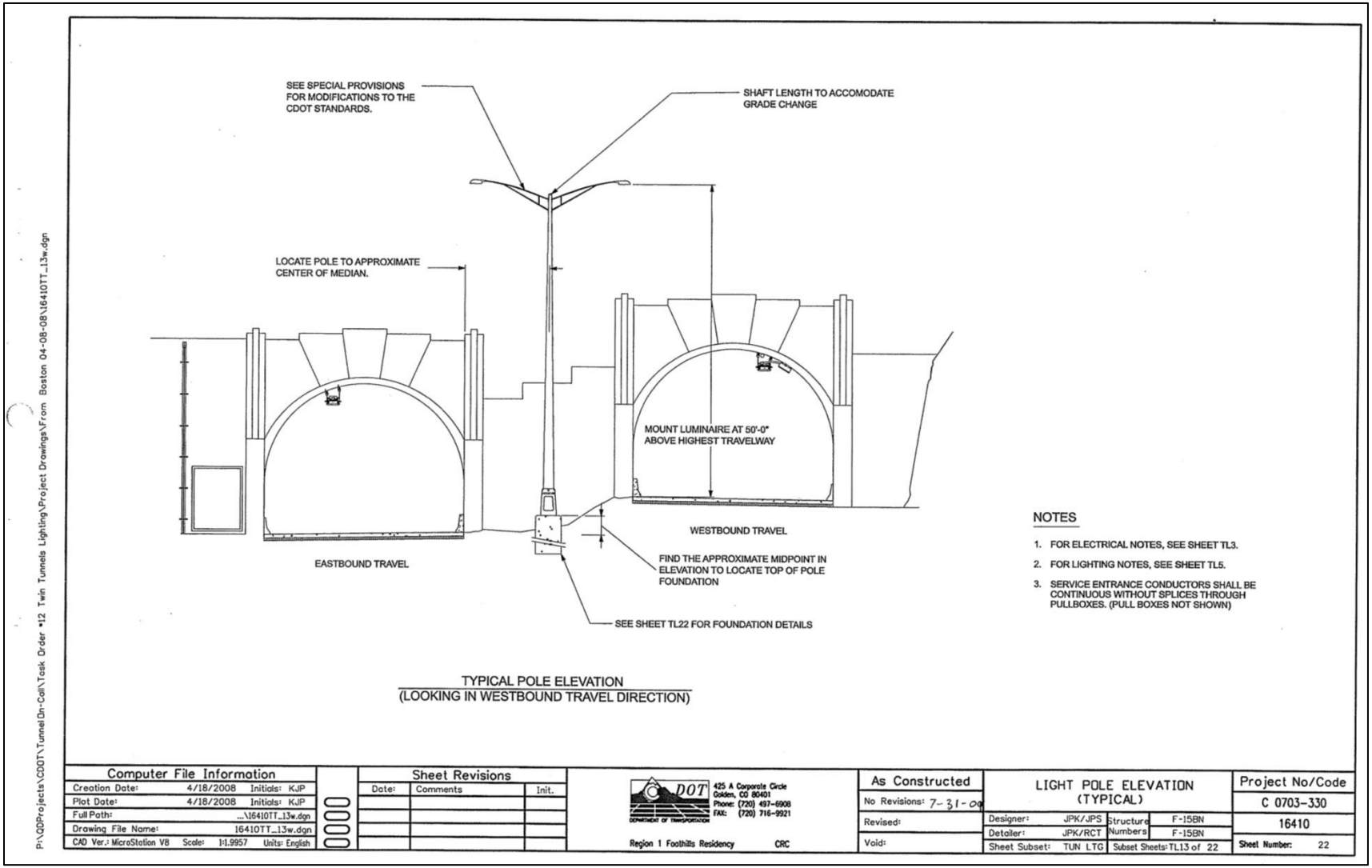


Figure B-3. Twin Tunnels Lighting Upgrade As Built Plans (Sheet 22). Typical tunnel-pole elevation for high-mast lighting.