
Documentation of the Historic St. Francis River Bridge

Bridge No. J0021R
Wayne County, Route 67
June 2012



**ST. FRANCIS RIVER BRIDGE
BRIDGE NUMBER J0021R**

**ROUTE 67, WAYNE COUNTY, MISSOURI
MoDOT PROJECT J0P0931F**

HISTORICAL AND PHOTOGRAPHIC DOCUMENTATION

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JUNE 2012

HISTORIC DOCUMENTATION BRIDGE J0021R

Introduction

Bridge J0021R was a 12 span 851' long structure that carried US Highway 67 over the St Francis River at Greenville in Wayne County Missouri (Figure 1). The bridge included an 8-panel 170' Warren 'camelback' through truss river span, with a series of three 190' (60'-70'-60') continuous I-beam steel stringer approach spans on the north side of the river and a pair of 50' simple I-beam steel stringer approach spans on the south side.

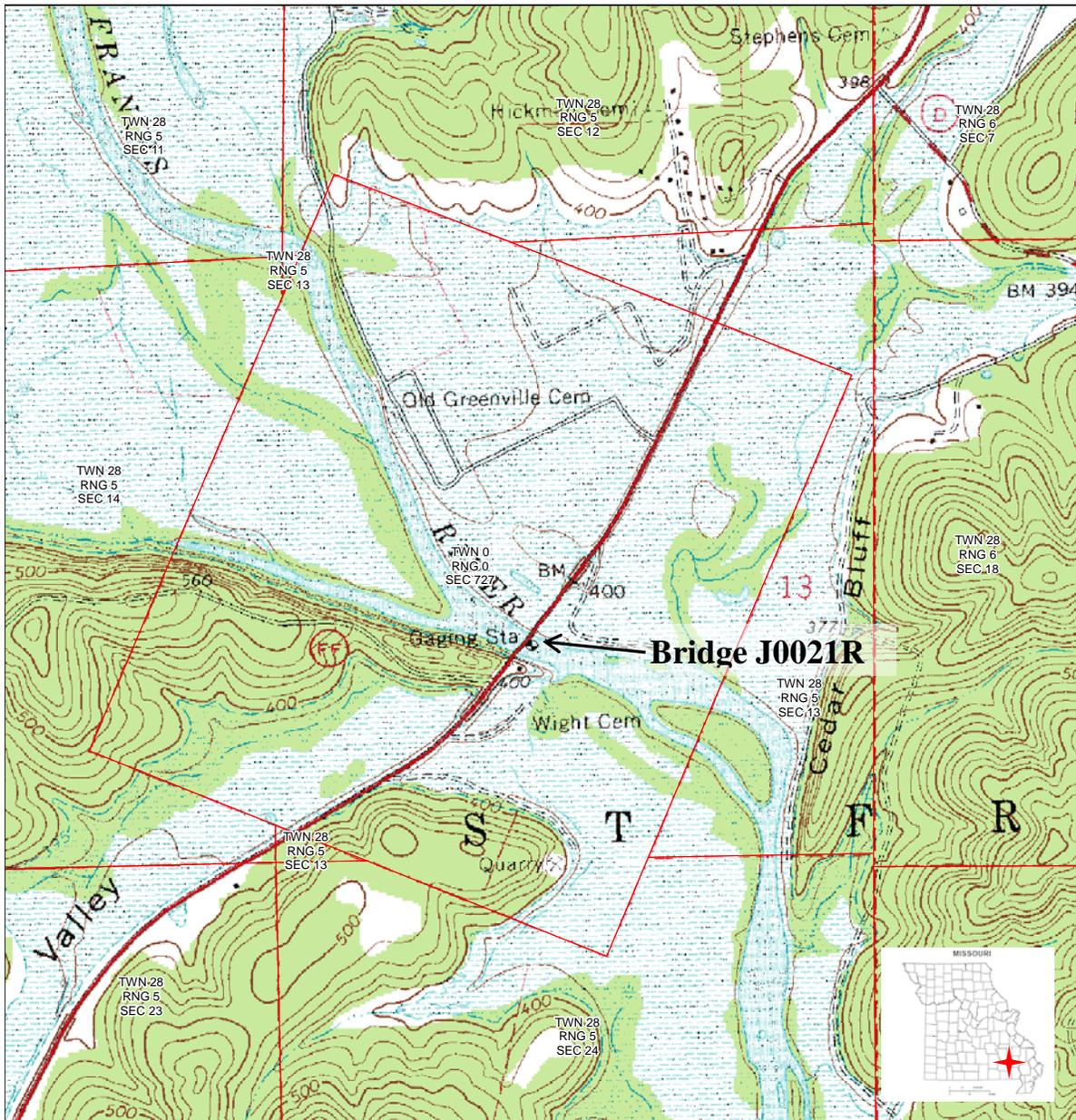


Figure 1. USGS Greenville topographic map showing the location of Bridge J0021R, southeast of 'Old Greenville' on US Route 67 at the St Francis River in Wayne County, 20 miles above the Wappapello Dam.

The approach spans of bridge J0021R were supported by 11 concrete bents while the truss span was on dumbbell piers. Bridge J0021R had a 26' concrete roadway deck with asphalt overlay wear surfaces. It opened to traffic in December 1941, and for the next 70 years bridge J0021R carried Route 67 traffic over the St Francis River/Lake Wappapello. Bridge J21R replaced a 20' wide converted railway bridge (J21) that had been modified for highway use in 1930. Bridge J0021R was removed from service in August 2010 after a new four lane structure on the new Route 67 expressway opened and it was demolished a year later in December 2011 (Figure 2).



Figure 2. Bridge J0021R (left) and its new four lane replacement on the Route 67 expressway

Construction of Bridge J0021R in 1941 was part of a series of upgrades and improvements to Route 67 that began in 1930, when the road was realigned and provided with an 18' graded gravel surface through Madison Wayne and Butler Counties. The 1930 improvements at Greenville included realignment of the highway along the southeast edge of the town (along the abandoned W. G. & St. L. railroad grade) and modification of an abandoned railroad bridge (J21) over the St Francis River for use by the highway. The Route 67 St Francis River bridge constructed at Greenville in 1930 replaced a 16' wide 510' long bridge that had been built in 1911 by the Stupp Brothers Bridge and Iron Co. under contract with the Wayne County Court (Figures 3 and 4). Further improvements to Route 67 continued in 1939 with concrete paving projects along the highway south of Fredericktown in neighboring Madison County and with

similar paving projects in Wayne and Butler Counties in 1941. Replacement of Bridge J21 by J0021R was made necessary by construction of the Wappapello Dam 20 miles downstream.

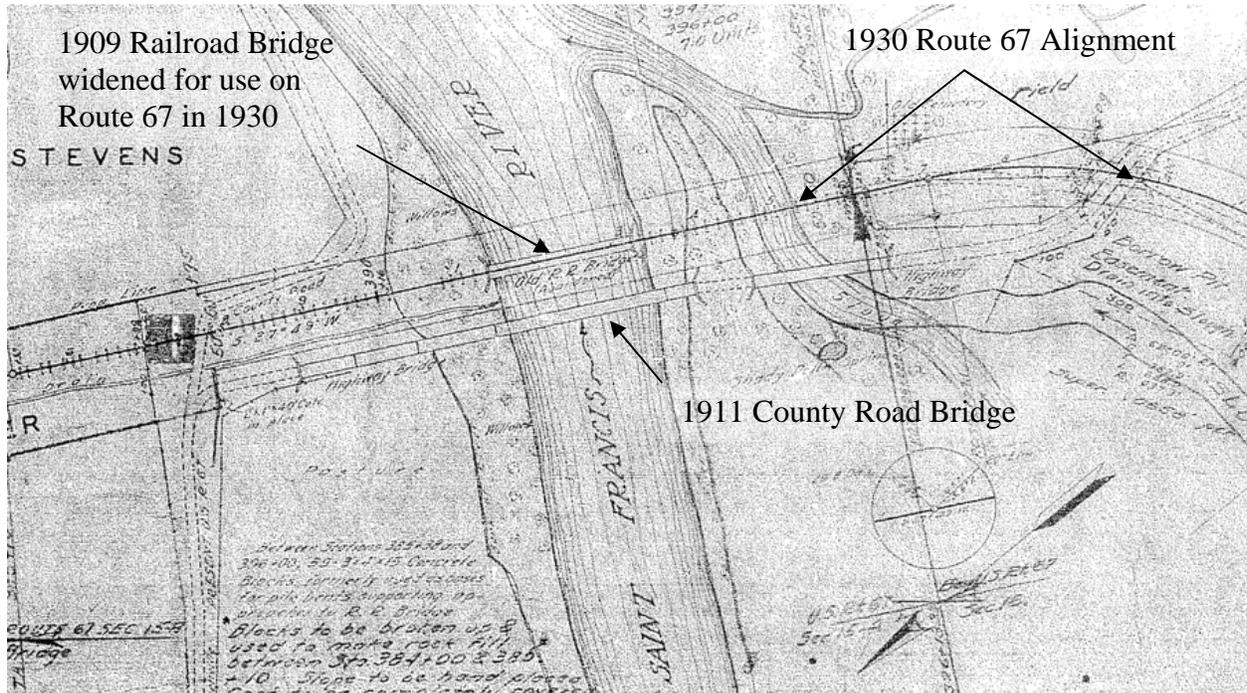


Figure 3. A portion of the highway plans for 1929-30 Route 67 Section 15A improvements illustrating the realignment of Route 67 at the St Francis River showing both the 1911 highway bridge and the abandoned Pratt through truss railroad bridge erected there in 1909, which was to be widened for use by Route 67.

History of the St Francis River Crossing at Greenville

The highway leading to St Francis River crossing at Greenville developed along the route of earlier 19th century roads that in turn developed from ancient Indian trails (Schoolcraft 1853:139, Nuttall 1905:145). The early road/trail crossed the St Francis River a few hundred feet below Bridge J0021R, at a point where the river could be readily forded during times of normal stream flow. The early road/trail extended south from the St Francis River along the eastern edge of the Ozark escarpment as far south as Natchitoches on the Red River in Louisiana. North of the St Francis River ford one branch of the ancient Indian trail followed the east side of river into the St Francois Mountains where it provided access to unusual geologic materials that can be found there, including rhyolite and diabase used to make chipped and ground stone tools as well as salt and lead ore (galena). Another branch of the trail diverged to the east from the river ford at Greenville toward the Mississippi River. In the 18th century during the French Colonial Period, that ancient Indian trail likely served as the overland return route for boatmen involved in the downstream transport of lead to New Orleans¹. The road was illustrated on the

¹Lead dug from surface mines in the Potosí and Fredericktown area was hauled overland to the Mississippi River and then from Fort de Chartres/Kaskaskia/Ste. Genevieve/La Saline it was then shipped downstream to New Orleans by flatboat. In much the way that the Natchez Trace formed east of the Mississippi, the ancient Indian trail was probably used as the return route up the west side of the Mississippi valley by boatmen engaged in the lead trade (Darby 1818:149, 161-62). Shinn (1908:153) has suggested that the road was in use as early as 1765.

many early 19th century maps of the western frontier and is described in a number of early travel accounts (Darby 1818, Nuttall 1905, Featherstonhaugh 1844)

During the Spanish Colonial period in the late 1790's, trails leading to the St Francis River ford at Greenville brought the first Anglo-American settlers to the area². Following the War of 1812, the two overland routes leading to Bettis' Ferry/Greenville that began as prehistoric Indian trails were among the principal overland routes used by pioneer settlers migrating to the future states of Arkansas Texas and Oklahoma (Figure 4) (Houck 1908:227, Shinn 1908:104, Flint 1826:149).

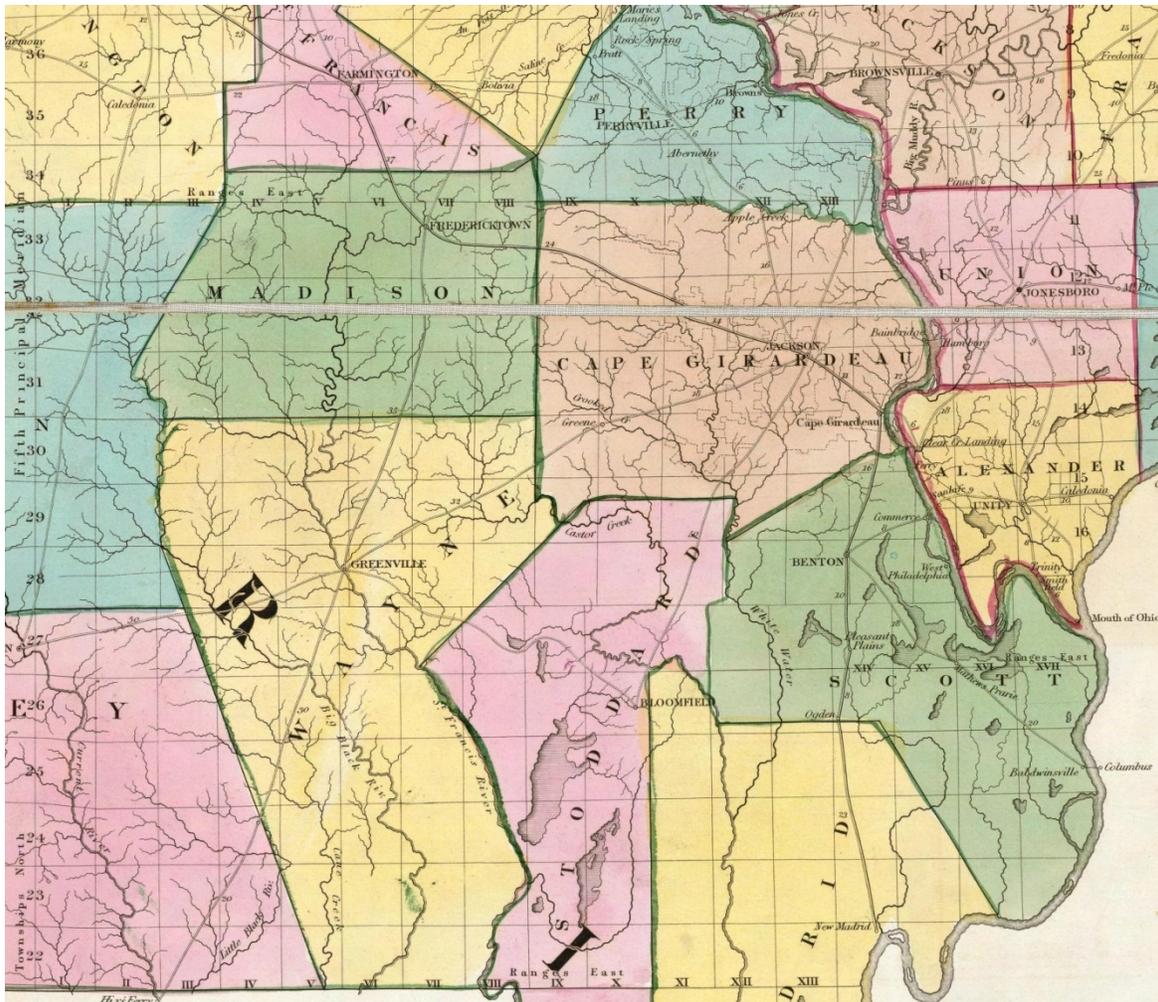


Figure 4. A portion of the 1839 David H Burr Map of Postal Routes in Illinois and Missouri, illustrating the state roads from Fredericktown and Jackson leading to the St Francis River ford at Greenville and on to Hix Ferry.

² Early settlers were attracted to Spanish Upper Louisiana by the availability of generous land grants. Thirteen Spanish land grants were made along the St Francis and its tributaries prior to 1804. Among the earliest settlers were Isaac Kelly and his brother Jacob Kelly. In 1801 Isaac Kelly claimed a grant later known as US Survey 727, at the point where two ancient Indian trails joined and crossed the St Francis River and his land grant includes the future site of bridge J0021R and the village of Greenville. Kelly sold his grant to Dr. Elijah Bettis and his family who had immigrated to the St Francis valley from North Carolina in 1806. Dr Bettis and his sons Elijah Jr. Overton and Ransom and sons in law, Ezekiel Rubottom, Elijah Matthews and William Alston formed the core of a community first known as Bettis' Ferry that in 1818 would be renamed Greenville.

The roads were formally ‘marked out’ by an order from the Cape Girardeau County Court³ in November 1816 and in 1817 those routes were then designated as postal roads (Yarborough 1959). They later became “state roads” which fixed their alignment and made them subject to regular county maintenance.

The roads that converged at Greenville, one leading west through Jackson from the ferry crossings on along the Mississippi River in Cape Girardeau County and the other leading southwest from the St Louis, Ste. Genevieve and Fredericktown witnessed a variety of important historic events during the early 19th century⁴(Wood 1936). Early western cattle drives were observed along these roads in 1819 (Schoolcraft 1821:86). In 1820 the road through Greenville led Moses Austin, the father of Texas, from his home in Potosi to Little Rock and then on to Texas where he obtained permission from the Spanish government for the first Anglo-American settlement there. In 1820, the returning members of the Stephen H. Long Expedition followed that road from Little Rock through Greenville to Cape Girardeau on the final leg of their US Government sponsored scientific expedition to explore the Rocky Mountains and western plains. By 1836 regular stage coach service operated along the road through Greenville between Mississippi River ferry east of Jackson and Little Rock Arkansas⁵.

During the Civil War the road witnessed troop movements by both Union and Confederate forces. In the last major campaign west of the Mississippi in September 1864, the road lead 5000 men in the central column of General Sterling Price’s ‘invasion force’ from Arkansas through Greenville and Fredericktown to the Battle of Pilot Knob. The road remained in use after the Civil War and on into the 20th century but with little in the way of improvements and its importance as an overland travel and commercial route was reduced after the war by the expansion of railroads and the reorientation of the road system in relation to them.

Prior to 1922, road maintenance and improvements were county functions. In 1905 Wayne County began a program of bridge construction (WCC 5/18/1905). On February 22, 1907 the Wayne County Court declared that for three miles all roads leading to the court house at Greenville were to be made 1st class roads (which required that they have a 60’ ROW and a grade less than 5%). In tune with the growing nationwide “Good Roads” movement, a January 14, 1908 article in the *Greenville Sun* discussed efforts to induce the US Bureau of Public Roads

³ Wayne County was part of Cape Girardeau County until 1818

⁴ Early travel accounts document the migration of numerous pioneer settlers along the road through Greenville into Arkansas. Between 1805 and 1830 the population of Arkansas Territory expanded from about 500 to more than 30,000 and after 1815 the majority of the new settlers arrived there over the roads through Greenville (Shinn 1908:104). Daniel Cloud and Peter Bailey travelled south down the road from Jefferson City in December 1835 on a path that led them through Greenville and Little Rock to Natchitoches Louisiana and on to fight for the liberty of Texas as the youngest defenders of the Alamo. In 1837 the road from Cape Girardeau through Jackson and Greenville to Pittman’s Ferry on Current River was designated as a ‘state road’ and its alignment was documented by a formal survey. A year later in 1838 the Benge Detachment of Cherokee passed down the road through Greenville on their Trail of Tears journey from northeast Alabama to the Indian Territory in what is now Oklahoma.

⁵ Mitchell’s Traveller’s Guide through the United States 1837, Rt 301 Little Rock Arkansas Terr. to Bainbridge Mo.

to help the states and counties build better roads, which required trained engineers and proper equipment, and commented that “there is hardly a road in the county worth that name.” In response to growing public demand for better roads, the Missouri State Highway Department was created by an act of the state legislature in 1913 and soon after, the Federal Aid Road Act of 1916 made road improvement funds available to the states based on their size, population and postal road mileage. However, formal operations of the Missouri Highway Department did not begin until 1921, following passage of the Centennial Road Law, which established the State Highway Commission and the positions of Commission Secretary, Chief Engineer and Chief Counsel. Prior to 1921 ‘state roads’ authorized by the state legislature, were locally ‘built’ and maintained by the counties. Improvements on the ‘state road’ leading to Greenville and the county road bridge over the St Francis River were made in 1916 and again in 1918 when it was known as the Fredericktown-Greenville Road and the road from Taskee to Greenville⁶. When the State Highway Department assumed responsibility for the road in 1922, it was initially designated as State Route 23. Then in 1927, with implementation of a nationwide system of intrastate route numbering, the road from Arkansas through Greenville to Fredericktown Missouri was designated as US Route 67.

Early Bridges

The first bridge across the St Francis River at Greenville was a timber structure built in 1892 by the Williamsville Greenville and Northeastern Railroad. In 1899, after sustaining damage in a flood, the main span of that bridge collapsed under the weight of a heavily laden train delivering logs to the sawmill at Greenville (Cramer 1972:300). The railroad, which by then had been reorganized as the Williamsville Greenville & St. Louis RR, replaced the collapsed main river span of their bridge with a 100’ wooden Howe truss. The Wayne County Court contributed \$750 toward the 1899 reconstruction of the railway bridge, which after being rebuilt then allowed both wagon and railroad traffic across on the same deck. Prior to 1899, the river at Greenville was crossed at the traditional ford located just downstream from the railroad bridge or by means of a small two man ferry⁷

The dual use railroad-wagon bridge built in 1899 served local needs for eight years. Then after another damaging flood in 1907, citizen complaints were made to the Missouri Railroad and Warehouse Commission that the wooden W. G. & St. L. Howe truss railroad bridge at Greenville had become unsafe. In response to those complaints, a structural engineer William L: Mathews was sent by the Commission to assess the safety of the railroad bridge. In a report submitted to

⁶ Improvements were made possible by the sale of “Good Road” Bonds (WCJB 1/27/1916).

⁷ The St Francis River ferry at Greenville was licensed by the county. Ferry service was first provided by Dr Elijah Bettis and his extended family who settled there in 1806. The nearby town that would be named Greenville in 1818 was first known as Bettis’ Ferry. Thomas Wight acquired the ferry and neighboring land from Elijah Bettis Jr. around 1830. Wight and his sons Andrew Wight and later James Henry Wight operated the ferry prior to the Civil War and for 40 years after the Civil War, the ferry license was held by Henry Wight’s widow Caroline Reeve Wight. In the 1870s, the widow Wight’s ferry was manned by Joe Lutes and John Gibson. Rates varied from 10 cents for a man on foot to \$1.00 for a four horse team and wagon. The ferry was controlled with a steering oar and relied on the river’s current and a sweep oar for propulsion. The ferry, located adjacent to the ford, operated mainly during the winter months when fording the river was impractical due to high water or cold weather (*Greenville Sun* March 7, 1940, Cramer 1972:251, Schroeder 2002: 348-49).

the Commission on Dec 15, 1907, Mathews described repairs made to the bridge that rendered the structure temporarily safe and stable (albeit at the very slow speed of 3 mph), but concluded that the wooden railroad bridge had 'lived its limit' and needed to be replaced⁸. The Railroad and Warehouse Commission subsequently required the W. G. & St. L. railroad to construct a new bridge across the St Francis River at Greenville.

In January 1908 as railway officials began to plan the bridge replacement they met with Judge Johnson of the Wayne County Court to discuss the possibility of building a combination railway and road structure that would maintain the kind of dual railroad/wagon use that had been in place since 1899. When Judge Johnson reported that the County Court lacked funds necessary for its share of a new joint road - railroad structure, the railroad proceeded to replace the deteriorated wooden bridge with a steel railway-only structure⁹.

Newspaper articles in January of 1908 noted that the cost of a new steel span with concrete piers and new timber approaches was estimated to be between \$16,000 and \$18,000 and that WG & St L railway officials were negotiating to acquire a 'second-hand' bridge from the Missouri Pacific Railroad, which could result in a considerable saving. A letter dated October 30, 1908 from the W. G. & St. L. Railroad to the Missouri Railroad and Warehouse Commission reported that contracts had been awarded to construct the promised new bridge and that work was progressing rapidly on the concrete piers and that rail traffic was expected to be routed over the new structure by February of 1909 (MRWC 1909:149-51).

The 180' pin connected 7-panel Pratt through truss railroad bridge with concrete piers and new timber pile approaches was erected over a four month period in 1908 and early 1909 by the Edward Crebo Construction Co. of Kansas City.



Figure 4. A view facing upstream of Bridge J21 on the St Francis River. This pin connected 180' 7- panel Pratt through truss span and concrete piers were erected in 1908-09 by the Crebo Construction Co of Kansas City for the WG & St L RR at a cost of \$12,000 (WCJB 2-18-09). Following demise of the railroad, the abandoned railroad structure was widened and converted to highway use in 1930 by S. J. Cohen Co and the St Louis Structural Steel Co. In 1941 after it had been replaced by bridge J0021R, this structure was moved to Cross County Arkansas where in 1944-45 it was re-erected as the main span of Bridge No. 2011 on Arkansas Route 42 over St Francis Bay Ditch west of Parkin.

⁹ *Greenville Sun* 1/7/08 and 1/21/08

Progress on the bridge construction was closely followed in the *Greenville Sun* and *Wayne County Journal Banner* newspapers and when it was completed in February 1909, the ‘new’ steel bridge was the focus of considerable local pride as well as relief that the bridge was now safe. A photo of the new steel bridge appeared on the front page of the *Wayne County Journal Banner* on Sunday Feb 18, 1909. The accompanying article reported that the bridge had been built at a cost at \$12,000 (or only 2/3rds the original estimate), suggesting that the ‘new’ steel truss span was in fact a ‘second-hand’ structure.

The steel railroad bridge at Greenville was erected during a period of economic turmoil when the nation was beginning to emerge from a deep recession and a banking crisis that erupted in November of 1907 following a failed scheme to corner the market on silver. While the owners of the railroad had hoped to expand the line and use it in the development of the local limonite iron mining industry, they were thwarted in part by the railroad’s existing debt and the difficulty of selling new bonds to finance the expansion during the ongoing recession (Cramer 1972:304).

In November 1909, new owners of the railroad announced a bold plan to extend the rail line north to Fredericktown or Chester Illinois. However, the investors were unable to raise the funds necessary for that expansion and by 1912 the railroad was operating at a deficit (Cramer 1972:304). Then in 1913 the WG & St L railroad failed to make an interest payment to bond holders and entered bankruptcy. A foreclosure sale failed to attract a buyer and finally in November 1914 the court approved a short sale. The WG & St L railroad was restructured and returned to operation on January 22, 1915 as the Ozark Valley Railway. Reborn as an electric railway, the renamed Ozark Valley Railway was short lived. In August 1915 a severe flood damaged the wooden trestle approach to the St Francis River bridge and other parts of the roadbed and track were washed out or damaged. Although repairs were made and the Ozark Valley Railroad continued to operate in 1916, it did so at an increasing deficit and by 1918 it had fallen into bankruptcy again and was abandoned. The bankrupt railroad was then sold for scrap. The 60# steel rails were salvaged, but the steel span over the St Francis River was left behind¹⁰.

On March 7th 1907, in the wake of the flood that damaged the dual-use Howe truss railroad and wagon bridge, the Wayne County Court ordered the local road supervisor to ‘patch’ and ‘look after’ the bridge. The court then also issued a license to Alex Upton to renew the ferry service across the St Francis River at Greenville that had elapsed in 1899 after modifications were made to allow wagon traffic across the rebuilt wooden railroad bridge¹¹. In May 1911, after managing for four years without a bridge on the main road leading south from Greenville, the Wayne County Court contracted with the Stupp Brothers Bridge and Iron Co of St Louis to build a steel wagon road bridge across the St Francis River at Greenville.

The 510’ wagon bridge built at Greenville in 1911 was constructed at a cost of \$6980.00. It consisted of a 16’ wide, pin connected 10-panel Pennsylvania through truss main span (similar to the bridge built earlier that year by the Stupp Brothers Bridge and Iron Co. across the St Francis River at Wappapello) with a 5 panel Pratt through truss approach span and a Warren pony truss

¹⁰ The abandoned roadbed was then converted by the county for highway use and became known as the Holladay Highway, after Hiram Holladay the founder of the railroad (Cramer 1972:306)

¹¹ Minutes of the Wayne County Court March 7, 1907

approach span on the north side of the river, which in turn connected to a sharply curved wooden approach (Figures 3 & 5). The main span was supported by four concrete filled riveted steel tubular piers, typical of bridges built in that era.

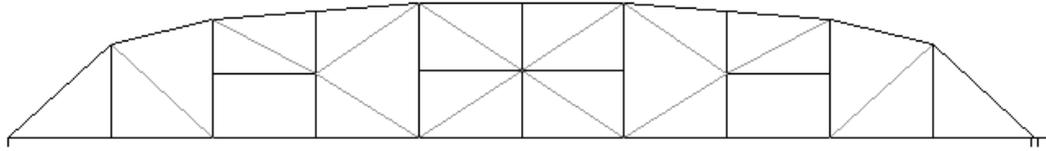
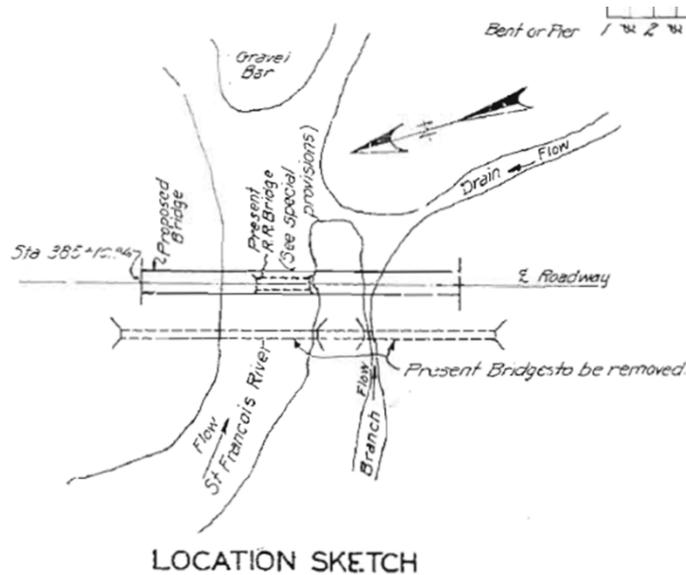


Figure 5. A diagram of the county road bridge at Wappapello built by the Stupp Bros. Bridge and Iron Co in 1911. This span was identical to the main span they built later that year at Greenville. The bridges at Wappapello and 'Lone Rock' were built under a November 1910 contract with the Wayne County Court at a cost of \$10,190 for the pair (figure courtesy of James Baughn 2012, Bridgehunter.com)

Bridge J21

The 16' wide wagon bridge built by the Stupp Bros. for the county in 1911 and the road leading to it became part of the state highway system in 1922. Planning to provide a modern highway bridge at Greenville began in 1927 when State Road 23 was designated US Route 67. In 1928 Fred Harris, the Division 10 Engineer in Sikeston, proposed a preliminary design for a new 1160' bridge comprised of 17 I- beam approach spans on the north side of the river and seven I- beam approach spans on the south side that would incorporate the abandoned railroad truss for its main span.



Drawn Nov. 1928 By A.O.U.

Figure 6. A preliminary location sketch for Bridge J21, which proposed replacing the 16' wide 1911 Stupp Bros. bridge built by the Wayne County Court, with a new 20' wide structure that would include new approach spans and would widen and incorporate the abandoned Pratt through truss railroad bridge erected in 1909 .

since there was no past or future prospect for commercial navigation on the St Francis River at Greenville¹².

The Missouri Highway Department then proceeded with the plan to realign Highway 67 over the abandoned W. G. & St. L. railroad alignment and to build new approaches and widen and incorporate the abandoned steel truss span that had been erected across the St Francis River by the railroad in 1908-09. S. J. Cohen Construction Co. of Blytheville Arkansas was the low bidder in the April 1930 letting and was awarded the contract to build bridge J21 on US Route 67 at Greenville. The crew that built bridge J21 moved to that project after completing construction of Bridge J92 on US Route 60 over the St Francis River at Fisk¹³.



Figure 8. Bridge J21 under construction by S. J. Cohen Co. in August or September 1930. The 1911 Stupp Bros county road bridge is the structure to the right. The Pratt through truss railroad bridge erected here in 1909 was widened by the St Louis Structural Steel Co. in December 1930 (photo courtesy of C. Ellinghouse 2010)

S. J. Cohen's work on Bridge J21 began in June 1930. The project employed between 15 and 70 men and one foreman. The contractor's work was overseen by Highway Department Project Engineer S. J. White and bi-monthly inspection reports documenting progress and problems with the construction were compiled by D. C. Wolfe, the State Bridge Construction Engineer. Wolfe's inspection reports indicate some minor problems in driving timber foundation piles and obtaining suitable sand from the river for mixing the concrete but overall suggest that construction of the concrete bents and approach spans progressed satisfactorily. At one point, the contractor was pouring one span per day (Figure 8).

¹² The St Louis Post Dispatch article appeared the day after the 1929 stock market crash began

¹³ Samuel J (Jimmy) Cohen was a Russian Jewish emigrant who arrived in America in 1913. He studied engineering in New York and moved to Blytheville Arkansas in 1919 where he worked for 10 years for the engineering firm Pride and Fairley building drainage ditches, levees as well as highway projects. Jimmy Cohen founded his own company in 1929 and contracts to build bridges J92 and J21 for the Missouri Highway Department were among the S. J. Cohen Co.'s first projects and their success was instrumental to the economic survival of that new firm

Then in August a significant problem was encountered, a previously undiscovered scour hole was found undermining the old railroad pier (Pier 15) on the south side of the river. Pier 15 was reported to rest on bedrock and was believed to be sound and stable when the project was planned. However during construction, it was discovered that Pier 15 rested not on rock but on a layer of cemented gravel 16' above bedrock and that a large scour hole had formed under the pier making it potentially unstable. Following that discovery, serious consideration was given to modifying the contract to include removal of the old bridge and construction of a new pier along with a completely new longer bridge. Faced with the high cost of that alternative, Cohen and Wolfe ultimately devised a plan to stabilize the pier by surrounding it with steel sheet piling, driving additional timber foundation piles and then filling the scoured void beneath the pier with concrete. That plan proved successful. The S. J. Cohen Co completed the concrete approach spans for Bridge J21 in November 1930 and widening of the 180' truss span was accomplished by the St Louis Structural Steel Co. in December of 1930. Bridge J21, which was constructed at a total cost of \$89,712, opened to traffic in December 1930 and remained in service until December 1941 when replacement of what was still a fairly new structure was made necessary by construction of the Wappapello Dam¹⁴.

Bridge J0021R

Bridge J21 carried highway 67 across the St Francis River for just 11 years, from December of 1930 until December 1941. Replacement of the 1930 bridge was made necessary following the decision to build the Wappapello Dam located 20 river miles downstream. The Wappapello Dam was part of a depression era federal flood control project authorized by the Flood Control Act of 1938. While bridge J21 was near the upper end of the normal operating pool of the planned Wappapello Reservoir, the bridge deck and roadway approaches were at an elevation of 383' and would be subject to periodic flooding during high water events that the dam was designed to control, and therefore needed to be raised or replaced as a consequence of that undertaking.

Public meetings were held in Poplar Bluff in December 1937 and Greenville in January 1938 to address concerns about the effects the proposed Wappapello Dam would have on local communities¹⁵. Early in the planning process, it was clear that not only would farm families towns and villages need to be moved in response to the construction of Lake Wappapello, but that state and county roads schools and the county court house would also need to be relocated. Although some opposition was voiced in the public meetings, the dam project promised to bring much needed work to the area and it was generally considered a positive development.

A representative of the Missouri Highway Commission attending the January 1938 public meeting in Greenville reported that Highway 67 would probably be relocated west of the new lake created by the dam and that a new bridge would be built across the river at or just below the Route 34 crossing south of Patterson. Those comments led to speculation that the county seat and town of Greenville, which would be flooded by the project, might be relocated to that area¹⁶.

¹⁴ 7th Biennial Report of the State Highway Commission of Missouri 1931

¹⁵ Wayne County Journal Banner (WCJB) Dec 23 1937 and Jan 28 1938

¹⁶ WCJB March 3 1938

In February of 1938, the War Department provided an initial 2.1 million in funding for the Wappapello Dam, which was anticipated to be a 16 million dollar project. Construction began in August of 1938 and floodgates on the new dam were closed July 15, 1940. When the project was completed in June 1941, the Wappapello Dam and resulting lake had displaced 304 farm families and led to the abandonment of the Frisco Railroad and the railroad towns of Chaonia and Taskee along with relocation of the towns of Wappapello and Greenville.

While the dam was being planned and even after its construction had begun, the necessary changes to Highway 67 and the Greenville Bridge had not been resolved. Concrete paving work proceeded on Route 67 south of Fredericktown in Madison County early in 1939, but plans to pave the 25 miles of road in Wayne County were delayed by uncertainties related to proposed construction of the Wappapello Dam and the effects it would have on the town of Greenville and the alignment of Route 67.

By May of 1939 the Highway Department had decided to retain the existing alignment of Route 67 in Wayne County. In July of 1939, plans for relocation of Greenville still remained uncertain. Three of the six proposed options had been rejected and the final three were all along the existing highway, one about 1 mile north of the existing town, another about 3 miles north and the third near Silva¹⁷. In October 1939, the plan to relocate Greenville to the Silva area was still under consideration. Finally, a vote was then held to decide the issue. On Dec 7, 1939 results of a vote to extend the city limits 1.5 miles to the north overwhelmingly affirmed that plan.

On March 25, 1940, Leo F. Beckett Assistant Division 10 Engineer and L. B. Van Cleve arrived in Greenville to assess the existing bridge (J21) and to work on preliminary plans for either raising and widening that bridge or building a new structure upstream of the 1930 bridge, on the old alignment of the 1911 wagon bridge. In April of 1940, while an agreement was reached to move the Wayne County courthouse and county jail to the new town site and plans were being formulated to build the model community of 'New Greenville', the Highway Department had still not yet reached a final decision about whether to raise the existing bridge (J21) or build a new structure on the alignment of the old 1911 wagon bridge.

Plans to close the flood gates on the Wappapello Dam in July of 1940 heightened the need to reach a decision about either replacing or elevating Bridge J21. Consideration was given to the cost and benefits of widening and raising the 1930 bridge (J21) which would entail raising the main span of the bridge 17' to reach the 400' elevation or building a new structure. Division 10 Engineer Fred D Harris and bridge engineers returned to Greenville on Wednesday July 10, 1940 to further study the situation and concluded that a new bridge upstream of the existing bridge was the preferred option. Federal funds for the project would become available July 1, as part of a \$4.77 million allocation to Missouri for FY 1941.

Ultimately the decision was made to construct a new bridge (J0021R) for Route 67 on a slightly adjusted upstream alignment. In negotiations between the Highway Department and the Corps of Engineers held in July 1940, an agreement was reached on the general design of the project, with the Corps agreeing to pay the cost of replacing bridge J21 with a comparable structure at the higher 400' elevation and the Highway Department agreeing to pick up extra costs associated

¹⁷ WCJB July 6, 1939

with a wider structure (26' vs. the existing 20') and upgraded concrete pavement matching the new pavement elsewhere along the highway corridor and which the public had demanded.

In late July 1940, a preliminary layout and location sketch for a new bridge was prepared by L. B. Van Cleve with a new structure at an elevation of 400' along with new approaches above the flood pool of the reservoir at an elevation of 395' (Figures 9 & 10). The new bridge on Route 67 at Greenville was expected to be one of 22 projects constructed in Division 10 in FY 1941. Unlike the 21 other Federal Aid highway projects planned in Division 10 in FY 1941, because the new St Francis River Bridge at Greenville was necessitated by the Wappapello Dam project, it was to be paid for in large part by the US Army Corps of Engineers.

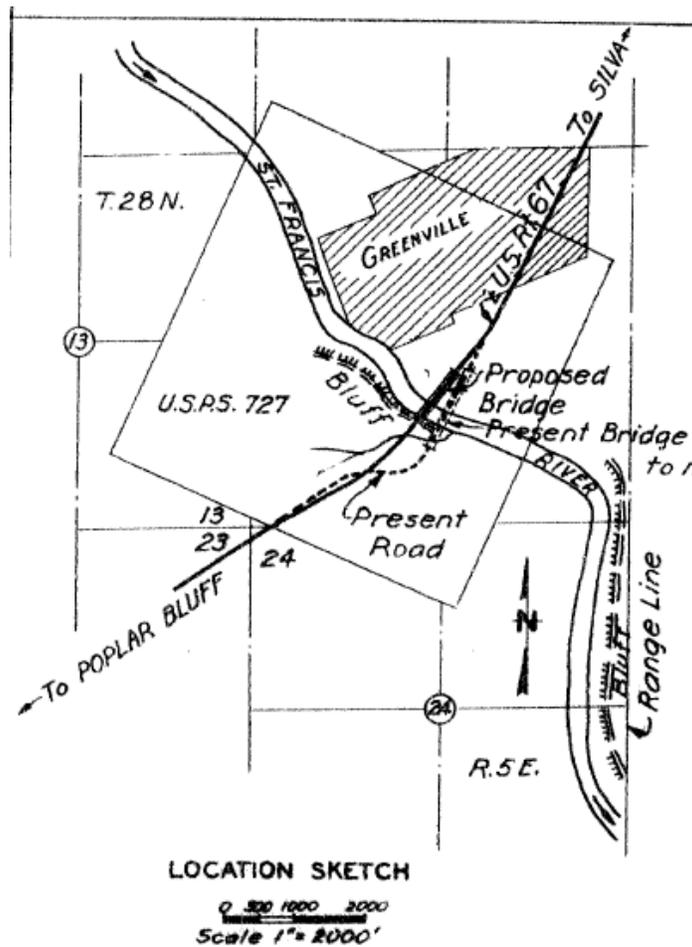


Figure 9. A location sketch illustrating the proposed location of bridge J21R and the existing bridge (J21) that it was to replace

The Corps of Engineers hired the firm of Sverdrup and Parcel in St Louis to design the bridge based on the Missouri Highway Department's revised preliminary plans which called for 3 continuous I-beam approach spans of 190' (each 60-70-60'), a 170' main through truss span, 2

50' approach spans, and a 26' roadway deck with Portland cement concrete pavement supported on 11 concrete bents and 2 dumbbell piers.

In August 1940, the new bridge and 2 miles of adjoining new concrete paving at Greenville was one of 22 road projects approved in Division 10 for letting in fiscal year 1941. Estimates for the grading paving and bridge work on Route 67 at Greenville were between \$350,000 and 360,000. While design and planning for bridge J0021 was a joint venture between the Missouri Highway Department and the US Engineer's Office in Memphis and the major funding for the project came from the War Department, letting, contract administration and construction oversight and inspection were all handled by the Missouri Highway Department. The responsibilities of each party in this unusual project were finalized in a contract signed on September 6, 1940¹⁸.

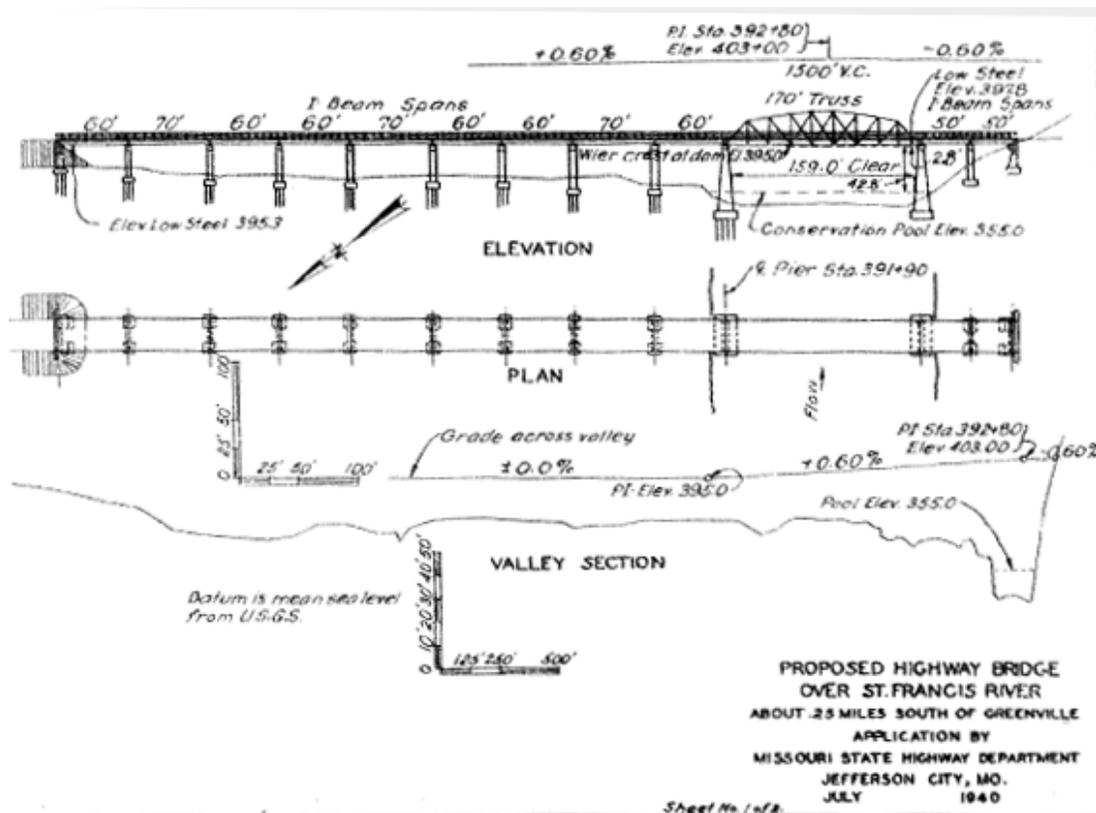


Figure 10. A July 1940 diagram illustrating preliminary design of bridge J0021R with a Parker Truss

Construction of Bridge J0021R

In December 1940 following their low bid of \$323,592, the George W. Condon Co. of Omaha Nebraska, was awarded the contract for construction of the new St Francis River Bridge at Greenville, as well as two miles of adjacent grading and paving leading to the bridge.

¹⁸ The September 6 1940 contract between the State Highway Commission of Missouri and the United States of America includes 19 articles that spell out the various responsibilities and obligations of each party

Final design of bridge J0021R was completed by Sverdrup and Parcel in late October 1940ⁱ. Shop drawings for fabrication of the new bridge based on that final design were then prepared by Dixon Engineering in St Louis. The George W. Condon Company of Omaha Nebraska built the foundations, erected the spans and truss, poured the deck and constructed the adjoining roadway approaches. The remainder of the work was done by subcontractors. Structural steel for the continuous spans was fabricated by the Illinois Steel Bridge Co, in Jacksonville Illinois while the truss and simple spans were fabricated by the Clinton Bridge Works, in Clinton Iowa. Gray iron alloy bearings for the 50' simple spans were fabricated by the Spuck Iron & Foundry Co of St Louis and cast steel bearings for the continuous spans and the truss span were made by the Omaha Steel Works, Omaha Nebraska. The bridge was painted by Stanley Hanks Painting Company of St Louis, with paint supplied by the Waugh Paint Co.

The George W. Condon Construction Co. had extensive prior experience with bridge construction and highway grading projects in Missouri and throughout the United States. Construction and grading were a multi-generation Condon family business. George W. Condon and his brother Russell Condon began their careers working for their father and uncle in the family construction company in Omaha and later for themselves, both on smaller projects and in various consortiums on larger projects. George W. Condon's company had primary capability as a grading contractor and had built a number of state and county road projects from Iowa to New York in the teens, 20s and 30s.

In the 1920s and 30s the G. W. Condon Co., alone or in partnership with various others including George R. Lemmon, C. W. Cunningham, W. C. Cole, A. H. Carley, built several bridges for the Missouri Highway Department prior to J0021R, including: the Little Tarkio Ditch Bridge (H457R) on US 59 in Holt County in 1926, Keytesville Bridge (H502R) over Mussel Fork in Chariton Co. in 1927, US Route 136 bridge (H840R) in Nodaway County in 1928, US 136 bridge (J176) over Tarkio River in Atchison Co. in 1929, the Gasconade River Bridge (S327) on Missouri Route 32 in Laclède County in 1932 and the Gasconade River bridge (T474) on Route 133 in Pulaski County in 1937. In partnership with Cunningham and Lemmon, G. W. Condon Co. also built highway bridges at Ramsey Creek (K322) on Route 79 in Pike Co. in 1936 and Bridge K768 at Nut Junction in Cape Girardeau Co. in 1938. In the course of those earlier highway bridge projects, George W. Condon Co. had established a network of working relationships with sub-contractors who fabricated the bridge superstructures. For example on bridge J25R, a riveted Parker through truss over Sni-A-Bar Creek in Lafayette County built in 1929, Condon subcontracted the fabrication to Clinton Bridge Works in Clinton Iowa, the same firm that fabricated the truss for the Route 67 Greenville Bridge 12 years later.

By the late 1930s, in addition to bridge and highway construction, G. W. Condon Co was also a major contractor engaged in the construction of large dam and reservoir projects. Condon was the principal contractor for construction of the Boca Dam on the Truckee River in California and Nevada in 1938 and was one of the principle contractors involved in 1940 in building the Dennison Dam project on the Red River in Texas and Oklahoma. While G. W. Condon did not win the contract to build the Wappapello Dam or the Clearwater Lake projects in southeast Missouri, those nearby dam and reservoir jobs likely brought the Route 67 bridge project to Condon's attention and may have made it more attractive to bid on, since it presented the

opportunity to position personnel and equipment for potential sub-contract work on large nearby grading projects.

In the lead up to and during the early years of World War II, G. W. Condon Co. in various partnerships with the Omaha construction firms C. W. Cunningham and Kiewit & Sons, was also heavily involved in major defense construction contracts, including the 1.7 million square foot Glenn L. Martin Bomber plant near Omaha begun in the Spring of 1941¹⁹ and the Kansas Army Ammunition Plant begun in August 1941. A year after completing the J0021R project on Route 67 Kiewit-Condon won a contract in February 1942 to construct Camp Carson in Colorado Springs and another contract in September 1942 to build runways and hangers at the Kearney Army Airbase and its three satellite airfields.

Physical Description of Bridge J0021R

Bridge J0021R was a 12 span structure comprised of three different sections – a series of three 190' continuous I-beam approach spans on the north side of the St Francis River, a 170' Warren through truss main river span and a pair of 50' simple I-beam approach spans on the south side of the river (Figure 11). The preliminary layout prepared by the Missouri Highway Department in July 1940 envisioned an 840' structure with continuous approach spans supported by standard concrete bents and the main span supported by a pair of standard dumbbell piers. A continuous approach span originally planned for the south side of the river was later changed to a pair of simple spans, perhaps due to weathered rock in the Bent 12 area and concerns about the potential for differential foundation settlement there. The 170' 9-panel Parker through truss main span illustrated in the preliminary layout diagram was changed by the designers at Sverdrup and Parcel to a 7-panel Warren through truss with polygonal top chord and verticals (Figures 10 & 11). The final design also shifted the entire structure 10' to the south to allow the point of intersection of the vertical curve on the bridge to fall at the mid-span point, allowing for symmetrical camber within the truss span.

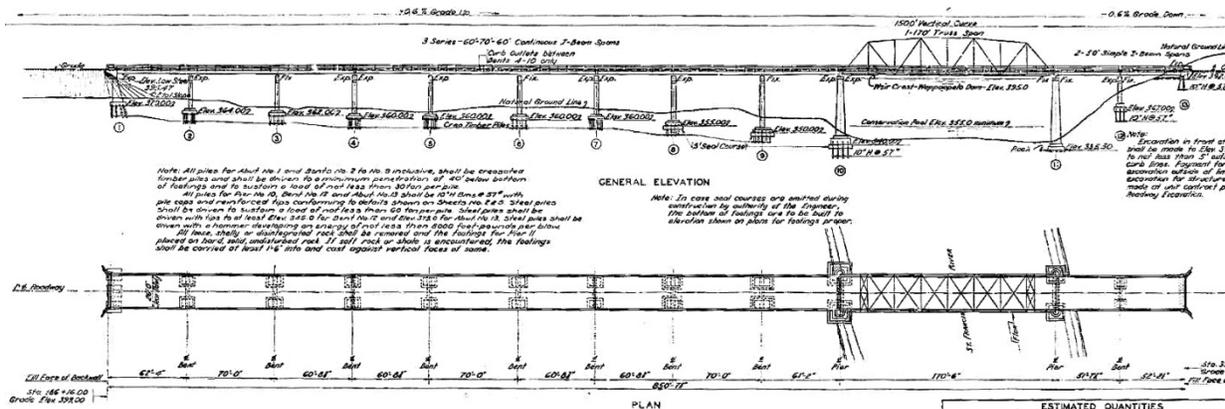


Figure 11. Sverdrup and Parcel's October 1940 final design for Bridge J0021R over St Francis River at Greenville

¹⁹ While building J0021R in 1941 G. W. Condon Co. was unable to obtain aluminum bridge paint specified in their contract because all aluminum was being reserved for the war effort, particularly for aircraft production. In the spring of 1941, while construction of Bridge J0021R was underway, G. W. Condon began work building the Glenn L. Martin Bomber Assembly Plant near Omaha, which turned out aluminum B-26 and later B-29 bombers, including the B-29s *Enola Gay* and *Bockscar* that dropped the atomic bombs on Japan in 1945 ending the war in the Pacific.

Substructure

The nine approach spans on the north side of the St Francis River consisted of a series of three 60-70-60' or 190' continuous I-beam approaches supported by a substructure consisting of a concrete spill-through abutment/end bent (Bent 1, photo #1), eight reinforced concrete two column bents of standard design (Bents 2-9, numbered from north to south or left to right in Figure 1), and a standard design dumbbell pier.

The north end bent (Bent1) consisted of a spill-through abutment comprised of a concrete beam cap supporting the bridge seat, supported by three reinforced concrete columns, which in turn were supported by three 9 x 12' steel reinforced concrete footers poured atop a foundation of driven creosoted timber piles. Footers beneath the outside columns in the end bent were supported by nine timber piles per footing while the center column was supported by 12 piles driven on 3' centers. . Timber piles beneath the outside row of the footers were battered to provide increased lateral and longitudinal support for the end bent. Timber piles were to be driven 40' below the bottom of the footings and were designed to support a load of not less than 30 tons per pile. The reinforced concrete columns were each 3 x 3' and supported a 3 x 4' x 26'4" reinforced concrete beam cap. The end bent was backfilled covering the columns and protecting them from scour during periods of high water. The backfilled slope around the end bent was further stabilized and protected with a rock blanket revetment (Photo #1).

For the continuous spans on the north side of the river, the Sverdrup and Parcel design for the footings under the column bents varied depending on height of the bents and whether they supported fixed or expansion bearings. Bents 2, 4, 5 and 7 with expansion bearings originally called for 10 creosoted yellow pine piles per footing, which were to be driven a minimum of 40' below the base of the footers, while twelve piles were to be driven beneath each of the footings at Bents 3 and 6, in order to resist the greater longitudinal force exerted on piers with fixed bearing. The design also called for additional pilings for taller piers. The foundation design included twelve piles at Bent 8 due to its greater height (5' taller than Bents 4-7) and at Bent 9, which carried a fixed bearing and was another 5' taller than Bent 8. The original plans called for a total of 15 piles beneath each footing.

Although geotechnical borings had been made in July 1940 and test piles were successfully driven at three of the pier locations in February 1941, during construction when the contractor attempted to drive the timber foundation piles to the required depths, they were unable to reach the 40' penetration specified by the design. That problem was particularly vexing at Bents 7, 8 and 9, where significant problems were encountered obtaining the designed penetration of the timber piles. Sverdrup and Parcel had been advised by the Bridge Bureau in a letter dated August 5, 1940 that "*our experience indicates that steel piling is more desirable in this formation and is generally more economical than timber piling and your design should be based on this type.*" Disregarding that advice, the Sverdrup and Parcel footing design persisted in calling for timber piles. Then in March 1941, in response to the difficulties encountered during construction, the designers at Sverdrup and Parcel were asked to reassess and revise the footing design. Consequently, the requirement for timber pile penetration was reduced from 40' to 30' and the footings and foundations for Bents 7 8 and 9 were redesigned; substituting 10" wide flange steel H-piles for the timber piles (see Sheets 208 and 218). Due to the increased bearing strength of

the steel piles, fewer steel piles were required at each footing. At Bent 7, each footing was supported by 6 steel H-piles, at Bent 8 each footing used 8 H-piles and at Bent 9 the footings used 10 H-piles. The top elevation of the revised footers remained the same and employed the same system of dowels and steel reinforcing bars to tie the footers to the columns.

The 170' through truss span was supported by two massive reinforced concrete dumbbell piers (Bents 10 & 11) of standard design, similar to piers used for other bridges designed by the Missouri State Highway Department and in earlier Sverdrup and Parcel designs, such as the Hermann Bridge (K-226A, Gubbels 2005). The two footings for Pier 10, the dumbbell pier on the north side of the river, were each supported by 16 driven steel foundation piles, consisting of 10" H-piles (Figure 2). Reinforced concrete footings poured over the foundation piles consisted of a 3' thick 18 x 18' seal course topped by a 15 x 15 x 5' reinforced concrete footer, which encapsulated the top 2.5' of the steel foundation piles (Figure 12).



Figure 12. View south across the St. Francis River during the winter of 1940-41, illustrating the early stage of construction of Bridge J0021R, showing the excavations for Bents 12 and 13 on the south side of the river and the 10" steel H-piles driven to support the footer at Bent 10 (inside the temporary sheet pile cofferdam) on the north side of the river. Bent 12 was located in the rock cut halfway down the opposite bank. The timber piles protruding from the water on the south side of the river are the remains of a temporary scaffold used to support the drilling equipment for the test borings and are not part of the bridge foundation.

Pier 11 on the south side of the river supported the south end of the through truss span. The foundation at Pier 11 rested on bedrock and consisted of a pair of 13 x 13' concrete seal courses poured on rock at an elevation of between 337.2 and 335.5' that were topped by 10 x 10' reinforced concrete footers. Above the footers, the dumbbell piers consisted of tapered reinforced concrete columns (measuring 7' 8" in diameter at Pier 10 and 8' 1" at Pier 11) that were tied together above the top of the footer at an elevation of 357' by an integrated reinforced concrete web wall 18" thick, and by an integrated reinforced concrete beam and beam cap and bearing seat. Pier 10 was 51' 1/8" tall from the top of the footer while Pier 11 was 58' 5 1/4" tall.

The two simple I-beam approach spans on the south side of the river were supported by a substructure consisting of a standard two-column concrete bent (Bent 12) and a concrete end bent/abutment (Bent 13). In the original foundation plan, the footings beneath Bent 12 were each to have been supported by nine steel 10" H-piles driven with reinforced tips, while the southern end bent abutment (Bent 13) was to be supported by a staggered array of 7 steel 10" H-pile foundation pilings, which were to be driven 10' into bedrock and secured with a reinforced concrete footing. The four piles along the north side of the footer at Bent 13 were battered to provide additional longitudinal stability at the end bent. Steel foundation piles at Bents 12 and 13 were designed to support a load of not less than 60 tons per pile.

During construction of Bent 12, difficulties similar to those encountered on the north side of the river occurred. When the contractor leveled off the sloping rock along the bluff at Bent 12 and attempted to drive the steel piles, areas of impenetrable rock and a crevice in the rock were encountered. Irregularities in the bedrock in that area were not entirely unexpected as the revised preliminary bridge layout (Aug 27 1940) indicated that the piles at Bent 12 were expected to vary greatly in length and "may be eliminated in whole or in part." Ultimately, after discussion and approval from the designers at Sverdrup and Parcel, only 5 of the 9 steel piles planned for the upstream footer at Bent 12 were driven and the downstream footer was placed on rock which was deemed solid enough to forgo the use of foundation pilings altogether (Plan Sheet 218).

Superstructure - Continuous Spans

The nine approach spans on the north side of the St Francis River consisted of a series of three nearly identical 190' long continuous I-beam spans, which were fabricated by the Illinois Steel Bridge Co. of Jacksonville, Illinois. Continuous spans of this type came into use beginning in the 1930s, following the development of the 'moment distribution method' of computing the stresses and deflections in a statically indeterminate frame, which was pioneered in the 1920s by Hardy Cross, then a professor of Civil Engineering at the University of Illinois, Urbana-Champaign. Cross's method allowed for practical hand calculation of stresses in continuous beam bridges. By spreading loads over multiple piers (4 rather than 2), the continuous span design allows for a reduction in the size or depth of the steel stringers supporting the roadway, which helps to reduce the material cost for both the substructure and foundation. In this example, it was possible to construct longer continuous approach spans of 60-70-60' using 33" wide flange beams weighting 125# and 141#, as compared with the shorter 50' simple spans on the south side of the bridge that required heavier 33" 141# and 150# I-beams. Continuous spans also reduce the number of expansion joints and bearings in the structure, which allowed for further cost savings in both

construction and maintenance. In this case, the continuous spans reduce the number of bearings from 72 to 40 (a 44% reduction) when compared with a simply supported multiple-span structure of similar length and also allowed more of the bearings to be centered over the piers.

While continuous spans provide several advantages, they are vulnerable to differential settlement in the foundation, a factor which probably accounts for the great attention accorded to the design of the foundations supporting this span. Similar bridges built in Missouri just 10 years earlier (K-112 and K-113 for example) were made of up multiple simple spans (Austin 2008:6-9). The use of continuous approach spans in bridge J0021R represents a technological innovation that contributes to the historical significance of this bridge.

In the continuous I-beam spans, the 26' reinforced concrete roadway deck was supported by four steel stringers spaced 7' 8" apart consisting of an outside pair of 33" wide-flange beams weighing 125#, which ran 2' 7" in from the outside edge of the slab and an inside pair of heavier 33" 141# beams. Stringers were made continuous with a series of bolted splice plates connecting both the web and the top and bottom sides of both flanges of the I-beams (see Photo #9). All the I-beams were also reinforced in the bearing areas with cover plates that were welded in place along both the top and bottom flanges²⁰.

The continuous beam spans were stiffened with lateral cross-frame bracing used to resist torsional movement. The cross frame braces consisted of X-shaped diaphragms fabricated from riveted 5/16" thick 3 ½ x 3 ½" single angles and plates, which were sized to fit tightly between the flanges of the I-beams and were riveted to the web of the stringers at 14-15' intervals (Photos #7 and #9). The ends of the stringers were connected at each end of the continuous spans by 14" wide-flange 43# I-beam floor joists or floor beams. Finger joint expansion devices were in turn attached to those end beams.

The handrail was similar to the standard design used by the Missouri Highway Department in the 1930s (see the Gasconade River Bridges J802, K112, K113 for example – Austin 2008). It consisted of a system of bracket plates, 4" H-posts and 6" ship channel rails. Posts were riveted to the brackets, which were attached with rivets to the outside run of stringers below the deck and to bolts anchored in the concrete curb and deck slab. Brackets supporting the hand rail posts were composed of a ¼" trapezoidal plate and ¼" thick 3 x 2 ½" angles along the top and bottom edges, which were riveted along the outside edge of outside stringers beneath the deck with a 3 x 2 ½" 5/16" thick angle (Photos #3-#8). The handrail posts were alternately spaced 6' 10 ¼" and 7' 1" apart. This design differed slightly from the earlier standard design in its use of slotted brackets which were shop welded to the rails to facilitate bolting the rails to the posts (Plan Sheet 214, Shop Drawings Sheet 8). Expansion devices were fitted to the handrails at the ends of each span, providing for a continuous rail between the spans.

²⁰ Correspondence identifies four welders certified to perform that work on bridge J21R. C B Howard and O K Gaither were qualified based on earlier work at the Illinois Steel Bridge Co fabricating a highway bridge for a Boone County project. Joseph McSherry and Walter White, the other welders on the job, were required to pass welding certification tests witnessed by the Highway Department's shop inspector George Morgan. They were certified to weld on the J21R bridge project only after their sample test welds passed Morgan's visual inspection and their test welds were then broken in the department's materials testing laboratory and examined for proper contour and lack of undercutting, gas pockets and other defects. (George Morgan Arc Welding Tests Feb 14 and 19 1941, Sack to Illinois Steel Bridge Co Feb 8, 1941)

The surface of the deck of the continuous spans joined the roadway approach at the end bent and the adjoining spans at bents 4 and 7 with standard fingerplate expansion devices, which were cut from 1 ¼" steel plate and attached with countersunk fasteners to the 14" end beams.

Truss Span

The 8-panel 170' Warren through truss with verticals was designed by Sverdrup and Parcel and was fabricated by the Clinton Bridge Works, Clinton Iowa in March and April 1941. This truss was similar in design to a 240' 10-panel Warren through truss that formed the northern span of the Hermann Bridge, which was the first bridge designed by the firm of Sverdrup and Parcel 10 years earlier. Bridge J0021R differed from the Herman Bridge span in that it incorporated more rolled I-beams in the web and fewer fabricated box girders. While the top and bottom chords of the Hermann span and J0021R were similarly constructed box girders made up of riveted plates, channels and lace bars, the vertical posts and some of the diagonal web members of the Greenville bridge were rolled I-beams in contrast to the earlier Hermann bridge, which utilized fabricated girders and box beams made up from combinations of riveted plates, angles, channels, battens and lace plates.

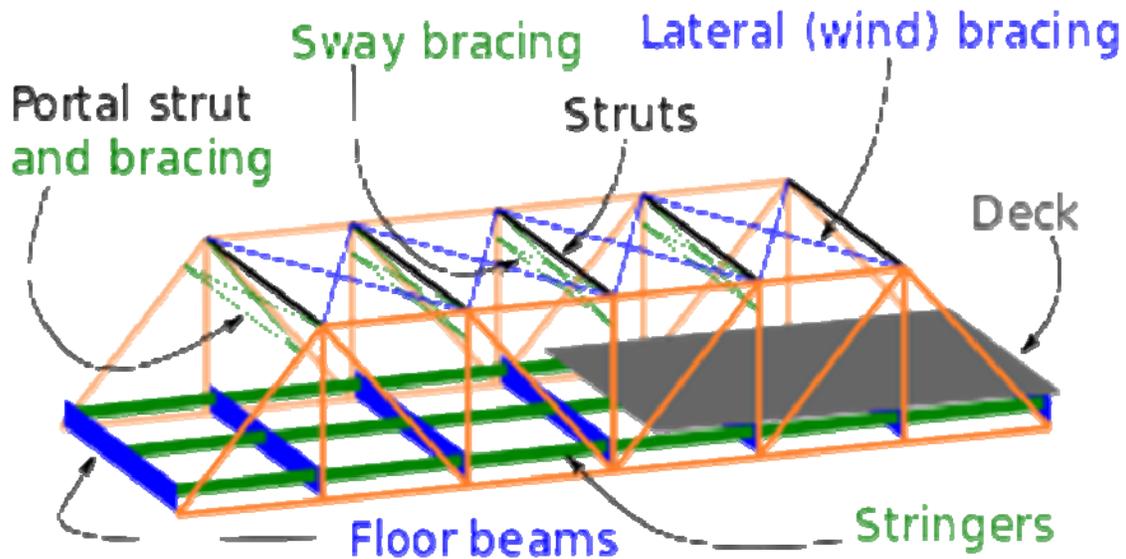


Figure 13. An illustration of the integral members of a through truss bridge (after La Rue 1898)

Bridge J0021R crossed the St Francis River at a slight skew angle but contrary to the description in the Missouri Historic Bridge Inventory (Fraser 1996), the bridge is bilaterally symmetrical about the centerline of the highway and is not skewed (Figures 11). Vertical clearance was designed to be 15' 3 7/8" from top of the wear surface of the roadway to the mid-strut of the portals and sway braces. Over time, the clearance was reduced to 14' 11" as a result of accumulated asphalt surface overlays.

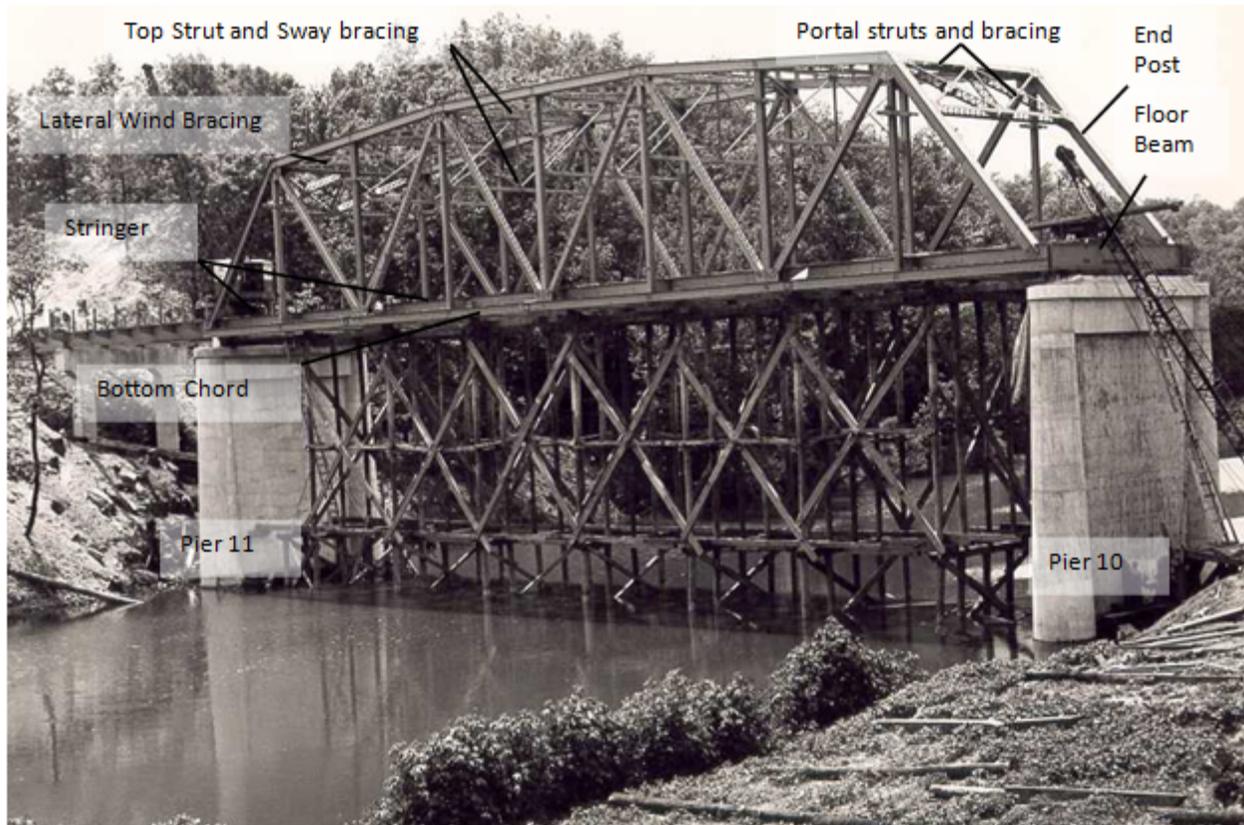


Figure 14. Truss span of Bridge J0021R during construction in 1941 prior to removal of the falsework

The 8 ½” thick reinforced concrete roadway deck on the truss span was supported by two pairs of steel stringers connected to heavy I-beam floor joists or floor beams at each panel point with lateral cross bracing between the beams connecting at opposite panel points (Plan Sheet 214). The inside pair of steel stringers were made from 21” wide-flange 68# I-beams, while the outside pair were made from lighter 21” 59# I-beams (Shop Drawing 102). The four stringers were riveted to the web of 36” 150# floor beams at each panel point with 6 x 3 ½” 3/8” thick connection angles. In addition to lower gusset plates, the posts of the truss also connected at each panel point to the ends of the 36” floor beams by pairs of 4 x 4” 3/8” thick angles riveted between the flanges at the ends of the beams.

Forty-eight X-shaped cross frame diaphragm braces were installed between the stringers, six in each panel. The cross frame braces in the truss span lack the horizontal angle rails used in the similar cross frame brackets in the approach spans. These cross frame braces, each 7’ 7 ½” long, were fabricated from 5/16” thick 3 x 2 ½” angles riveted at each end to the web of vertical 12” channels, which were ground to bear snugly between the flanges of the stringers. The cross frame braces were riveted through the channel flanges to the web of the stringers at third points between the ends of each panel (Plan Sheet 211).

Bottom lateral bracing composed of back to back stitch riveted 5/8” thick 4 x 3” angles (panels 0-1 and 7-8) or back to back 3 ½ x 3” 5/16” thick angles (panels 2-7) connected the ends of the floor beams across adjacent panel points and were joined to the ends of the floor beams and lower chord by means of 3/8” gusset plates. The bottom lateral bracing was also connected to the

stringers above with 9" wide 5/16" thick tie plate hangers which were riveted to the braces and to 3 1/2 x 3 1/2" angles welded to the stringers.

Box girders for the truss span were made up of riveted plates, channels and bar lacing. The plans, shop drawings and inspection reports all indicate that portions of the girders were also welded. Welding was apparently confined to the ends of the girders and splices where filler plates and reinforcing plates were tack welded and fillet welded into place to strengthen and dimensionally pad the areas where the web members connected to the gusset plates. American Welding Society standards for welding structural steel in highway and railway bridges were first published in 1936 along with tentative rules for qualification and testing of welding operators and welding was still a relatively new and innovative part of the bridge fabrication process in 1941 (Sapp 2012). The welders who fabricated Bridge J0021R at both the Clinton Bridge Works and the Illinois Steel Bridge Co. were required to qualify by demonstrating their skills to the highway department Shop Inspector and by submitting samples of their work for destructive testing. Welds were a particular focus of the shop inspections made by the Highway Departments shop inspector George Morgan in April 1941 and his inspection reports note several 'stress welds' that had to be redone.

The lower chord of the truss was a 1' 1" wide box beam composed of a pair of vertical back-to-back 15" 33.9 # channels connected across the top and bottom flanges with a combination of riveted 3/8" thick 1' end and intermediate tie plate battens in panels 3-6 and double lacing with 2 1/2 by 7/16" lacing bars in panels 1-2 and 7-8. Joints in the channels were secured with splice plates, which were attached with rivets and reinforced with welded filler plates.

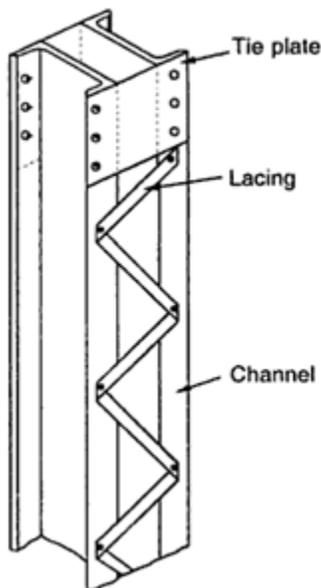


Figure 15. illustration of a beam or column fabricated from back-to-back channels, tie plates and single bar lacing

Vertical posts in the truss were made from 12" wide flange I-beams, with 45# I-beams in the panel points 1,3,5 and 7, with heavier 12" 53# bearing pile I-beams in panel points 2, 4 and 6.

The inclined end posts or batter posts and the top chord of the truss were composed of box beams fabricated from a 20" wide 7/16" thick cover plate riveted to the flanges of a pair of back-to-back 15" 33.9# channels spaced 1' 1" apart, which formed the sides of the box. The channels were connected along the bottom side of the beam with 24" 3/8" thick end tie plates and 2 1/2" wide 7/16" thick double bar laces, which were riveted to the bottom flanges of the 15" channels. The resulting box beam measured 20 x 15"

Diagonal web members at either end of the truss were made from 12" wide-flange 53# bearing pile I-beams (Plan Sheet 213 -L1 and U7-L6). The remainder of the diagonal truss members were 1' wide box beams fabricated from two facing 10" 20# channels single laced along the top and bottom flanges with alternating 2 1/2" wide 5/16" thick bar laces. (Figure 15)

Combination top struts and sway bracing was installed perpendicular to the trusses between the vertical posts at each panel point. The five top strut sway braces extended between the top chords and vertical posts of the left and right trusses. This bracing consisted of a top strut member fabricated from 2 pairs of 5/16" 5 x 3" angles single laced to form a 1' tall girder. Riveted below that top strut girder by means of 5/16" gusset plates, were a pair of cross braces made from 3 1/2 x 3 1/2" angles and a vertical brace made from a pair of stitch riveted 3 1/2 x 3" 5/16" thick angles. The pair of cross braces and the vertical brace were secured by 5/16" thick gusset plates to the top strut and to a mid-strut made from stitch riveted 3/8" thick 6"x 6" angles. The top and mid struts were in turn secured to the top chord and vertical I-beam posts with riveted gusset plates (Plan Sheet 214, Shop Drawing Sheet 102).

Top lateral X-shaped 'wind bracing' was installed diagonally between panel points along the top chord in the central six panels of the truss. These six sets of lateral wind braces were fabricated from two pairs of 3 x 3 1/2" 5/16" angles joined by 9" 5/16" tie plates to form girders which in turn were attached at their crossing point in the center of each panel by a pair of 5/16" gusset plates. The x-shaped lateral wind braces attached to the top chord at the same 5/16" gusset plates where the top strut/sway braces attached.

The portal sections at each end of the truss span were the most geometrically complex components of the bridge. Similar to the top struts and sway bracing, they consisted of a composite portal top strut, a pair of X-shaped cross brace diagonals, a vertical strut and a mid-strut²¹ (Plan Sheet 213, Shop Drawing 101).

The portal section top struts consisted of a composite box beam with a hexagonal cross section fabricated from a pair of girders made from single laced 3 1/2 x 3 1/2" 5/16" thick angles and 9" 5/16" thick end tie plates. The two girders laced with 2 1/4" wide 3/8" thick lace bars secured with 3/4" rivets were attached to nine 6" wide portal strut diaphragms spaced 3' apart between the left and right trusses, which were in turn secured with rivets to a 26" wide 3/8" thick cover plate fabricated to conform to the front and top sides of the strut. The portal strut diaphragms were welded from 5/16" web plates and 3/8" thick flanges and were designed to hold one of the girders in-plane with the inclined end posts of the truss and the other in-plane with the top chord (Plan Sheet 213, Shop Drawing 101). The portal top strut was joined to the end posts and top chords by means of riveted gusset plates. The ends of the pair of cross braces and the vertical strut were also joined to the top and mid-strut by riveted gusset plates.

The diagonal cross braces and the vertical brace in the portal sections were single laced girders fabricated from 3 1/2 x 3" 5/16" angles with 5/16" thick end tie plates and 2 1/4" wide 3/8" thick bar laces. They were attached to the top strut, end posts and mid strut with 3/4" rivets by means of gusset plates on both sides at all points of intersection.

The mid-struts in the portal sections were single laced girders made from four 3 1/2 x 3" 5/16" thick angles joined by 3/4" rivets with 2 1/4" wide 3/8" thick lace bars and 9" 5/16" thick end tie

²¹ The double X-shaped portal sections on Greenville Bridge differ from those featured on most Sverdrup and Parcel designs which typically employed a large single X-shaped portal brace.

plates. The portal mid-struts were attached to the diagonals, vertical strut and the inclined end posts of the truss with rivets and a combination of 5/16" and 3/8" thick gusset plates.

The principle members of the truss web were connected at each of the panel points by means of riveted gusset plates. Horizontal gusset plates used in the lower chord connections were 3/8" thick. Vertical gusset plates were 7/16" thick and gusset plates used to connect the sway braces and cross bracing struts and lateral wind bracing to the top chords were 5/16" thick. Additional filler plates and angles were welded and riveted to the ends of the truss members to strengthen the areas where the truss members attached to the gusset plates.

The hand rail on the truss span was continuous with that attached to the approach spans and consisted of a system of brackets fabricated from 1/4" trapezoidal plates and 3 x 2 1/2" 1/4" angles, which attached to the stringers with 3 1/2 x 3" riveted angles. The 4" H-posts, to which 6" channel rails were bolted by means of welded brackets, were riveted to the support brackets and bolted to anchor bolts set in the curb and deck slab. As with the approach spans, the hand rail brackets were riveted to the outside stringers beneath the deck. The hand rail was also bolted directly to all of the vertical I-beam post members of the truss span by means of a special bracket (Plan Sheet 214, Shop Drawing 104).

Simple Spans

A pair of 50' simple I-beam approach spans were located on the south side of the truss span. These simple spans were fabricated by the Clinton Bridge Works in Clinton Iowa. They were assembled and inspected by George Morgan in the fabricator's shop on April 17-18 1941. Morgan was generally pleased with the quality of the work but required the fabricator to remove burrs from all the metal edges and to sandblast and shop paint the spans before he would accept them.

In the two simple spans, the roadway deck was supported by four 33" wide flange I-beams spaced 7' 8" apart, with the outside pair of beams weighing 141#/foot and the inside pair 152#/ft. At the ends of each span, diaphragms made of 15" 33.9# channels and 9" wide 3/8" stiffener plates were riveted transversely between the stringers. The cross frame 15" channels and stiffener plates were riveted to the web of the stringers with 5 x 3 1/2" 3/8" thick angles which were ground to fit and bear inside the flanges of stringers²² (Plan Sheet 212).

Cross frame bracing was riveted to the web of the 33" I-beam stringers at third points (16' 8" apart) within each of the two simple spans. The cross frame braces in the simple spans were similar to those utilized in the continuous spans and consisted of diaphragms fabricated with top and bottom rails made from 5/16" thick 3 1/2 x 3 1/2" angles and cross members made from 3 x 2 1/2" 5/16" angles, which were riveted to 8 x 6" 7/16" end stiffener angles used to connect the braces to the stringers (Shop Drawings 96, Plan Sheet 211).

²² The six 15" channel diaphragms at the ends of the 50' spans where they join over Bent 12 were apparently installed backwards, that is back to back as seen in Figure 16 rather than facing as in the plans (Plan Sheet 212 Bent 12 longitudinal sections at supports). George Morgan did not note that change or error in his inspection report and that change between the design and the 'as built' structure does not appear to have resulted in any problems.

Deck

Bridge J0021R had an 8 ½" thick reinforced concrete deck slab, which was haunched to the top flange of the stringers, floor beams and the 15" channels at the ends of each span²³. The bridge deck was reinforced with top and bottom layers of 5/8" reinforcing bars which were spaced on 11" centers. The Laclede Steel Co. supplied the reinforcing steel. The deck in each of the continuous spans was poured in three sections of 36', 69' and 85' in length, working from south to north starting at the north end of the span so that only two transverse construction joints were present within the slab on each span (Plan Sheet 215).



Figure 16. The truss span portal and simple I-beam approach spans at the southwest end of Bridge J0021R during construction in 1941 showing the I-beam stringers, lateral cross-frame bracing, 15" channels and hand rail brackets and posts on the simple spans. The approach spans of the 1930 bridge (J21) are visible in the background.

²³ Reinforced concrete decks were typical of 2 out of 3 bridges built in the US after 1930 and were made possible by research and analysis conducted by H. M. Westergaard at the University of Illinois in the 1920s and 30s (Bettigole and Robinson 1997:3).

Expansion Joints

Expansion joints between the three 190' continuous spans and the north end abutment (Bent 1) and Pier 10 on the north side of the river were standard design finger-joint plates cut from a single 1 ¼" plates and were fixed to the underlying channels or beams with countersunk fasteners.

On the south side of the river, the two 50' simple spans were closely butted and required only narrow expansion joints filled with ¾" rubber compound.

Bearings

Specifications for the bearings for Bridge J0021R called for use of either cast steel or gray iron alloy and correspondence indicates that both cast steel and gray iron alloy bearings were used.

In a letter dated Dec 19, 1940, highway department bridge engineer N. R. Sack inquired of the Illinois Steel Bridge Co. whether the bearings for the 50' simple spans would be cast steel or gray iron alloy. In their reply to Sack, the Illinois Steel Bridge Co. responded on Dec 27, 1940 that steel castings had been purchased from the Omaha Steel Works, Omaha Nebraska and that the V. R. Andrus Co. of Kansas City would supply the gray iron alloy bearings. Omaha Steel Works produced the castings for the bearings used in the truss span and continuous spans and their castings passed the physical tests conducted in the highway department's materials lab in March 1941.

The V. R. Andrus Co. of Kansas City was the contracted supplier for gray iron bridge bearing plates for the simple spans but a letter of Feb 21, 1941 from Spuck Iron & Foundry Co. to N. R. Sack, highway department bridge engineer, indicates that they were awarded a sub-contract from the V. R. Andrus Co. to furnish the gray iron alloy bridge plates for the two 50' simple spans.

The fixed bearings installed on the north ends of the two simple spans were of a simple two piece design that consisted of a masonry plate with a convex top surface and a sole plate bolted to the flanges of the I-beam stringers with a corresponding concave surface. The expansion bearings were a three piece design consisting of a flat masonry plate, a separate slotted floater plate with convex upper surface and a sole plate with a concave lower surface (Plan Sheet 212). The bearings were designed to rest on 1/8" lead plate bearing pads and were fixed to the bents with anchor bolts.

When the Spuck Foundry submitted sample bars for required testing by the highway department's materials lab, the iron alloy from the pour they used to make the bridge bearing plates for the simple spans was found to be below the minimum specified tensile strength of 50,000 PSI (46,500 and 49,000 PSI, averaging about 5% below the 50,000 PSI yield point for ASTM specification for Class 50 gray iron). After some back and forth correspondence between the Highway Department's Bridge Engineer N. R. Sack and the president of Spuck Foundry, Bridge Engineer Sack agreed to accept the plates produced by the Spuck Foundry, provided that they passed visual inspection after machining. George Morgan made the visual inspection of the machined castings at the South Side Machine Co. in St Louis, on March 19, 1941 and with minor

additional machining to correct flatness of one surface on one plate, he accepted them for use in the bridge²⁴

Cast steel bearings used in the truss and continuous spans were of the pinned rocker type (Plan Sheet 214). For the truss span the masonry plates for both the fixed and rocker shoes were attached to the piers with four 1 ½” swaged anchor bolts. The fixed bearings consisted of a massive 30 x 20” cast steel masonry plate 14 ½” tall, a 3” diameter pin and a 13 x 20 ½” sole plate. The rocker shoes rest on a 3 ¼” thick 20 x 36” masonry plate and consisted of 13” tall rockers, a 3” pin and a 13 x 20 ½” sole plate. Lead plates 1/8” thick were installed beneath the masonry plates. Similar but smaller rocker type bearings with 3” pins and 9” rockers were used for the continuous approach spans (Plan Sheet 212, Photo #1).

Conclusion

The St Francis River Bridge (Bridge J0021R) built on Route 67 at Greenville in 1941-42 is a good example of a Warren ‘camelback’ through truss with verticals. Although Warren trusses were commonly used for mid-length highway and railroad spans during the early to mid-20th century, they were rarely employed by the Highway Department in Missouri (which more typically built Pratt and Parker trusses) except for bridges designed by Leif Sverdrup and his firm Sverdrup and Parcel (Guise 2006, Gubbels 2005).

Several factors contribute to the significance of bridge J0021R, including the ‘camelback’ polygonal top chord of the Warren truss, its design by the firm of Sverdrup and Parcelⁱⁱ, whose Warren through truss bridges dominated the landscape of major river spans in Missouri during the mid-20th Century²⁵, its use of continuous approach spans and technological advances in fabrication related to use of both welded and riveted joinery, at a time when welding was beginning to replace riveting in the fabrication of steel structures. Finally, Bridge J0021R is also significant for its location at the edge of the NRHP listed ‘Old Greenville’ town site and for its role in bridging the St Francis River along an important historic transportation corridor.

After nearly 70 years of service, bridge J0021R was removed in November 2011, having been replaced by a new four lane structure on the new Route 67 expressway, which was built by Robertson Contractors on the upstream side of J21R (Photo #37).

²⁴ The compressive strength of cast iron is more than three times its tensile strength. While the specification for ‘Class 50’ iron in bridge bearing plate applications is an industry standard, that standard may have been considered conservative. Both Spuck Foundry and N. R. Sack were ultimately unwilling to discard and remake even the comparatively small quantity of material (1040#) that tested short of the Class 50 specification, apparently because it seemed wasteful and punitively costly for the foundry to remake the plates. The decision to use slightly ‘substandard’ material seems to be an example of the ‘make do attitude’ and ‘depression era mentality’ that characterized the generations of Americans who lived through the great depression.

²⁵Sverdrup and his firm Sverdrup and Parcel designed or managed construction of a number of Warren through truss major river spans including the Glasgow Bridge on Route 240 in Howard and Saline Counties in 1925, the Blair Bridge in Washington Co. Nebraska in 1929, Hermann Bridge 1929, Waubonsie Bridge, Nebraska City 1930, Gasconade River Bridge on Missouri Route 100 in 1931, Fairfax Bridge Platte Co. 1931, Missouri River Bridge at Washington Mo. 1934, Mark Twain Bridge at Hannibal 1936, Des Moines River Bridge St. Francisville 1937, the Amelia Earhardt and Miami bridges in 1939 and the Mississippi River bridge at Chester Illinois 1941-42 .

ⁱ Shortly after completion of the design of Bridge J0021R, on November 7, 1940 the five month old Tacoma Narrows Bridge collapsed. Leif Sverdrup was hired by the Toll Authority who owned the bridge to help establish its insurance value. Sverdrup then chaired a board of inquiry charged with investigating the cause of that collapse.

Leif Sverdrup issued the committee findings on June 16, 1941 (while bridge J21R was being erected) which concluded that the primary causes of the Tacoma Narrows Bridge collapse lay in design flaws that made the bridge subject to effects of wind that in previous designs were otherwise negligible.

Less than year after completing the design of Bridge J0021R and while that bridge was still under construction, Sverdrup and Parcel partner D C Wolfe was directing a project to design and build underground bomb proof bunkers in Hawaii (Contract W-414-eng-808). On November 16 1941 Sverdrup arrived in Hawaii and signed a cost-plus fixed-fee contract (DAW-414-eng-511) to design and supervise construction of a series of secret military airfields in the south Pacific, which were designed to ferry B-17 bombers to the Philippines in advance of an anticipated Japanese attack, which was expected in the Spring of 1942.

ⁱⁱ Sverdrup and Parcel was founded by Leif Sverdrup and John Parcel in 1929. Sverdrup studied engineering under Parcel at the University of Minnesota in 1921 and then worked briefly for the Minnesota highway department before becoming the Bridge Engineer at the Missouri Highway Department. The firm specialized in bridge design. Sverdrup and Parcel was regarded as one of the leading bridge design firms in the country based on a legacy of design excellence earned over a span of 70 years. The firm's reputation was sullied following the August 27, 2007 collapse of the I-35W Bridge (Bridge 9340) in Minneapolis-St Paul, which they had designed in 1962. In November 2008, the National Transportation Safety Board released a report citing a 'design error' in the gusset plates as the cause of the collapse, which resulted in the deaths of 13 people and injuries to another 145. The NTSB analysis concluded that a ½" gusset plate at the U10 node in the bridge failed due to substantial increases to the weight of the bridge resulting from previous modifications (20% increase in dead load from pavement overlays) and the heavy traffic and construction loads on the bridge at the time its collapse (578,000 pounds of material and equipment were on the bridge, which was about to be repaved). In their review of the bridge design, the NTSB found that 24 'under designed' gusset plates had been incorporated in the bridge, each about ½ the thickness they should have been.

Since a design flaw was cited by the NTSB as the main underlying cause of the I-35W bridge collapse, concern then arose that other Sverdrup and Parcel bridges might also incorporate similar design flaws. Fears about the scale of the legal liability should another of their bridges collapse led to a nationwide program of inspection and analysis of structures similar to the I-35W Bridge. Although no other design flaws were detected, as a precautionary move many Sverdrup and Parcel designed bridges were slated for replacement.

In the course of the legal battle over liability for the collapse of the I-35W Bridge, alternate theories for the cause have been developed, mainly related to previously identified fatigue cracks in truss beams and unmanaged signs of strain evidenced by bowed gusset plates, which have been attributed to frozen expansion bearings. In a theory developed in 2009 following analysis by Thornton Tomasetti Inc. (structural engineering consultant hired by lawyers representing the victims and their families), the imbalanced overloading of the structure during the construction project and the very high temperature (91 degrees) the day of the collapse lead to the disaster mainly because some of the poorly maintained expansion bearings, which had previously been reported as severely corroded and fouled with paint build up, were frozen and not functioning properly. The frozen bearings consequently failed to accommodate the thermal expansion of the bridge. According to the Thornton Tomasetti Inc. theory, the bridge collapse was due to buckling and failure of a horizontal beam (L9-L11 chord) in the lower part of the truss, caused by faulty expansion bearings, which then in turn lead to a cascading failure of the gusset plates during the collapse of the bridge.

A lawsuit is still pending against Jacobs Engineering, which acquired Sverdrup and Parcel in 1999 and the liability for their earlier designs. In May 2012 the US Supreme Court declined to hear Jacobs appeal to dismiss the suit, which argued that too much time had elapsed since the 1960s design of the I-35W Bridge. Reanalysis of the cause or causes of the collapse during the upcoming trial may help to finally determine the extent to which design flaws, faulty bearings or some other factor or factors caused the collapse of Bridge 9340 on I-35W in Minneapolis-St Paul.

Bibliography

Austin, David

2008 Documentation of the Historic Gasconade River Bridge. Gasaconade River Bridge J-802 and Overflow Structures K-112 and K113, Route 17, Pulaski County, Missouri. Missouri Department of Transportation

Bettigole, Neal H. and Rita Robinson

1997 Bridge Decks: Design, Construction, Rehabilitation, Replacement. ASCE Publications

Baughn, James

2012 Wappapello Bridge, Wayne County Missouri. <http://bridgehunter.com/>

Cohen Family Papers #5178, Southern Historical Collection, Wilson Library, UNC- Chapel Hill

Congress of the United States

1946 Hearings before the Joint Committee on the Investigation of the Pearl Harbor Attack, Proceedings of Army Pearl Harbor Board, Seventy Ninth Congress, Second Session.

Cramer, Rose Fulton

1972 Wayne County Missouri. Ramfre Press, Cape Girardeau.

Darby, William

1818 *The Emigrant's Guide to the Western and Southwestern States and Territories*. Kirk & Mercein, New York

Duggal S. K.

2000 *Design of Steel Structures*. 2nd edition Tata McGraw-Hill.

Ellinghouse, Cletis, R.

2008 *Wayne County's Lost River Settlements*. Xlibris, Philadelphia

2010 *Old Wayne, a Brit's Memoir*. Xlibris, Philadelphia.

Enslow, V. W.

1928 Inspection Report US Route 67 Wayne Co, May 17, 1928. Bridge correspondence files for Bridge J21R, on file, MoDOT Bridge Division, Jefferson City.

Featherstonhaugh, George W.

1844 *Excursion through the Slave States, From Washington on the Potomac to the Frontier of Mexico; with Sketches of Popular Manners and Geological Notices*.

Greenville SW Quadrangle, Wayne County, Missouri

1966 USGS 7.5' Topographic Map, US Geological Survey, Denver.

Greenville Sun Newspaper,

microfilm on file, State Historical Society of Missouri, Columbia.

Gubbels, Thomas J.

2005 Documentation of the Historic Missouri River Bridge at Hermann, Bridge No. K-226A, Gasconade County, Route 19. Missouri Department of Transportation

Guise, David

2006 The Evolution of the Warren, or Triangular Truss. *Industrial Archaeology* 32(2):23-40

Flint, Timothy

1826 *Recollections of the Last Ten Years passed in Occasional Residences and Journeyings in the Valley of the Mississippi*. Cummings Hilliard and Company, Boston.

Fraser, Clayton B.

1996 Missouri Historic Bridge Inventory. FraserDesign Inc., Loveland Colorado.

Goggins, A. L.

1929 Missouri State Highway Department Bureau of Bridges Preliminary Inspection Report, Bridge J-21. March 3, 1929 report on file in MoDOT Bridge Division correspondence file for bridge J0021R.

Houck, Louis

1908 A History of Missouri From the Earliest Explorations Vol I.

Missouri Yearbook of Agriculture

1893 Proceedings of the Roads Improvement Convention held at Chillicothe, Mo August 16-19 1892. Vol. 25:176-191.

Missouri Department of Transportation

Bridge Correspondence Files for Bridge J21R, MoDOT Bridge Division, Jefferson City.

Missouri Highway and Transportation Department

1992 Structural Inventory and Appraisal: Structure J21R. Primary System Bridge Record, Bridge Division, Jefferson City.

Missouri Railroad and Warehouse Commissioners

1908 33rd Annual Report of the Missouri Railroad and Warehouse Commissioners, for the year ending June 30, 1908. Hugh Stephens Printing Co, Jefferson City.

Mitchell, Samuel A.

1837 *Traveller's Guide Through the United States. Illustrated by an accurate map of the United States*, Mitchell and Hinman, Philadelphia

Morgan, George

1941 Report of Arc Welding Test for Qualification of Operators Joseph McSherry and Walter White. February 14, 1941 Bridge Correspondence Files for Bridge J21R, on file, MoDOT Bridge Division, Jefferson City

Nuttall, Thomas

1905 Nuttall's Journal of Travels into the Arkansa Territory October 2, 1818-February 18, 1820, Vol XIII in *Early Western Travels 1748-1846* edited by Ruben Gold Thwaites , Clarke, Cleveland.

Rossow, Mark

Inspection of Bridge Bearings, CED Engineering.com

<http://www.cedengineering.com/upload/Inspection%20of%20Bridge%20Bearings.pdf>

Bridge Inspection: Piers and Bents. CED Engineering.com

<http://www.cedengineering.com/upload/Piers%20and%20Bents.pdf>

Sapp, Mark

2012 *A History of Welding* <http://www.weldinghistory.org/whistoryfolder/welding/index.html>

Schoolcraft Henry Rowe

1821 *Journal of a Tour into the Interior of Missouri and Arkansaw, from Potosi, or Mine a Burton, in Missouri Territory, in a South-West Direction, toward the Rocky Mountains, in the Years 1818 and 1819.* Richard Phillips and Company, London.

1853 *Scenes and Adventures in the Semi-Alpine Region of the Ozark Mountains of Missouri and Arkansas, which were first traversed by De Soto in 1541.* Lippincott Grambo & Co., Philadelphia.

Schroeder, Walter A.

2002 *Opening the Ozarks: A Historical Geography of Missouri's Ste. Genevieve District 1760-1830.* University of Missouri.

Shinn, Josiah H.

1908 *Pioneers and Makers of Arkansas.* Genealogical and Historical Publishing

State Highway Commission of Missouri

1933 7th Biennial Report of the State Highway Commission of Missouri for the year ending December 31, 1930.

Stevens, Donald L. Jr.

1991 *A Homeland and A Hinterland – The Current and Jacks Fork Riverways: Historic Resource Study Ozark National Scenic Riverways.* NPS Midwest Regional Office, Omaha. http://www.cr.nps.gov/history/online_books/ozar/index.htm

Wayne County Journal Banner Newspaper

Microfilm on file, State Historical Society of Missouri, Columbia.

Wayne County Court,

1905 Minutes of the County Court of Wayne County for May 18, 1905, microfilm on file Missouri State Archives.

Wilby, F. B.

1929 Highway Bridge; St Francis River at Greenville, Mo. Letter from Lt. Col. F. B. Wilby to Chief Engineer T. H. Cutler, on file in MoDOT Bridge Division correspondence file for bridge J0021R, Jefferson City

Wood, Martha May

1936 Early Roads in Missouri. Unpublished MA Thesis, University of Missouri.

Yarbrough, Anna Nash

1959 Arkansas' Struggle for Communication. *Arkansas Historic Quarterly*, 18(1):45-49.

**St. Francis River Bridge (Bridge No. J0021R)
Route 67, Wayne County, Missouri**

Photographer: Randall Dawdy, Missouri Department of Transportation

Date: February 16, 2008

Location of Negatives and Digital Images: Missouri State Historic Preservation Office

Archival Photo Index:

- #1 of 37. Bridge J0021R. Abutment 1. View to northwest.
- #2 of 37. Bridge J0021R. North approach spans. View to northwest.
- #3 of 37. Bridge J0021R. North end. View to west.
- #4 of 37. Bridge J0021R. East side. View to southwest.
- #5 of 37. Bridge J0021R. East side. View to southwest.
- #6 of 37. Bridge J0021R. Main span. View to southwest.
- #7 of 37. Bridge J0021R. East side. View to southwest.
- #8 of 37. Bridge J0021R. Main span. View to southwest.
- #9 of 37. Bridge J0021R. Piers 10, 11 and subdeck. View to southwest.
- #10 of 37. Bridge J0021R. Details at Pier 10. View to southwest.
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- #12 of 37. Bridge J0021R. South end. View to southwest.
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- #15 of 37. Bridge J0021R. South end. View to northeast.
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- #18 of 37. Bridge J0021R. Details at Pier 11. View to northeast.
- #19 of 37. Bridge J0021R. West side. View to northeast.

- #20 of 37. Bridge J0021R. West side. View to northeast.
- #21 of 37. Bridge J0021R. Abutment 13. View to southwest.
- #22 of 37. Bridge J0021R. East side. View to northwest.
- #23 of 37. Bridge J0021R. Main span. View to northwest.
- #24 of 37. Bridge J0021R. Details at Pier 11. View to northwest.
- #25 of 37. Bridge J0021R. East side at Pier 11. View to northwest.
- #26 of 37. Bridge J0021R. East side at Pier 10. View to northwest.
- #27 of 37. Bridge J0021R. Main span. View to west.

Post-construction Photo Index:

- #28 of 37. Bridge J0021R. East side. View to southwest.
- #29 of 37. Bridge J0021R. Between bridges. View to south.
- #30 of 37. Bridge J0021R. From new bridge. View to south.
- #31 of 37. Bridge J0021R. From new bridge. View to south.
- #32 of 37. Bridge J0021R. North approach. View to south.
- #33 of 37. Bridge J0021R. East side. View to southwest.
- #34 of 37. Bridge J0021R. East side. View to southwest.
- #35 of 37. Bridge J0021R. 1905 bridge pier in foreground. View to southwest.
- #36 of 37. Bridge J0021R. West side. View to northeast.
- #37 of 37. Bridge J0021R. West side. View to northeast.



#1 of 37. Bridge J0021R. Abutment 1. View to northwest.



#2 of 37. Bridge J0021R. North approach spans. View to northwest.



#3 of 37. Bridge J0021R. North end. View to west.



#4 of 37. Bridge J0021R. East side. View to southwest.



#5 of 37. Bridge J0021R. East side. View to southwest.



#6 of 37. Bridge J0021R. Main span. View to southwest.



#7 of 37. Bridge J0021R. East side. View to southwest.



#8 of 37. Bridge J0021R. Main span. View to southwest.



#9 of 37. Bridge J0021R. Piers 10, 11 and subdeck. View to southwest.



#10 of 37. Bridge J0021R. Details at Pier 10. View to southwest.



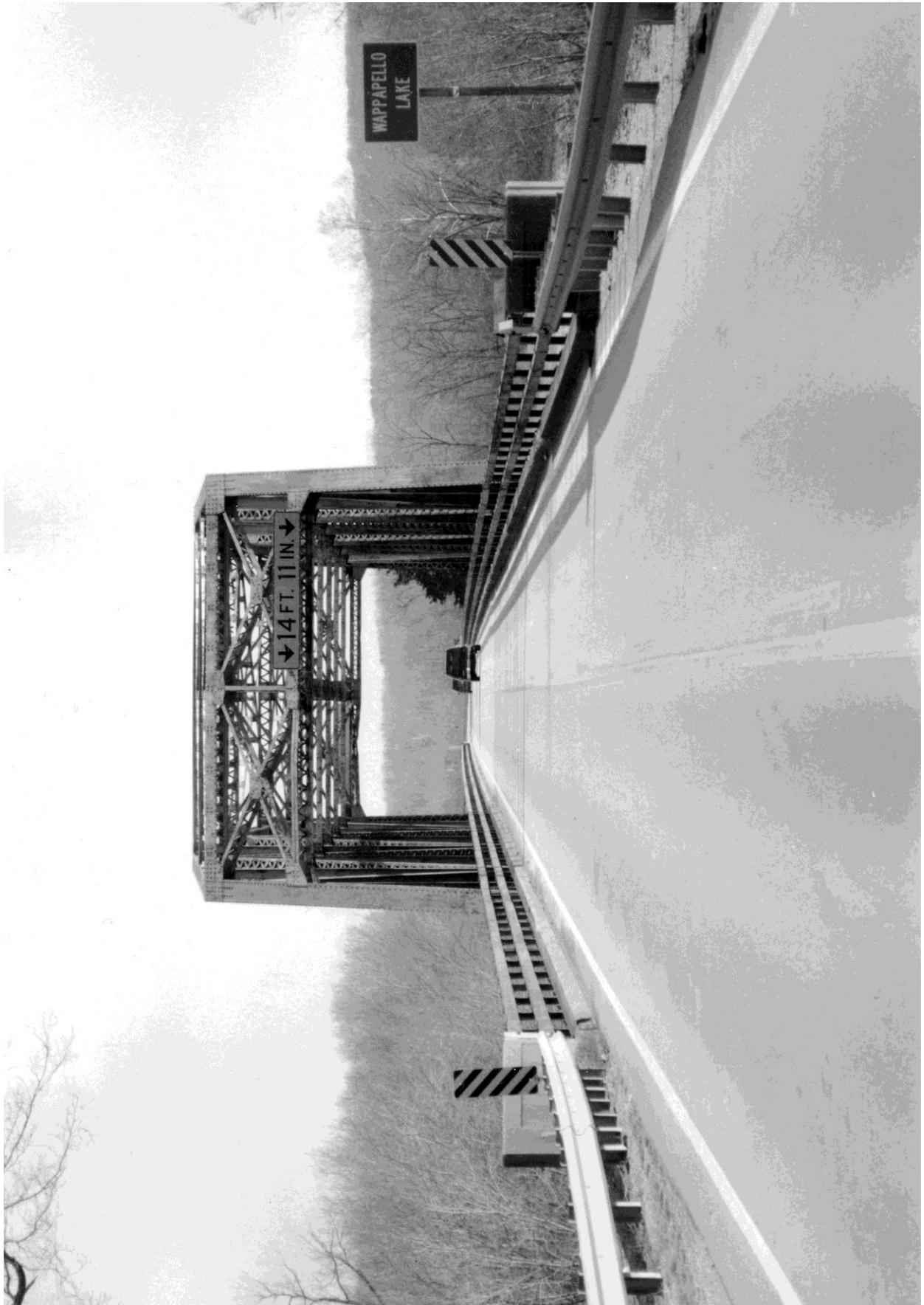
#11 of 37. Bridge J0021R. Details at Pier 11. View to southwest.



#12 of 37. Bridge J0021R. South end. View to southwest.



#13 of 37. Bridge J0021R. South portal. View to north.



#14 of 37. Bridge J0021R. South approach. View to north.



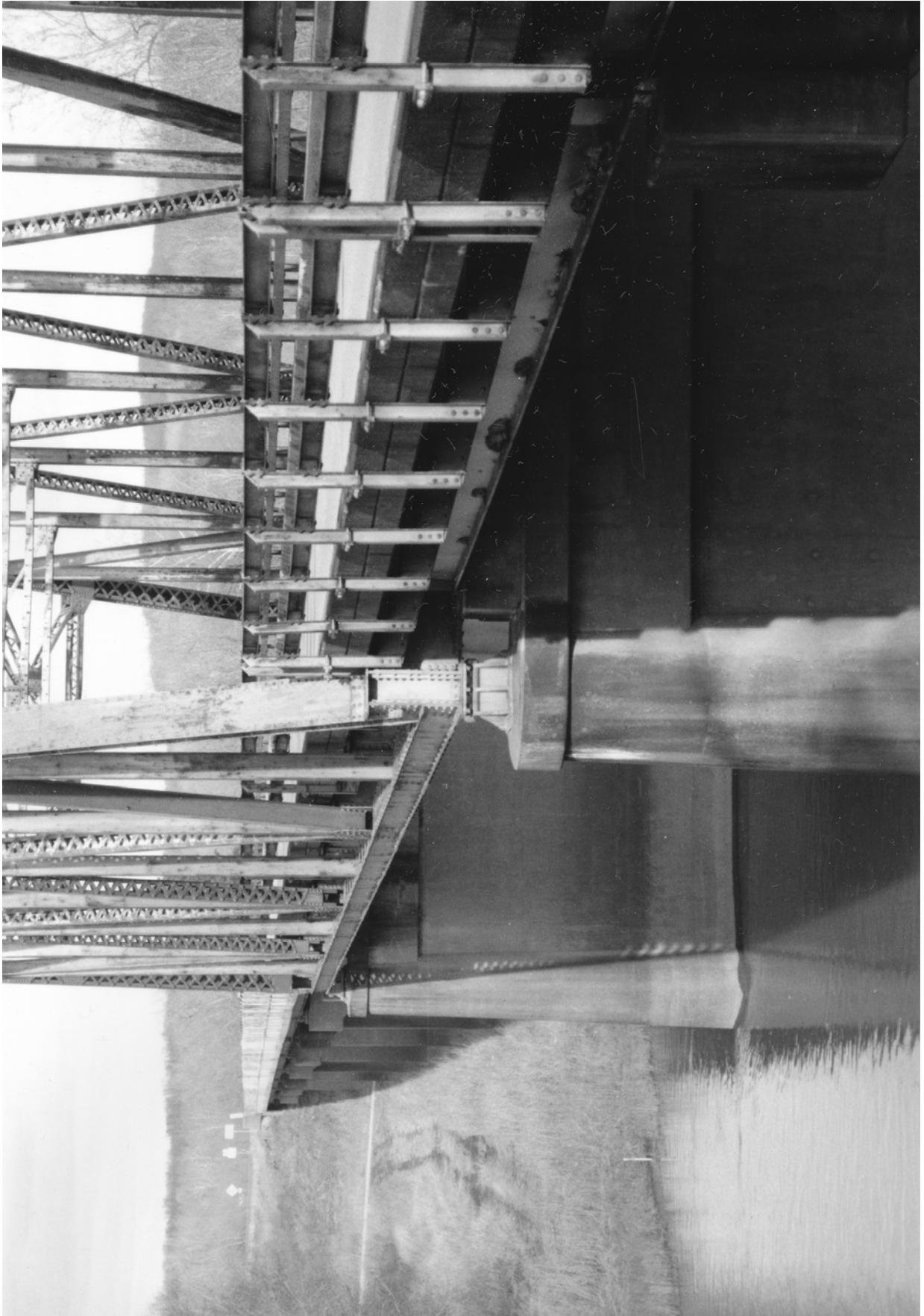
#15 of 37. Bridge J0021R. South end. View to northeast.



#16 of 37. Bridge J0021R. South approach spans. View to northeast.



#17 of 37. Bridge J0021R. West side. View to northeast.



#18 of 37. Bridge J0021R. Details at Pier 11. View to northeast.



#19 of 37. Bridge J0021R. West side. View to northeast.



#20 of 37. Bridge J0021R. West side. View to northeast.



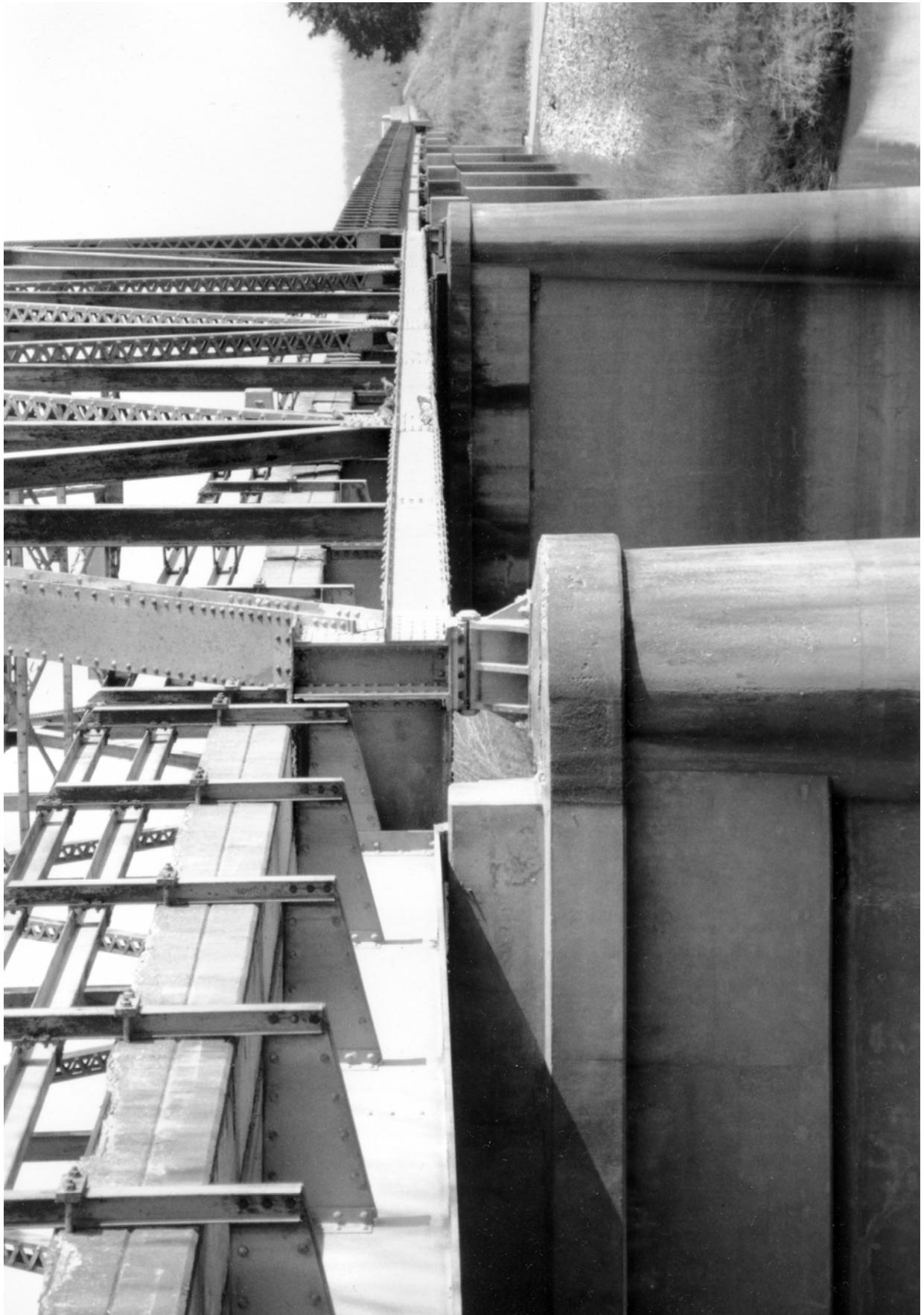
#21 of 37. Bridge J0021R. Abutment 13. View to southwest.



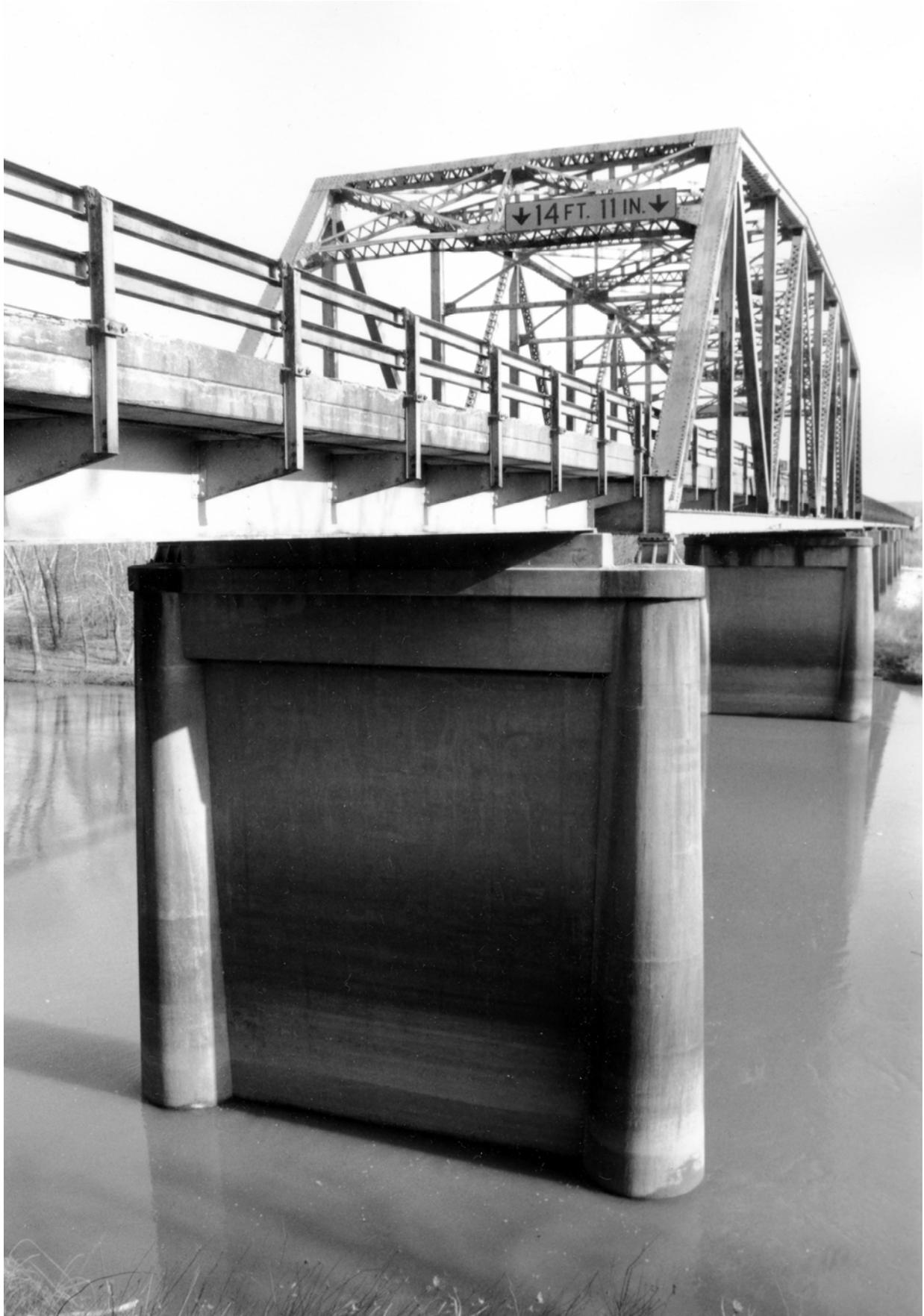
#22 of 37. Bridge J0021R. East side. View to northwest.



#23 of 37. Bridge J0021R. Main span. View to northwest.



#24 of 37. Bridge J0021R. Details at Pier 11. View to northwest.



#25 of 37. Bridge J0021R. East side at Pier 11. View to northwest.



#26 of 37. Bridge J0021R. East side at Pier 10. View to northwest.



#27 of 37. Bridge J0021R. Main span. View to west.



#28 of 37. Bridge J0021R. East side. View to southwest.



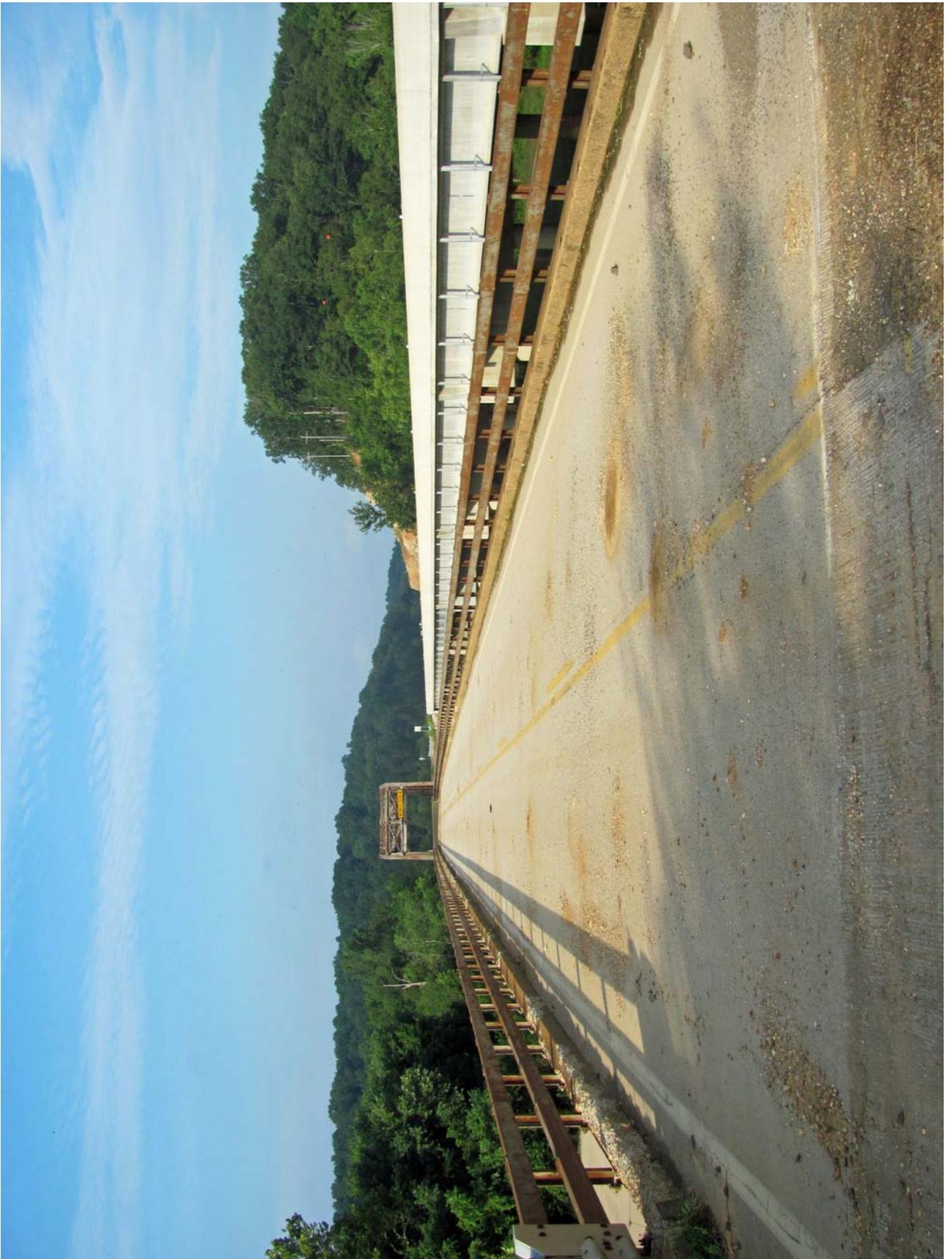
#29 of 37. Bridge J0021R. Between bridges. View to south.



#30 of 37. Bridge J0021R. From new bridge. View to south.



#31 of 37. Bridge J0021R. From new bridge. View to south.



#32 of 37. Bridge J0021R. North approach. View to south.



#33 of 37. Bridge J0021R. East side. View to southwest.



#34 of 37. Bridge J0021R. East side. View to southwest.



#35 of 37. Bridge J0021R. 1905 bridge pier in foreground. View to southwest.



#36 of 37. Bridge J0021R. West side. View to northeast.



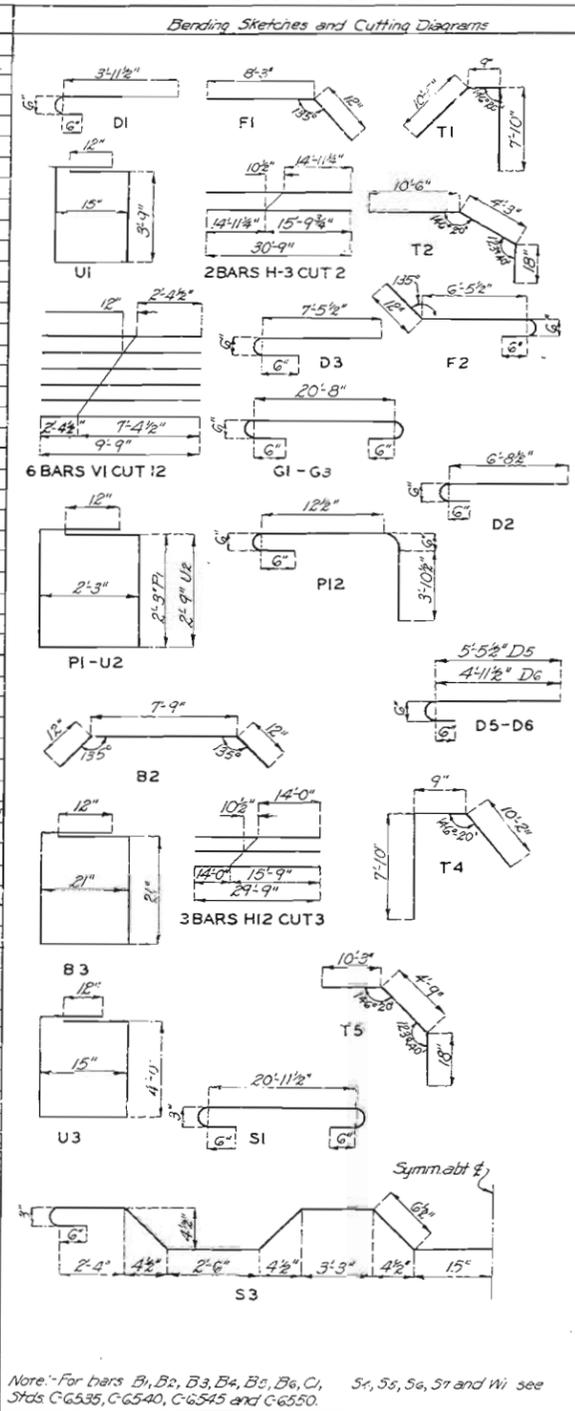
#37 of 37. Bridge J0021R. West side. View to northeast.

Bridge Plans, Rehabilitations and Shop Drawings

**St. Francis River Bridge (Bridge No. J0021R)
Route 17, Wayne County, Missouri**

BILL OF REINFORCING STEEL

No.	Size	Length	Mark	Location
Substructure				
Bent No. 1				
12	3/4"φ	5'-3"	D1	Footing
8	3/4"φ	9'-3"	F1	Haunch
6	3/4"φ	17'-6"	H1	Wing
2	3/4"φ	17'-0"	H2	"
2	3/8"φ	30'-9"	H3	"
4	1 1/2"φ	21'-3"	H4	Beam
4	1 1/2"φ	21'-3"	H5	"
2	3/4"φ	21'-3"	H6	"
3	3/8"φ	21'-3"	H7	"
4	3/4"φ	19'-0"	T1	Wing
6	3/4"φ	16'-3"	T2	"
3	3/4"φ	21'-3"	T3	Beam
25	1/2"φ	11'-0"	U1	"
6	1/2"φ	9'-9"	V1	Wing
12	3/4"φ	14'-3"	V2	Column
Bents 2 to 11 incl.				
80	1"φ	8'-9"	D3	Footing
80	3/4"φ	9'-3"	F1	Haunch
80	3/4"φ	8'-9"	F2	"
180	1"φ	23'-3"	G3	Beam
20	3/8"φ	21'-3"	G2	"
198	1/2"φ	10'-0"	P1	Column
8	1"φ	12'-0"	P2	Col Bent #2
8	1"φ	12'-0"	P3	Col Bent #3
8	1"φ	12'-0"	P4	Col Bent #4
8	1"φ	17'-3"	P5	Col Bent #5
8	1"φ	17'-3"	P6	Col Bent #6
8	1"φ	17'-6"	P7	Col Bent #7
8	1"φ	17'-6"	P8	Col Bent #8
8	1"φ	24'-6"	P9	Col Bent #9
8	1"φ	24'-9"	P10	Col Bent #10
8	1"φ	29'-9"	P11	Col Bent #11
240	1/2"φ	11'-0"	U2	Beam
Pier No. 12				
16	1"φ	8'-0"	D2	Footing
3	1"φ	22'-0"	H8	Web
18	1/2"φ	22'-0"	H9	"
4	1"φ	21'-3"	H10	Cap
36	3/4"φ	7'-0"	F12	"
22	1/2"φ	20'-3"	V3	Web
16	1"φ	29'-6"	V4	Shaft
Pier No. 13				
16	1"φ	8'-0"	D2	Footing
3	1"φ	22'-0"	H8	Web
22	1/2"φ	22'-0"	H4	Web
4	1"φ	21'-3"	H10	Cap
36	3/4"φ	7'-0"	F12	"
22	1/2"φ	24'-6"	V3	Web
16	1"φ	29'-6"	V4	Shaft



No.	Size	Length	Mark	Location
Piers No 14 & 15				
42	3/4"φ	3'-9"	D4	Parapet
8	1/2"φ	21'-3"	H11	"
Bents No 16-17 & 18				
16	3/4"φ	6'-0"	D6	Footing
24	3/4"φ	9'-3"	F1	Haunch
24	3/4"φ	8'-9"	F2	"
18	1"φ	23'-3"	G3	Beam Bent 16
32	3/8"φ	23'-3"	G1	Beam Bent 16
6	3/8"φ	21'-3"	G2	Beam
54	1/2"φ	10'-0"	P1	Column
8	3/8"φ	16'-3"	P16	Col Bent #16
8	3/4"φ	15'-0"	P17	Col Bent #17
8	3/4"φ	18'-0"	P18	Col Bent #18
12	1/2"φ	11'-0"	U2	Beam
8	3/8"φ	6'-0"	D5	Footing
Bents No 19-20 & 21				
24	1"φ	8'-9"	D3	Footing
24	3/4"φ	9'-3"	F1	Haunch
24	3/4"φ	8'-9"	F2	"
36	1"φ	25'-3"	G3	Beam Bent 19
20	3/8"φ	23'-3"	G1	Beam Bent 21
6	3/8"φ	21'-3"	G2	Beam
8	1"φ	31'-9"	P19	Col Bent 19
8	1"φ	31'-6"	P20	Col Bent 20
8	1"φ	27'-9"	P21	Col Bent 21
12	1/2"φ	11'-0"	U2	Beam
42	3/8"φ	16'-9"	B1	Tie-Beam
48	3/4"φ	9'-9"	B2	Tie-Beam
39	1/2"φ	8'-0"	B3	Tie-Beam
108	1/2"φ	10'-0"	P1	Column
Bent No 22				
12	3/4"φ	5'-3"	D1	Footing
8	3/4"φ	9'-3"	F1	Haunch
6	3/4"φ	17'-6"	H1	Wing
2	3/4"φ	17'-0"	H2	"
3	3/8"φ	29'-9"	H12	"
6	3/8"φ	21'-3"	H4	Beam
5	3/8"φ	21'-3"	H5	"
2	3/4"φ	21'-3"	H6	"
3	3/8"φ	21'-3"	H7	"
4	3/4"φ	18'-9"	T2	Wing
6	3/4"φ	16'-6"	T3	"
3	3/8"φ	21'-3"	T3	Beam
25	1/2"φ	11'-6"	U3	"
6	1/2"φ	9'-9"	V1	Wing
12	3/4"φ	15'-3"	V2	Column
Span 14-15				
678	5/8"φ	20'-9"	A	Slab
28	3/8"φ	29'-9"	B	Top Panel
65	3/8"φ	31'-9"	C	Top Panel
32	5/8"φ	28'-0"	D	Slab Curb
80	3/8"φ	28'-9"	E	Top Panel
180	3/8"φ	15"	F	Curb
Deck Girder Spans				
604	5/8"φ	22'-9"	S1	Slab
604	3/8"φ	21'-3"	S2	"
584	5/8"φ	23'-9"	S3	"
1200	3/8"φ	15"	C2	Curb

Note: For bars B1, B2, B3, B4, B5, B6, C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C57, C58, C59, C60, C61, C62, C63, C64, C65, C66, C67, C68, C69, C70, C71, C72, C73, C74, C75, C76, C77, C78, C79, C80, C81, C82, C83, C84, C85, C86, C87, C88, C89, C90, C91, C92, C93, C94, C95, C96, C97, C98, C99, C100.

Bars in above units to be billed and tagged separately. Dimensions are given along \pm of bars and are for computed lengths.

294

Drawn April 1930 By ACU
Traced April 1930 By H.V.H.
Checked April 1930 By G.T.N.

BRIDGE OVER ST. FRANCIS RIVER

STATE ROAD FROM GREENFIELD TO TASKEE
ABOUT 10 MILES NORTH OF TASKEE
PROJECT NO. U.S.R. 67-S15A STA. 385+10.86

WAYNE COUNTY

SUBMITTED BY *W. P. Baker* DATE *7/10/30*
APPROVED BY *T. H. Carter* DATE *7/10/30*
BRIDGE ENGINEER CHIEF ENGINEER

STD.G-6535
STD.G-6540
STD.G-6545
STD.G-6550
STD. S-818
J-21

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

SEC/SUR 13 TWP 28N RGE 5E



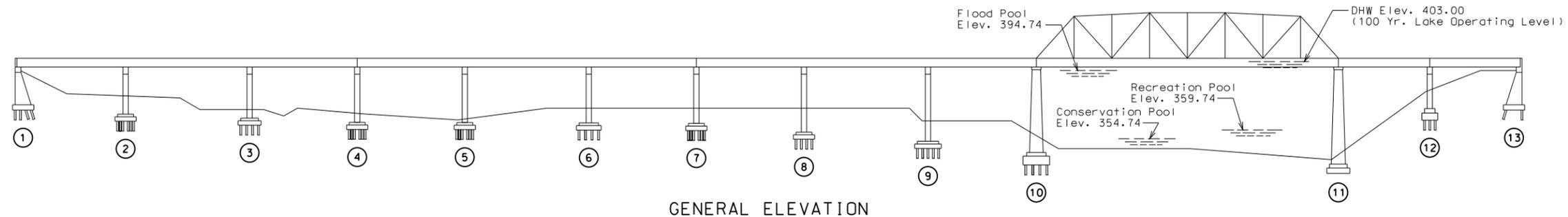
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DATE PREPARED 2/22/2011

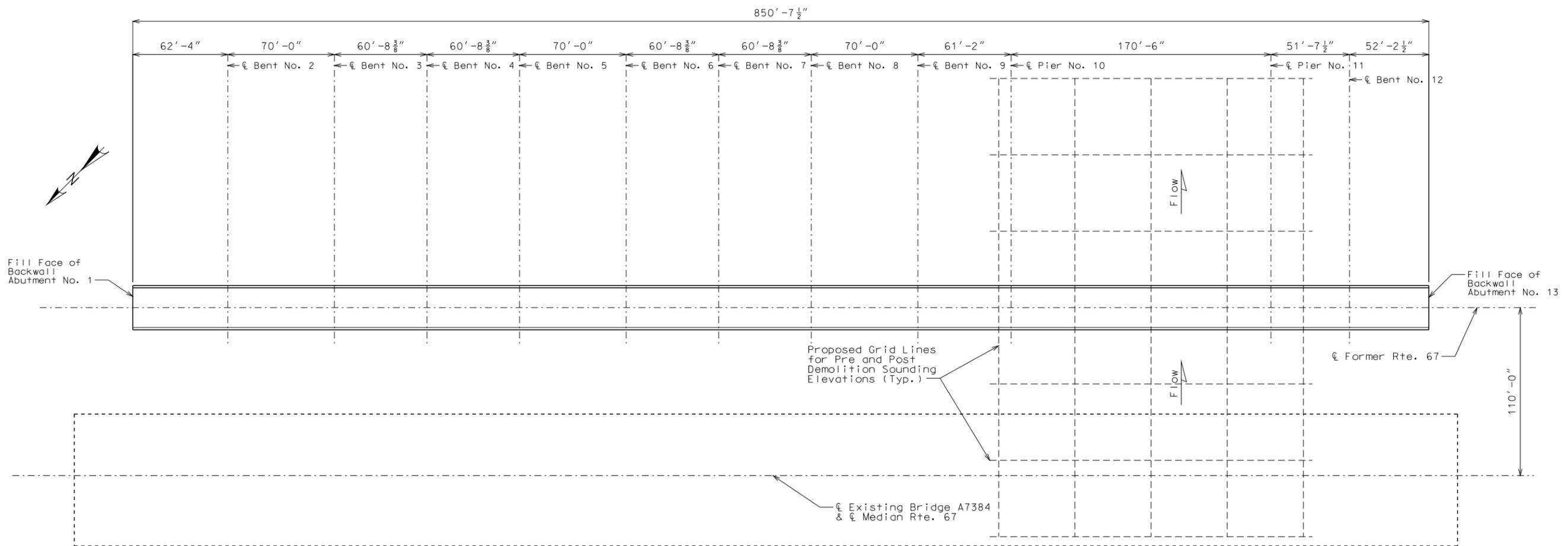
ROUTE 67 STATE MO
DISTRICT BR SHEET NO. 1

COUNTY WAYNE
JOB NO. JOPO931F
CONTRACT ID.

PROJECT NO.
BRIDGE NO. J0021R



GENERAL ELEVATION



PLAN

Estimated Quantities		
Item		Total
Removal of Bridges (J0021R)	lump sum	1

DEMOLITION PLAN FOR FORMER ROUTE 67
BRIDGE J0021R OVER WAPPAPELLO LAKE (ST. FRANCIS RIVER)
WAYNE COUNTY, MISSOURI

DEMOLITION PLAN FOR
BRIDGE OVER WAPPAPELLO LAKE
(ST. FRANCIS RIVER)

STATE ROAD FROM RTE 34 TO RTE 60
NEAR GREENVILLE
STA. 386+16.00±

Detailed May 2010
Checked May 2010

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 1

DESCRIPTION

DATE

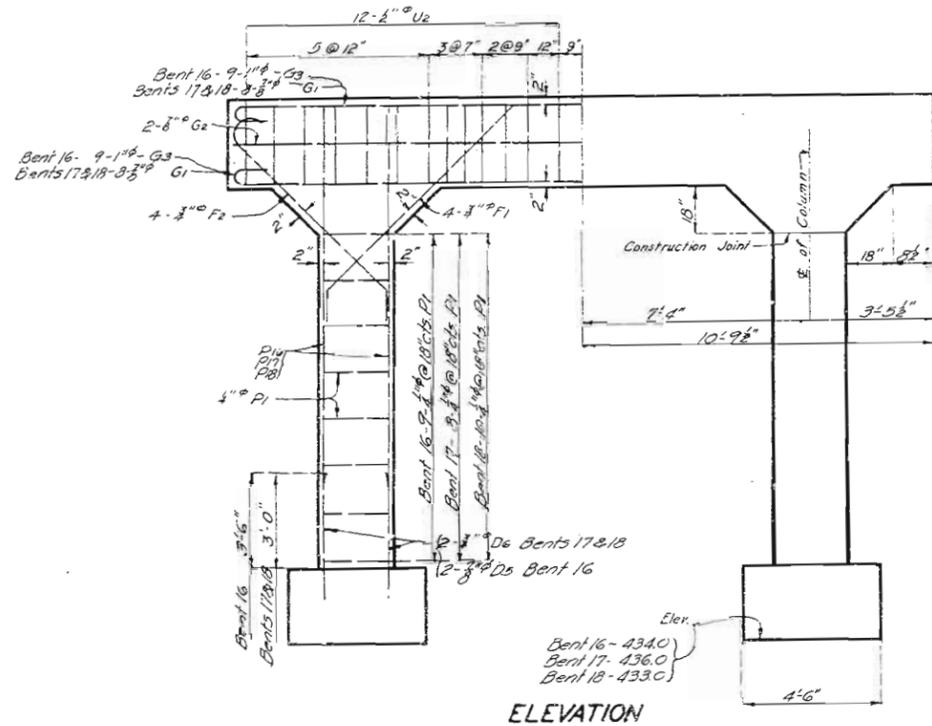
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

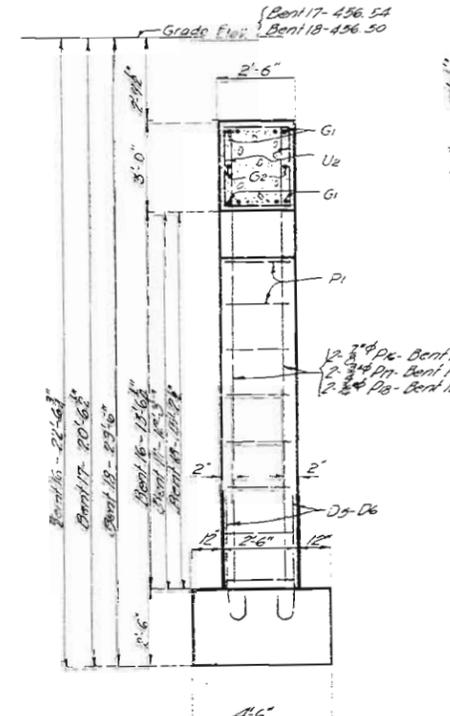
IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

MISSOURI STATE HIGHWAY DEPARTMENT

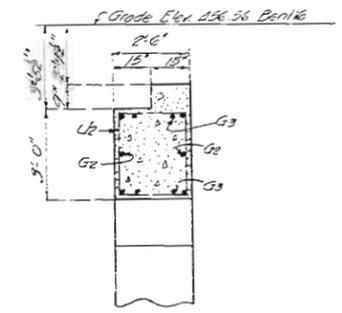
NO.	STATE	APP. AC.	FEED. ROAD	SHEET NO.	TOTAL SHEETS
5	MO.	1597	S-19		



ELEVATION

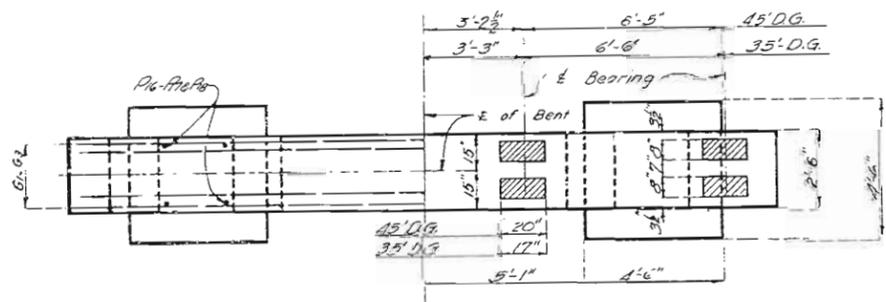


SECTION AT & BENTS NOS. 17 & 18



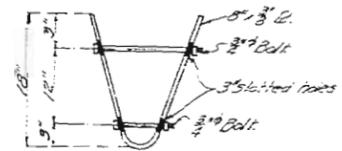
DETAIL OF BEAM FOR BENT NO. 16

Note: Details below beam for bents 16-17 & 18 are similar.



PLAN

DETAILS OF INTERMEDIATE BENTS NOS. 16-17 & 18



METAL SHOES FOR TIMBER PILES
Payment for shoes to be made in accordance with specifications.

BRIDGE OVER ST. FRANCIS RIVER

STATE ROAD FROM GREENFIELD TO TASKEE
ABOUT 10 MILES NORTH OF TASKEE
PROJECT NO. U.S.R. 67-SISA STA. 385+10.66

WAYNE COUNTY
DESIGNED BY: [Signature]
CHECKED BY: [Signature]

STD. C-653.
STD. C-654C
STD. C-654E
STD. S-818
STD. C-655D
J-21

Note: This drawing is not to show
found dimensions.

DATE: 4-1-18 FINISHED

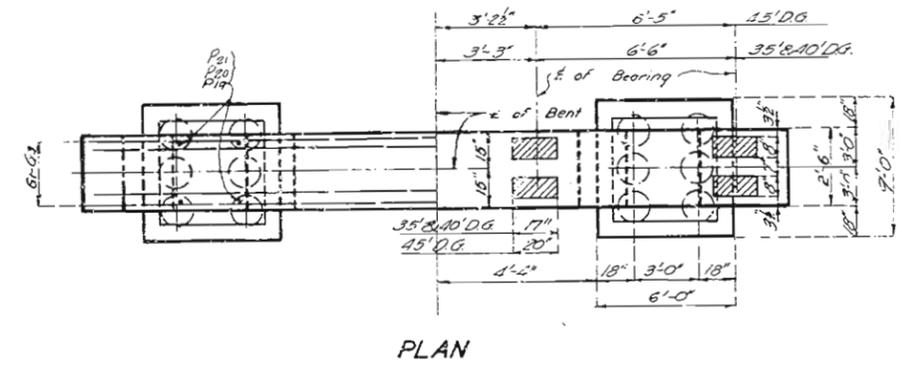
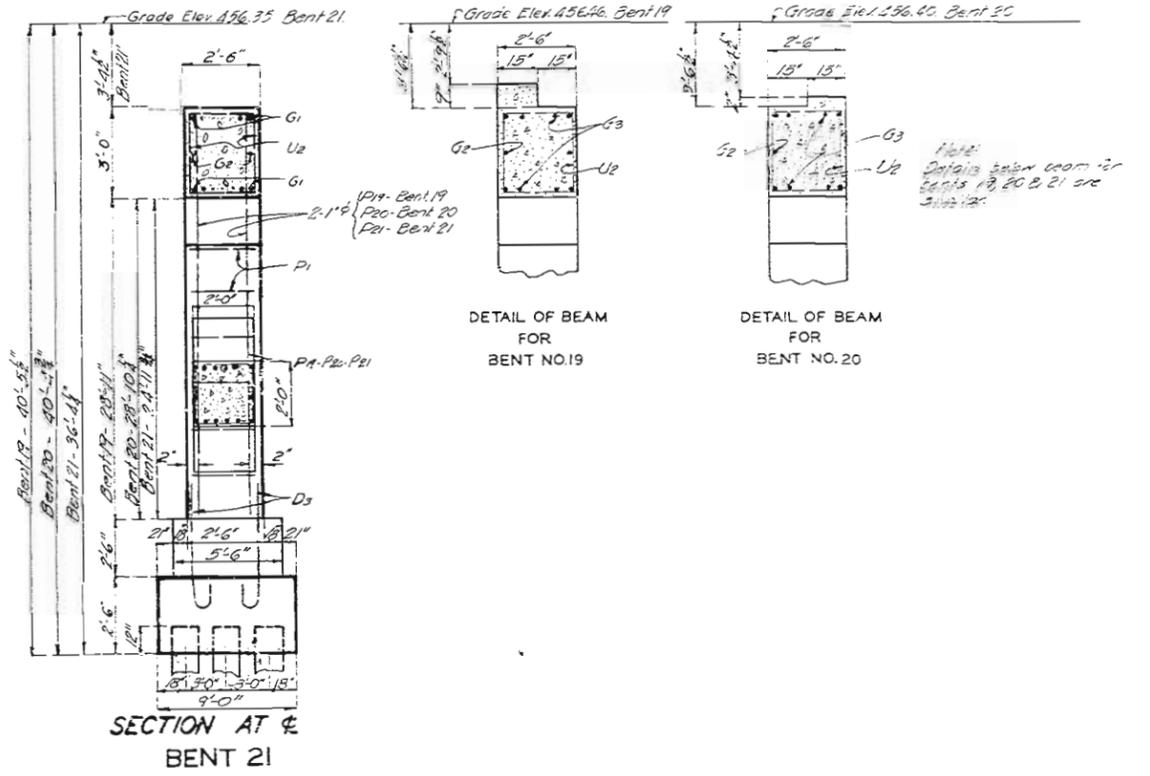
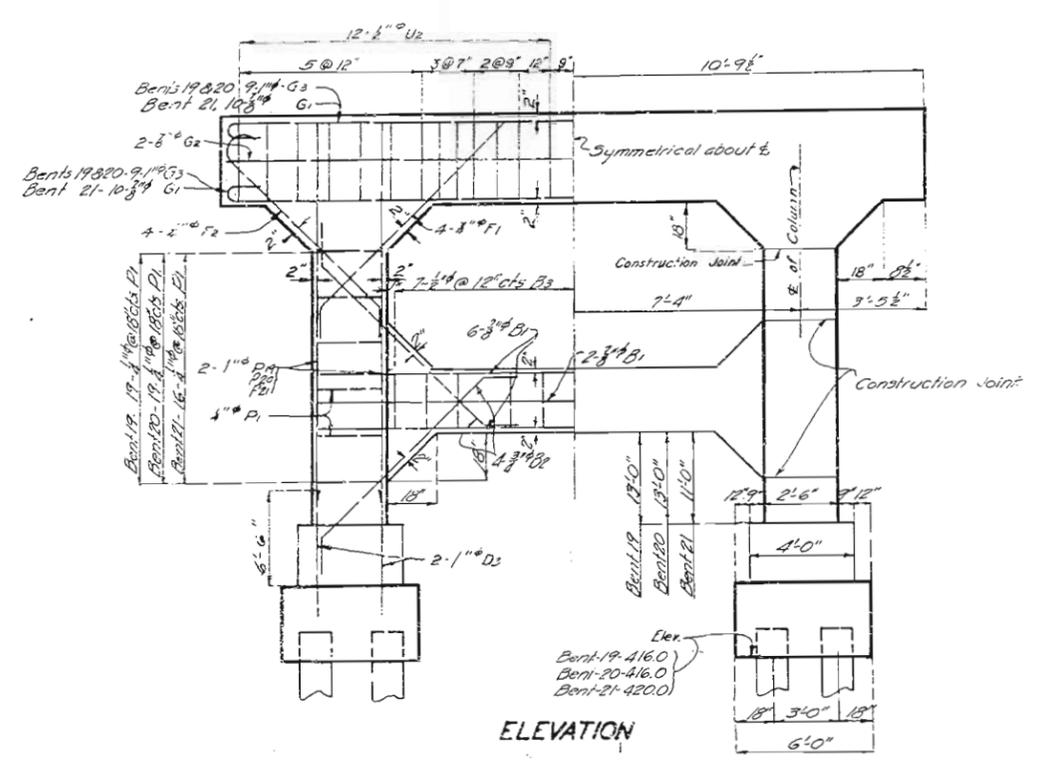
EQUAL SPAN BEAM GIRDERS INTERMEDIATE BENTS

296

Drawn for 1930 by A.O.U.
Checked for 1930 by G.T.K.

MISSOURI STATE HIGHWAY DEPARTMENT

No. 5	STAGE	NO. 40	DATE	SHEET	TOTAL
5	MO.	10/25/30	19		



DETAILS OF INTERMEDIATE BENTS NOS. 19-20&21

BRIDGE OVER ST. FRANCIS RIVER

STATE ROAD FROM GREENFIELD TO TASKEE
ABOUT 10 MILES NORTH OF TASKEE
PROJECT NO. U.S.R. 67-S15A STA. 365+12.86

WAYNE COUNTY
SUBMITTED BY *W. B. Clark* DESIGN ENGINEER

APPROVED BY *W. H. Miller* DIST. ENGINEER

STD.C-6533
STD.C-6540
STD.C-6545
SFS 58 1/2
SFS 60 5/8
J-21

Note: This drawing is not to scale.
Please dimension.

SCALE = 1/4" = 1'-0"

EQUAL SPAN BECK GIRDERS - INTERMEDIATE BENTS

298

Drawn Mar. 1930 by ROU
Checked Apr. 1930 by G. J. K.

MISSOURI STATE HIGHWAY DEPARTMENT

MO. ROAD DIST. NO.	STATE ROAD NO.	FED. AID PROJ. NO.	YEAR	SHEET NO.	TOTAL SHEETS
5	MO. USA 55A	19		?	

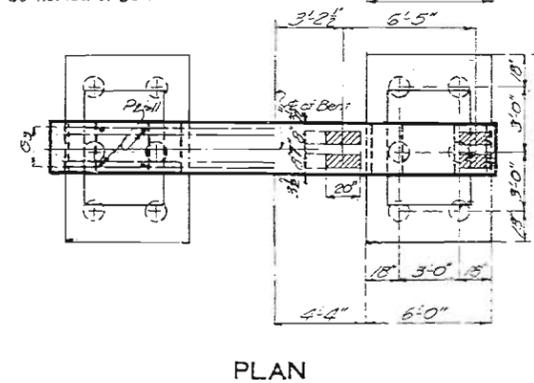
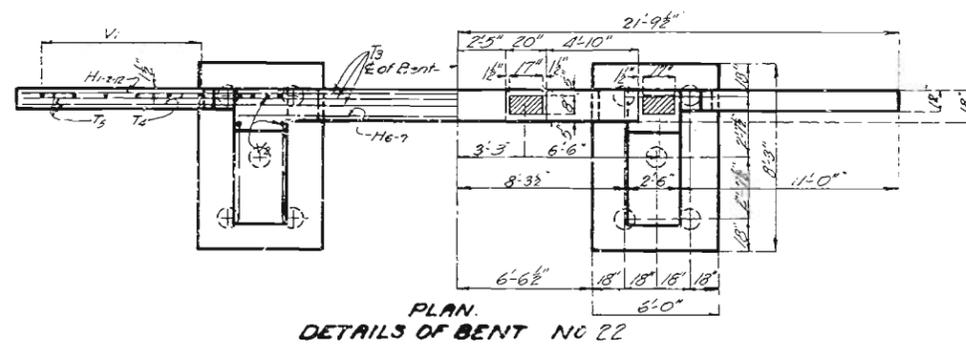
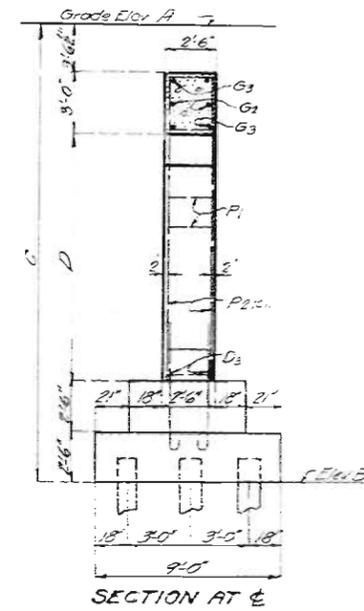
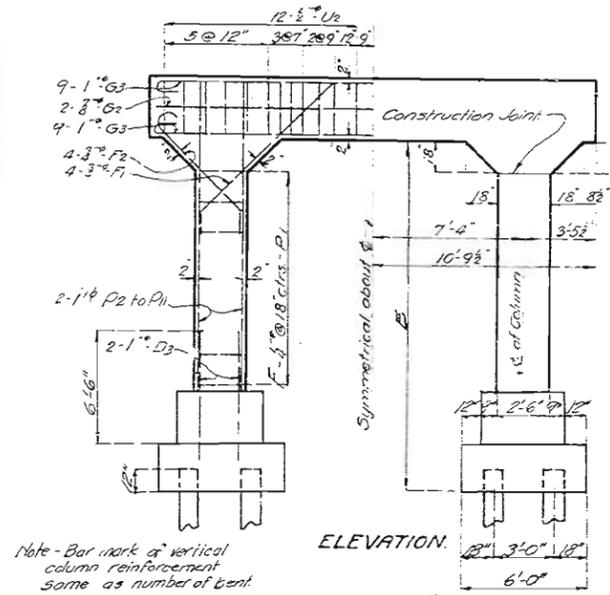
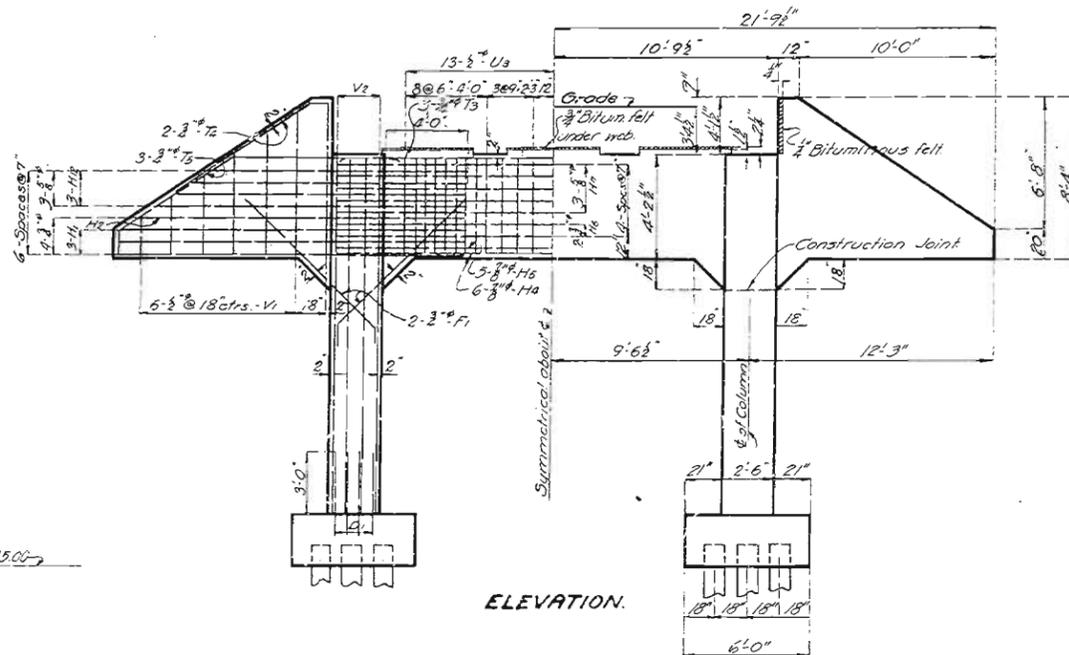
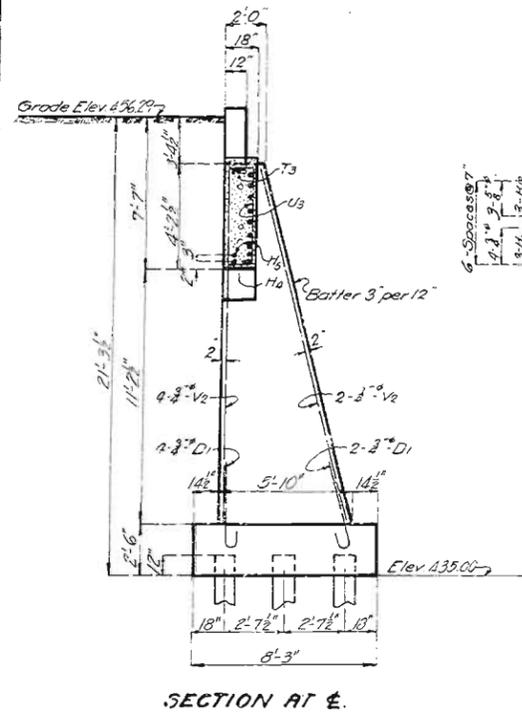


TABLE OF DIMENSIONS BENTS NO. 2 TO 11

Bent	A	B	C	D	E	F
2	455.66	435.00	20'-8"	9'-1 1/2"	14'-1 1/2"	6
3	455.79	435.00	20'-9 1/2"	9'-3"	14'-3"	6
4	455.90	435.00	20'-10 3/4"	9'-4 1/2"	14'-4 1/2"	6
5	456.02	430.00	26'-0 1/2"	14'-5 1/2"	19'-5 1/2"	9
6	456.12	430.00	26'-1 1/2"	14'-7"	19'-7"	9
7	456.21	430.00	26'-2 1/2"	14'-8"	19'-8"	9
8	456.29	430.00	26'-3 1/2"	14'-9"	19'-9"	9
9	456.35	423.00	33'-4 1/2"	21'-9 1/2"	26'-9 1/2"	14
10	456.42	423.00	33'-5"	21'-10 1/2"	26'-10 1/2"	14
11	456.48	418.00	38'-5 1/2"	26'-14"	31'-11 1/2"	17

BRIDGE OVER ST. FRANCIS RIVER
 STATE ROAD FROM GREENFIELD TO TASKEE
 ABOUT 10 MILES NORTH OF TASKEE
 PROJECT NO. U.S.R. 67-SISASTA. 385+10.85

WAYNE COUNTY

Submitted by *[Signature]* Date *[Date]*
 Approved by *[Signature]* Date *[Date]*

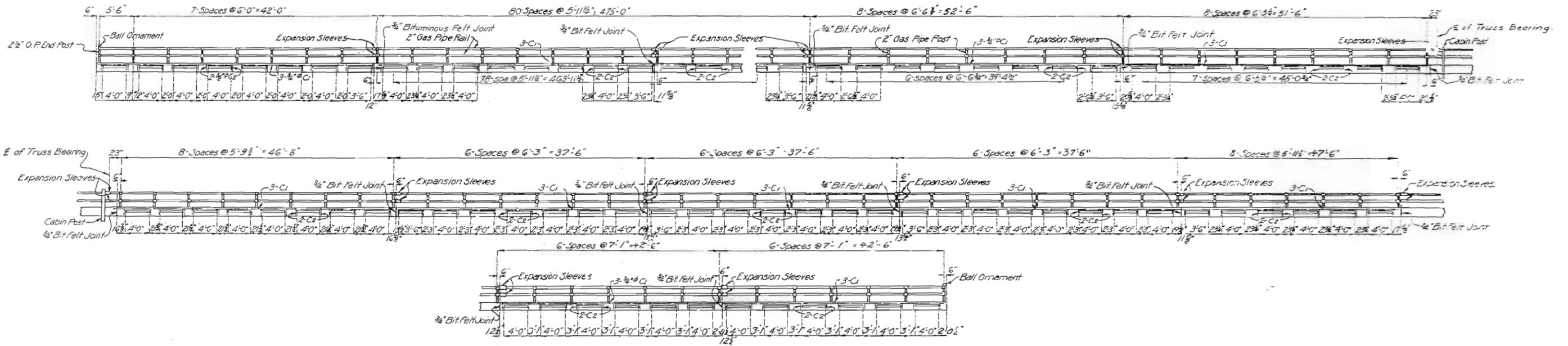
STD.C-6535
STD.C-6540
STD.C-6545
STD.C-6550
STD.S-818
J-21

Assembled Mar. 1930 By A.C.U.
 Checked April 1930 By G.F.K.
 Drawn Feb. 1925 By J.T.
 Checked April 1925 By W.L.O.

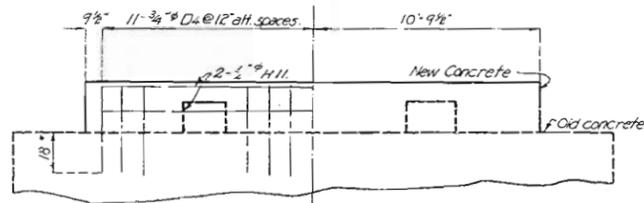
682

MISSOURI STATE HIGHWAY DEPARTMENT

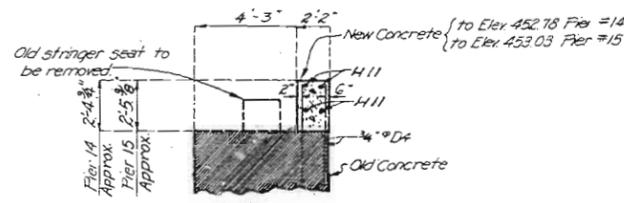
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	USP67-508	19		



DETAIL OF CURB AND HANDRAIL

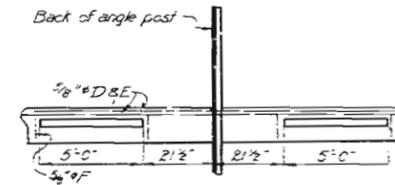


ELEVATION



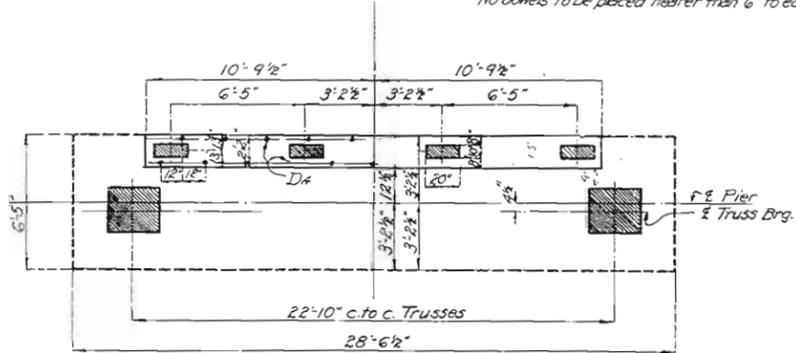
SECTION AT \mathcal{C}

Note: Top of Pier #14 to be bush hammered to allow 1" grout under old casting.



ELEVATION OF RAIL POST AND OUTLET - SPAN 14-15

Note: Old concrete surfaces to receive new concrete shall be roughened by bush hammering, and then painted with cement wash. Bars D4 to be doweled 15" into old concrete. Holes to be drilled to full depth, filled with cement mortar grout and bars driven in. Old stringer seats to be removed. No dowels to be placed nearer than 6" to edge of old concrete.



PLAN

DETAILS OF PIERS 14 & 15

BRIDGE OVER ST. FRANCIS RIVER

STATE ROAD FROM GREENFIELD TO TASKEE
ABOUT 10 MILES NORTH OF TASKEE
PROJECT NO. U.S.R. 67-515A STA. 385+10.86.

WAYNE COUNTY

DATE: 6/16/37
BRIDGE ENGINEER: [Signature]
DATE: [Signature]
THEY ENGINEER: [Signature]

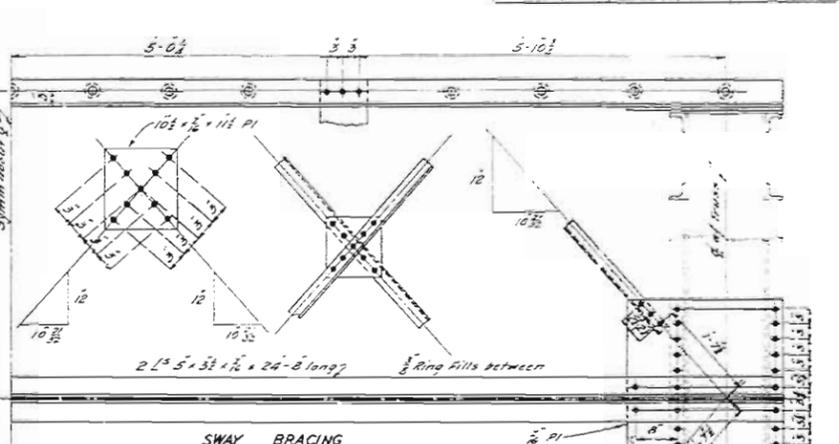
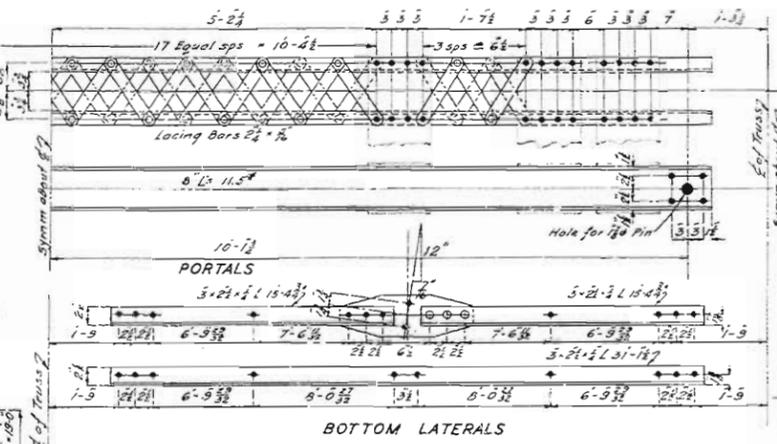
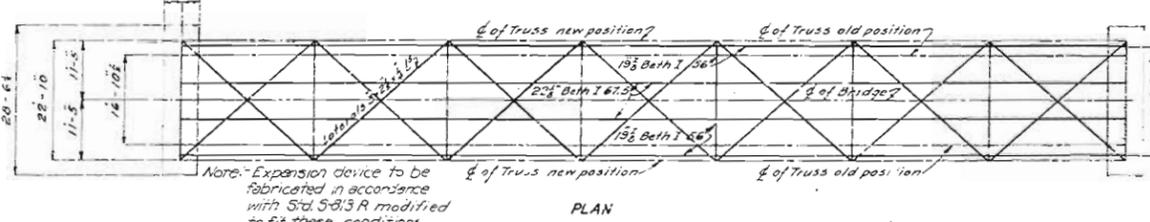
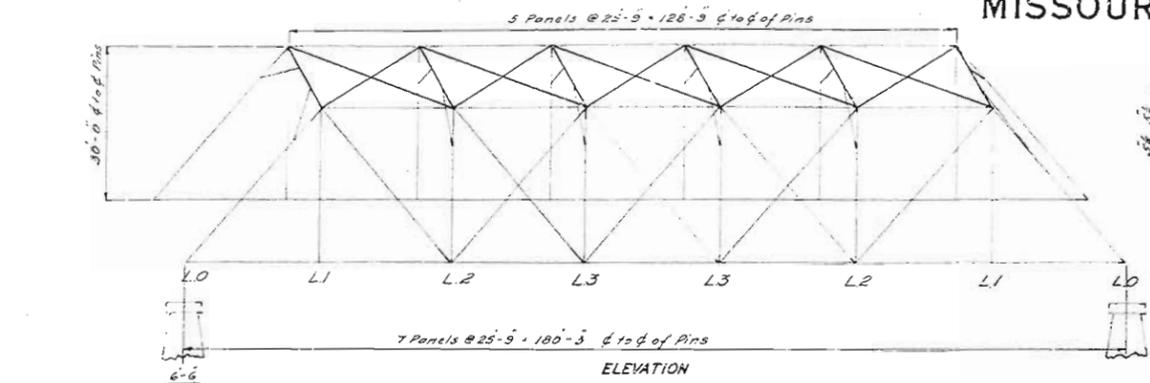
STD.C-6535
STD.C-6540
STD.C-6545
STD.C-6550
STD.S-816
J-21

300

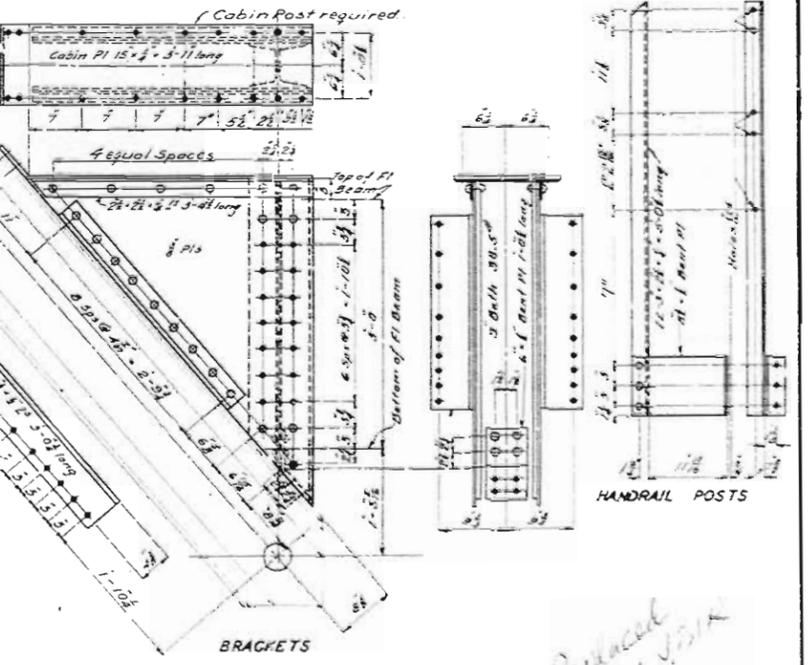
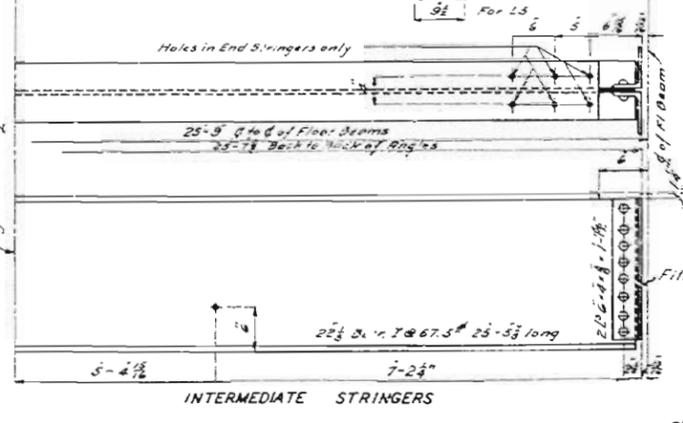
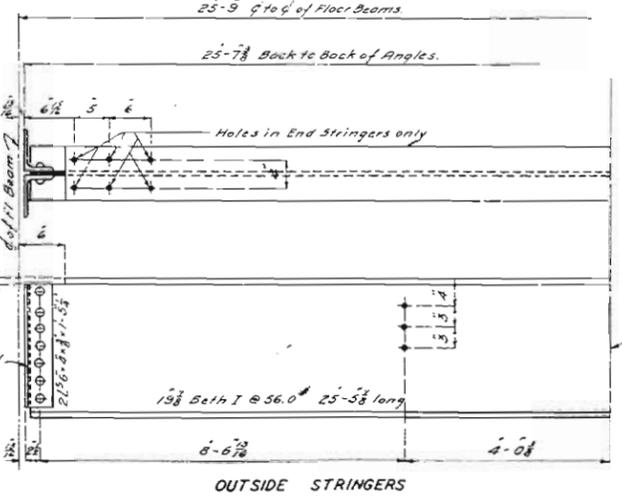
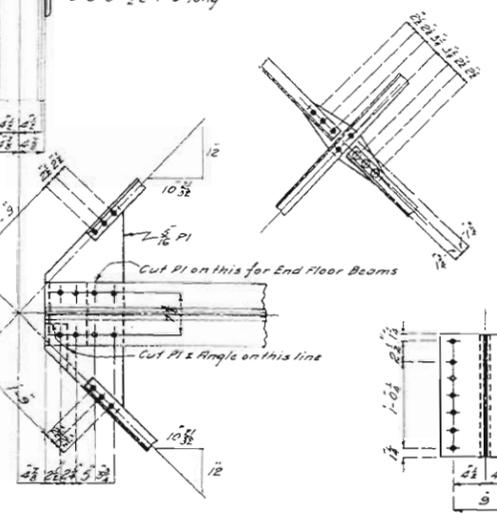
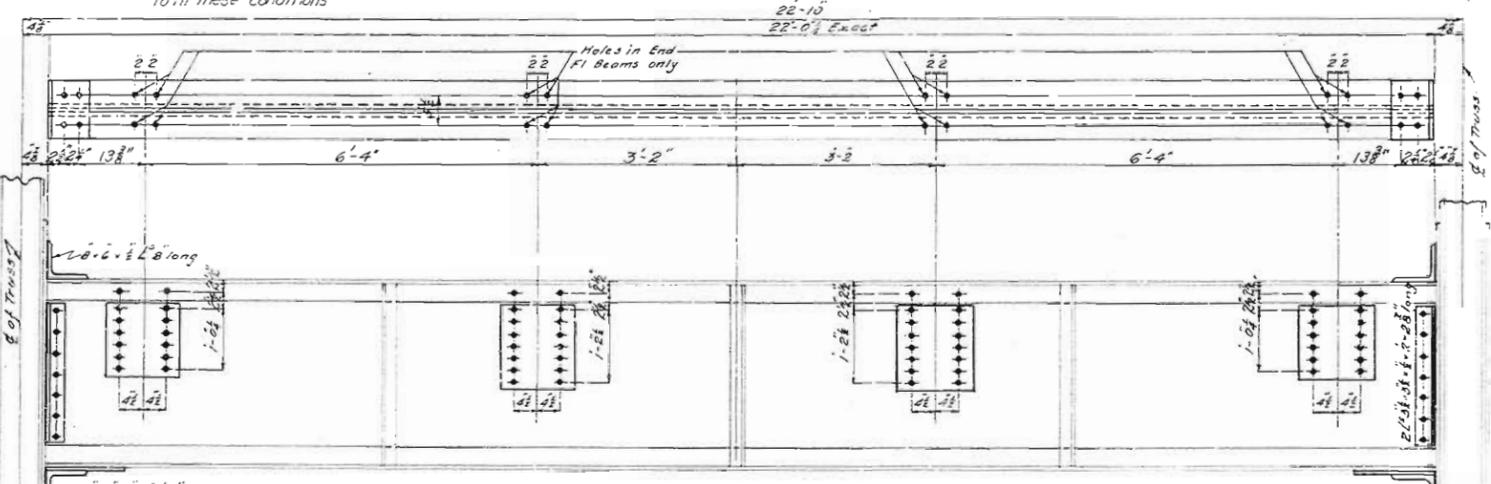
Drawn Nov. 1929 By A.O.U.
Traced Nov. 1929 By H.W.H.
Checked Apr. 1930 By C.C.F.

MISSOURI STATE HIGHWAY DEPARTMENT

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
3	MO.	USR 67-5154	19		



Note: For details of slab expansion device over Pier 4 see Mo. Highway Dept. Std. S 813 R. For details of device over pier 5 see Std. S 817.



BRIDGE OVER ST FRANCIS RIVER

STATE ROAD FROM GREENFIELD TO TASKEE
ABOUT 10 MILES NORTH OF TASKEE
PROJECT NO. USR 67-5154 STA 385+00SS

WAYNE COUNTY
SUBMITTED BY: *W. R. ...*
APPROVED BY: *W. R. ...*

STD. C-3535
STD. C-6540
STD. C-6545
STD. C-6550
STD. S-813
J-21

Drawn April, 1930 By, C.F.B.
Traced April, 1930 By, H.W.H.
Checked April, 1930 By, A.F.K.

302

Replaced as per

BRIDGE OVER ST. FRANCIS RIVER
 NEAR GREENVILLE, MISSOURI
 U. S. ROUTE 67-S15B STA. 386 + 16
 WAYNE COUNTY
 1940

LIST OF DRAWINGS

- I. GENERAL PLAN AND ELEVATION
2. DETAILS OF ABUTMENTS
3. DETAILS OF BENTS 2 - 9 INCL.
4. DETAILS OF PIERS 10 & 11
5. DETAILS OF BENT 12 AND ANCHOR BOLT PLAN
6. DETAILS OF I-BEAM SPANS
7. DETAILS OF I-BEAM SPANS
8. DETAILS OF TRUSSES - 170' SPAN
9. CROSS SECTIONS & MISC. DETAILS - 170' SPAN
10. DETAILS OF ROADWAY SLAB
- II. BAR LIST

DESIGNED BY
 SVERDRUP AND PARCEL
 CONSULTING ENGINEERS
 ST. LOUIS, MO.

APPROVED

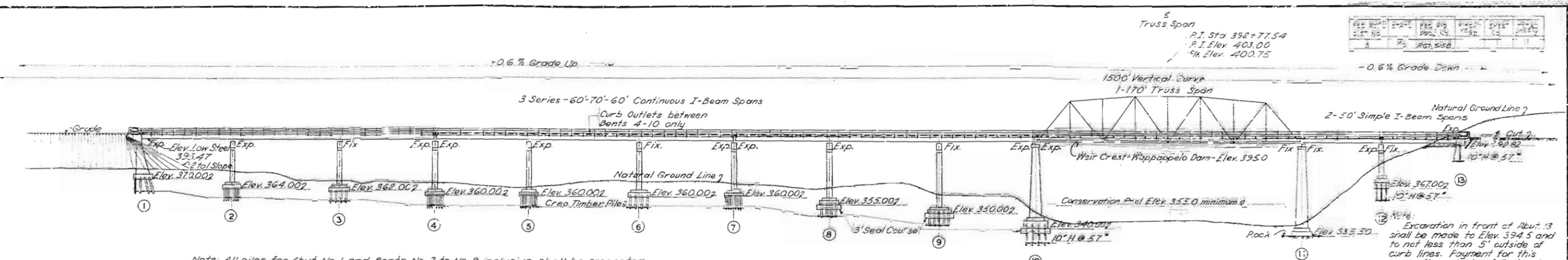
----- DATE -----
 LT. COL. CORPS OF ENGINEERS
 DISTRICT ENGINEER

W. B. ... DATE *11.1.40*
 BRIDGE ENGINEER
 MO. STATE HIGHWAY DEPARTMENT

W. ... DATE *11.1.40*
 CHIEF ENGINEER
 MO. STATE HIGHWAY DEPARTMENT

205

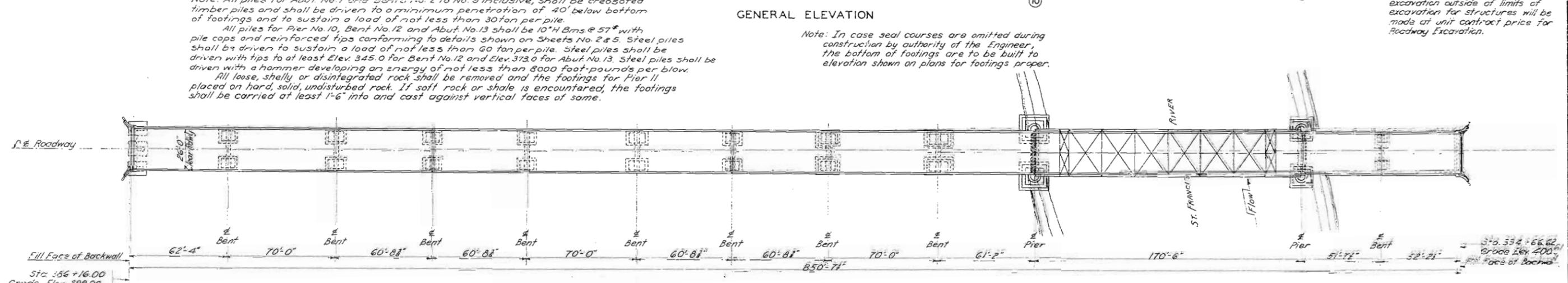
REV. NO.	DATE	REV. NO.	DATE	REV. NO.	DATE
1		2		3	



Note: All piles for Abut. No. 1 and Bents No. 2 to No. 9 inclusive, shall be creosoted timber piles and shall be driven to a minimum penetration of 40' below bottom of footings and to sustain a load of not less than 30 tons per pile.

All piles for Pier No. 10, Bent No. 12 and Abut. No. 13 shall be 10" H Bms @ 57" with pile caps and reinforced tips conforming to details shown on Sheets No. 2 & 5. Steel piles shall be driven to sustain a load of not less than 60 tons per pile. Steel piles shall be driven with tips to at least Elev. 345.0 for Bent No. 12 and Elev. 373.0 for Abut. No. 13. Steel piles shall be driven with a hammer developing an energy of not less than 8000 foot-pounds per blow.

All loose, shelly or disintegrated rock shall be removed and the footings for Pier II placed on hard, solid, undisturbed rock. If soft rock or shale is encountered, the footings shall be carried at least 1'-6" into and cast against vertical faces of same.



GENERAL NOTES

Design Specifications A.R.S.H.O. - 1935 edition
 Loading H-15 A.R.S.H.O.
 Structural Steel Stress 18,000 psi
 Reinforcing Steel Stress 10,000 psi
 Concrete Class "B" 900 psi
 All concrete shall be Class "B"

Qualification of all welding operators and electrodes will be required in accordance with Specifications, except that a proper certification of electrodes previously qualified will be acceptable.

Rivets 2" except as noted. All field connections riveted except as noted.

Paint: Shop, one coat of red lead. Field, surfaces inaccessible after erection two coats of red lead. All exposed surfaces, one coat brown and final coat aluminum. Payment for cleaning and painting will be included in unit price bid for material painted.

Excavation for the structure shall be in accordance with the Standard and Supplemental Specifications, except that the maximum horizontal limits of excavation paid for will be based upon the footings proper and not upon the seal courses under them. Quantities will be computed from Water Elevation 355.0 where existing ground line is below this elevation.

All rubber compound shall be gray in color.

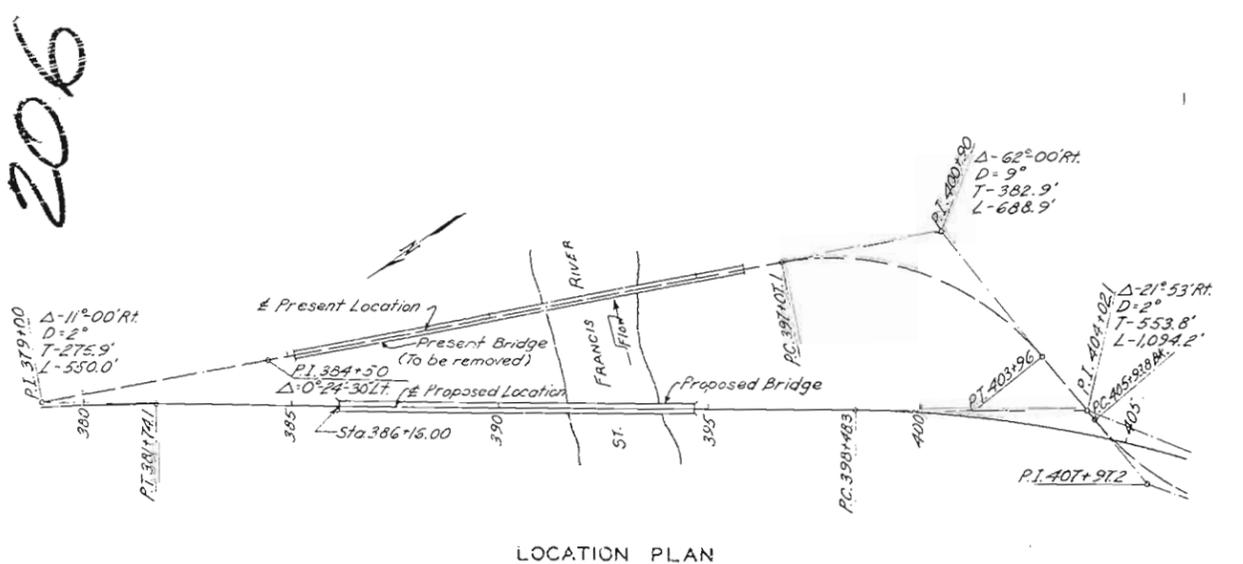
Item	Quantity	Unit	Estimated	Contract
Class 1 Excavation for Structures	Cu. Yds.	1380	1345	
Class 2 Excavation for Structures	Cu. Yds.	970	970	
Class B Concrete	Cu. Yds.	1149.6	687.0	546.6
Class B Concrete in Seal Courses	Cu. Yds.	160.0		160.0
Fabricated Structural Steel (Truss Span)	Lbs.	298,000	299,000	
Fabricated Structural Steel (Beam Spans)	Lbs.	630	360,000	360,630
Steel Castings	Lbs.	1830	1830	
Reinforcing Steel	Lbs.	33,480	17,320	21,600
Creosoted Timber Piles 12" Dia	Lbs.	8540		8540
Steel Piles in Place	Lbs.	1695		1695
Fabricated Wrought Iron	Lbs.	45	1000	1000
8" Corrugated Metal Pipe	Lbs.	45		45
Gray Iron Alloy Castings	Lbs.	1,600		1,600

Note: Excavation for bridge made above Elev. 355.0 will be paid for as Class 1 Excavation for Structures.

Excavation for bridge made below Elev. 355.0 will be paid for as Class 2 Excavation for Structures.

The 8" B on steel piles at Abut. 13 will be paid for at the unit price bid for Fabricated Structural Steel (I-Beam Spans)

B.M. 2 A.P. (U.S.C. & G.S. B.M.-M.58) Elev. 382.67. Bridge 200 ft in N. End St. Francis River Bridge J-2, 90 L. Sta. 365+00 M. & L. 14-1-1940.



BRIDGE OVER ST. FRANCIS RIVER
 NEAR GREENVILLE, MISSOURI
 U.S. ROUTE 67-588 STA. 366+16
 WAYNE COUNTY

GENERAL PLAN AND ELEVATION

OVERBURY AND CARREL
 CONSULTING ENGINEERS
 ST. LOUIS, MO.
 SHEET NO. 1

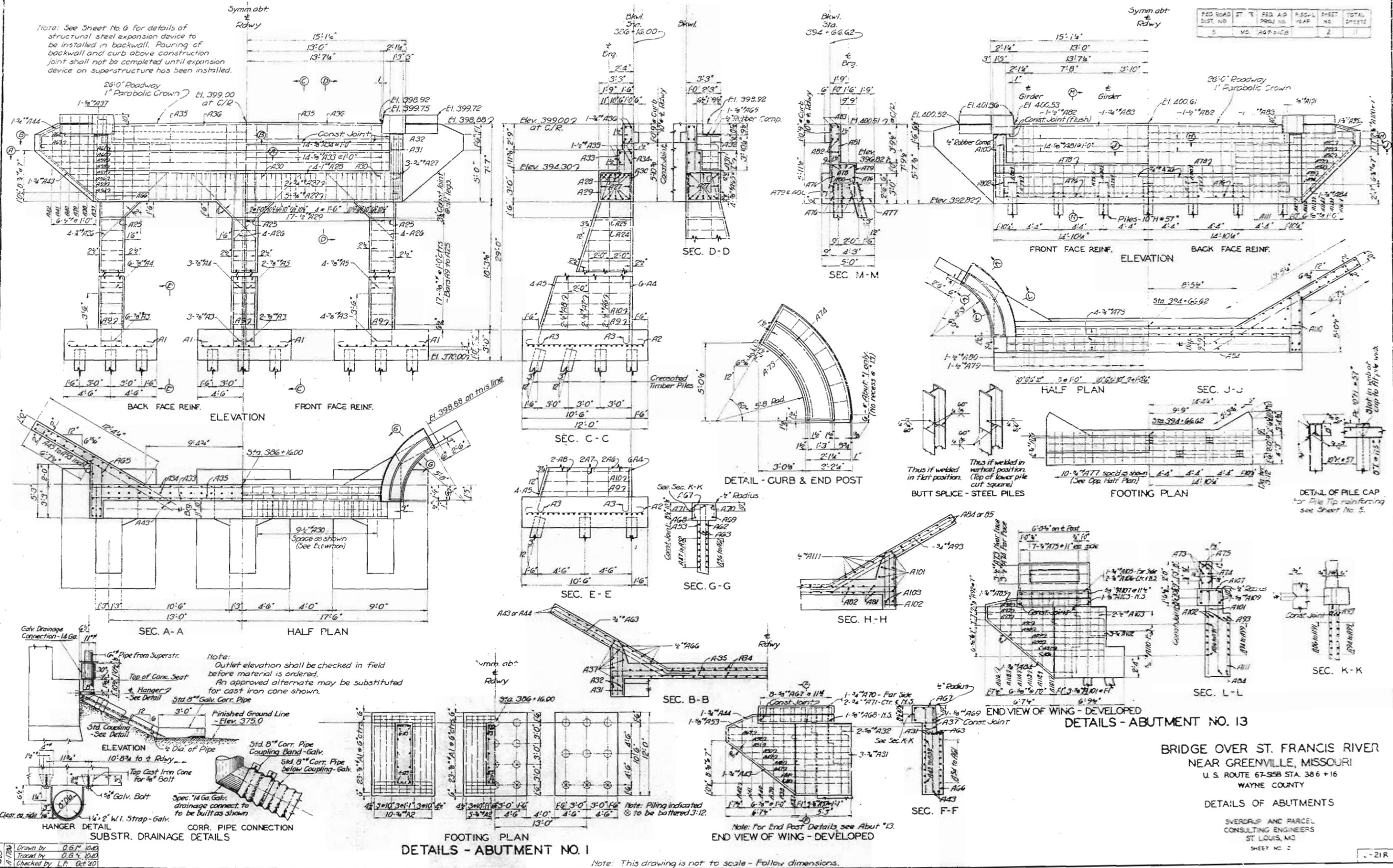
206

Drawn By L.E. Oct. 1940
 Traced By L.E. Oct. 1940
 Checked By L.F. Oct. 1940

This drawing is not to scale. Follow dimensions.

FED. ROAD DIST. NO.	ST. NO.	FED. AID PROJ. NO.	F.S.G.L. YEAR	SHEET NO.	TOTAL SHEETS
5	MO. 386+16.0			2	11

Note: See Sheet No. 6 for details of structural steel expansion device to be installed in backwall. Pouring of backwall and curb above construction joint shall not be completed until expansion device on superstructure has been installed.



207

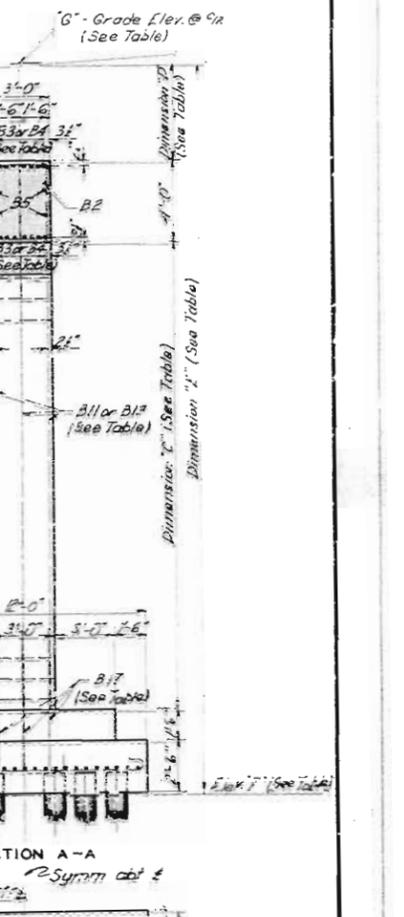
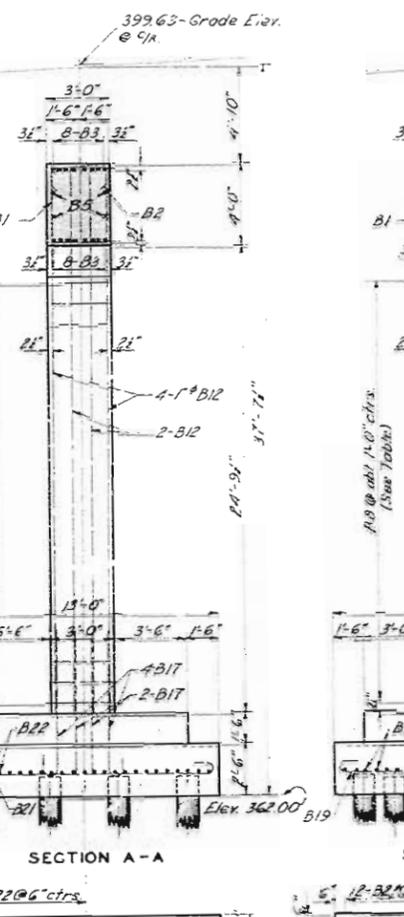
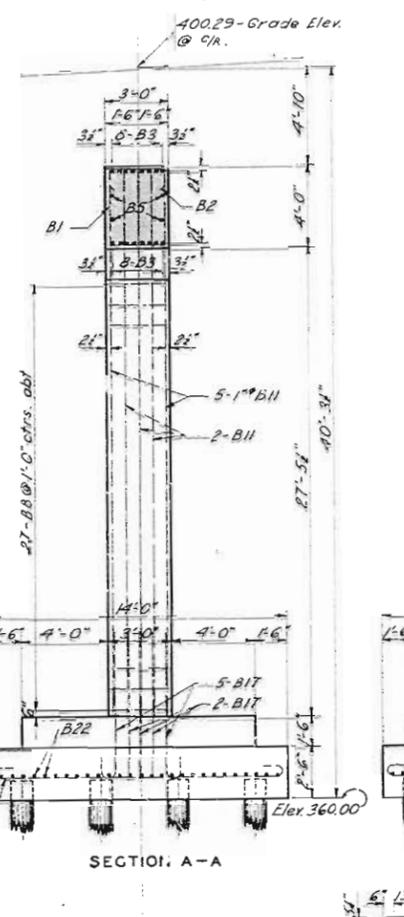
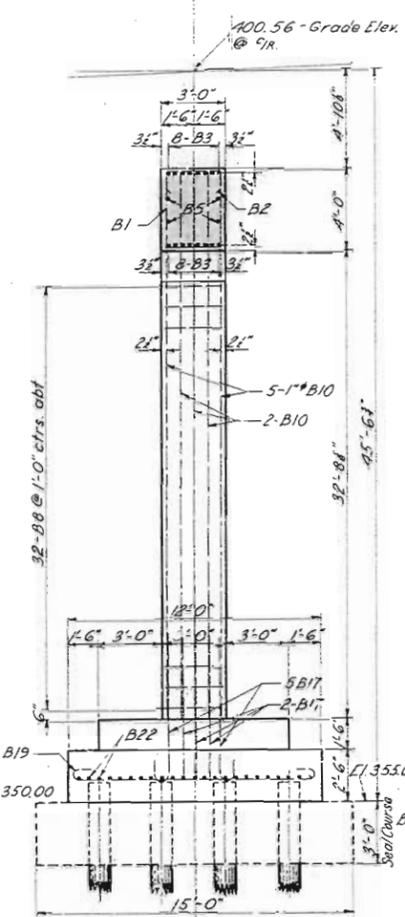
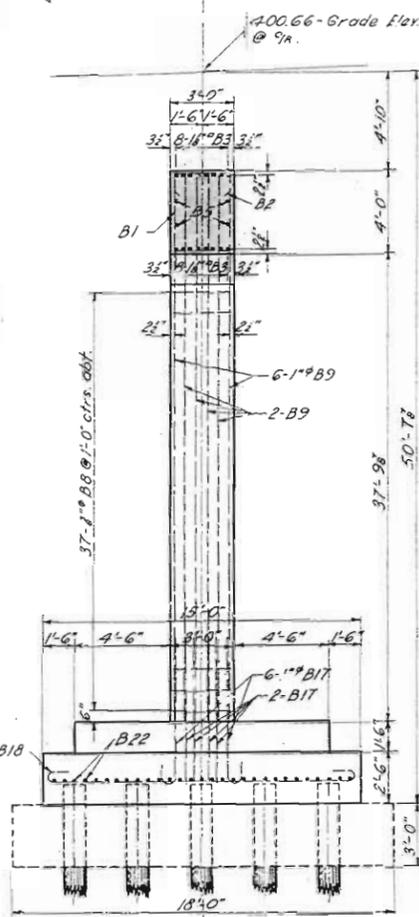
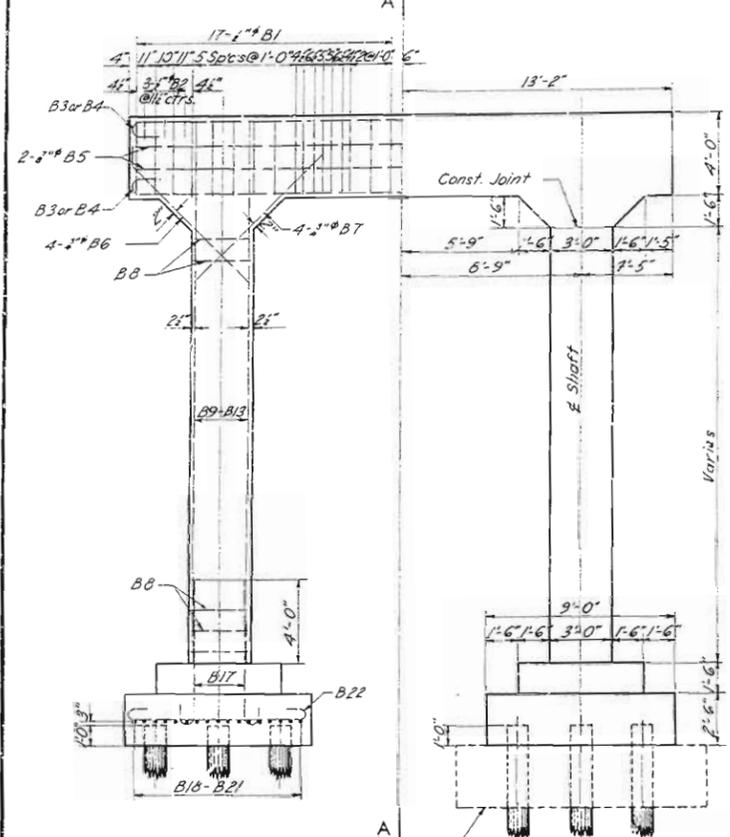
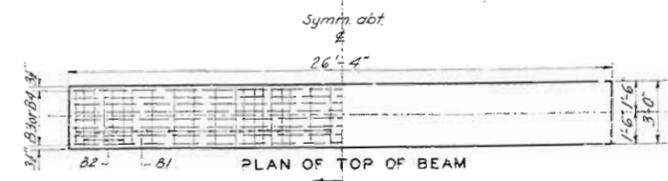
BRIDGE OVER ST. FRANCIS RIVER
NEAR GREENVILLE, MISSOURI
U.S. ROUTE 67-558 STA. 386+16
WAYNE COUNTY

DETAILS OF ABUTMENTS
SVERDRUP AND PARCEL
CONSULTING ENGINEERS
ST. LOUIS, MO.
SHEET NO. 2

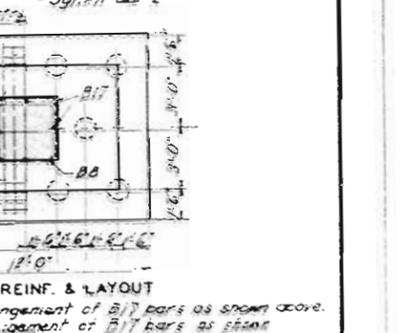
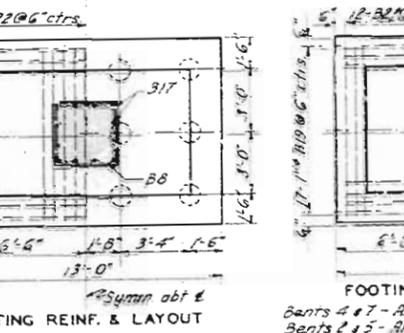
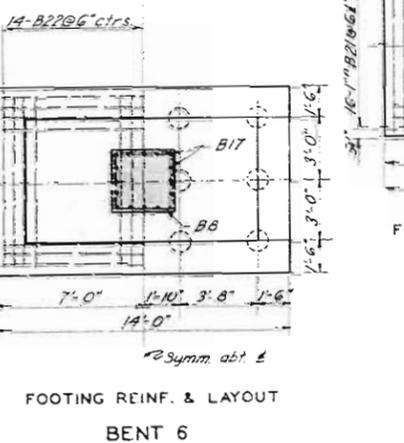
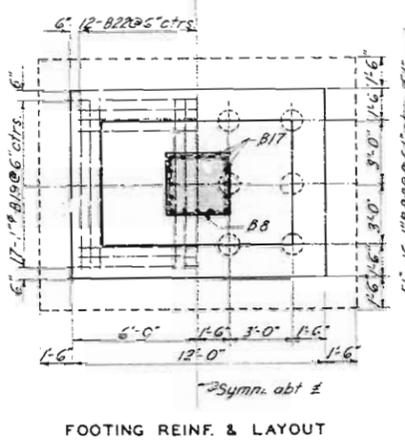
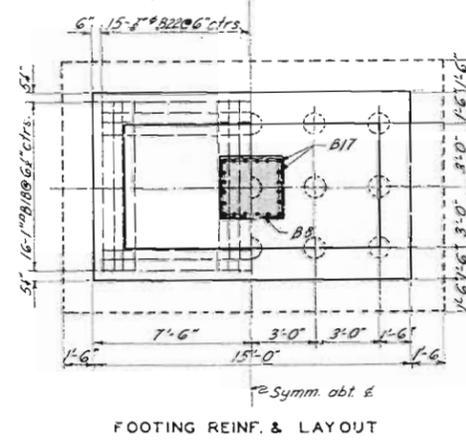
Drawn by O.G. 10/40
Traced by O.G. 10/40
Checked by L.F. 10/40

Note: This drawing is not to scale - Follow dimensions.

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	207-9150		5	11



Bent No.	Elevations	Dimensions	Number of Reinf. Bars per Bent							
	"G"	"F"	"D"	"E"	6" B3	4" B4	3" B5	2" B11	1" B13	1" B17
2	399.31	364.00	22'-5"	4'-10"	35'-3"	16	44	24	24	24
4	399.87	360.00	27'-8"	4'-8"	39'-10"	15	52	16	16	16
5	400.08	360.00	7'-2"	4'-10"	40'-1"	16	52	24	24	24
7	400.43	360.00	7'-8"	4'-8"	40'-5"	16	54	16	16	16



DETAILS OF BENTS 2 - 9 INCLUSIVE

BRIDGE OVER ST. FRANCIS RIVER
NEAR GREENVILLE, MISSOURI
U. S. ROUTE 67-556 STA. 386 + 16
WAYNE COUNTY
DETAILS OF BENTS 2 - 9 INCL.

STEEPLE AND RANGE
CONSULTING ENGINEERS
ST. LOUIS, MO.
SHEET NO. 3

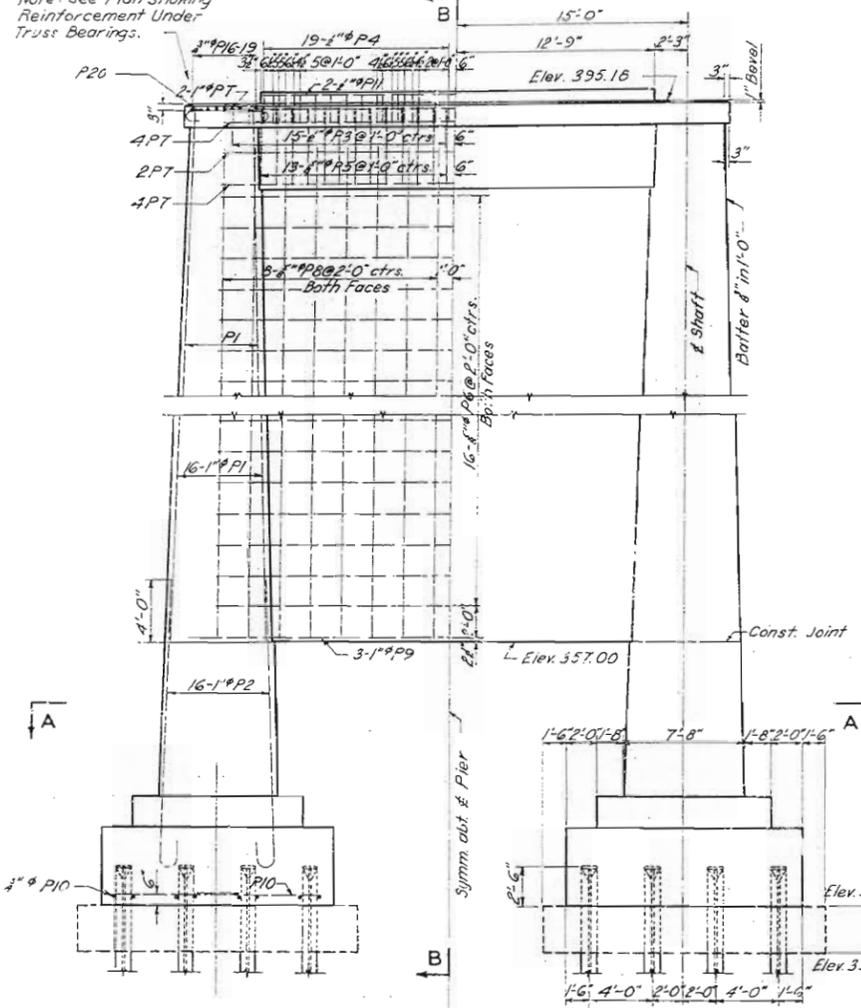
This drawing is not to scale. Follow dimensions.

208

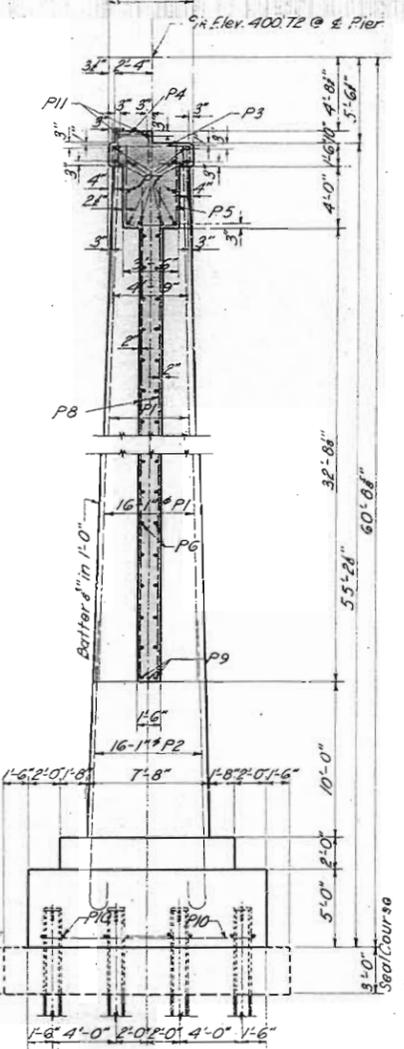
Drawn By L.E.B. Oct. 1940
Checked By L.E.B. Oct. 1940
Checked By L.F. Oct. 1940

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	RET. 3450		4	11

Note: See Plan Showing Reinforcement Under Truss Bearings.

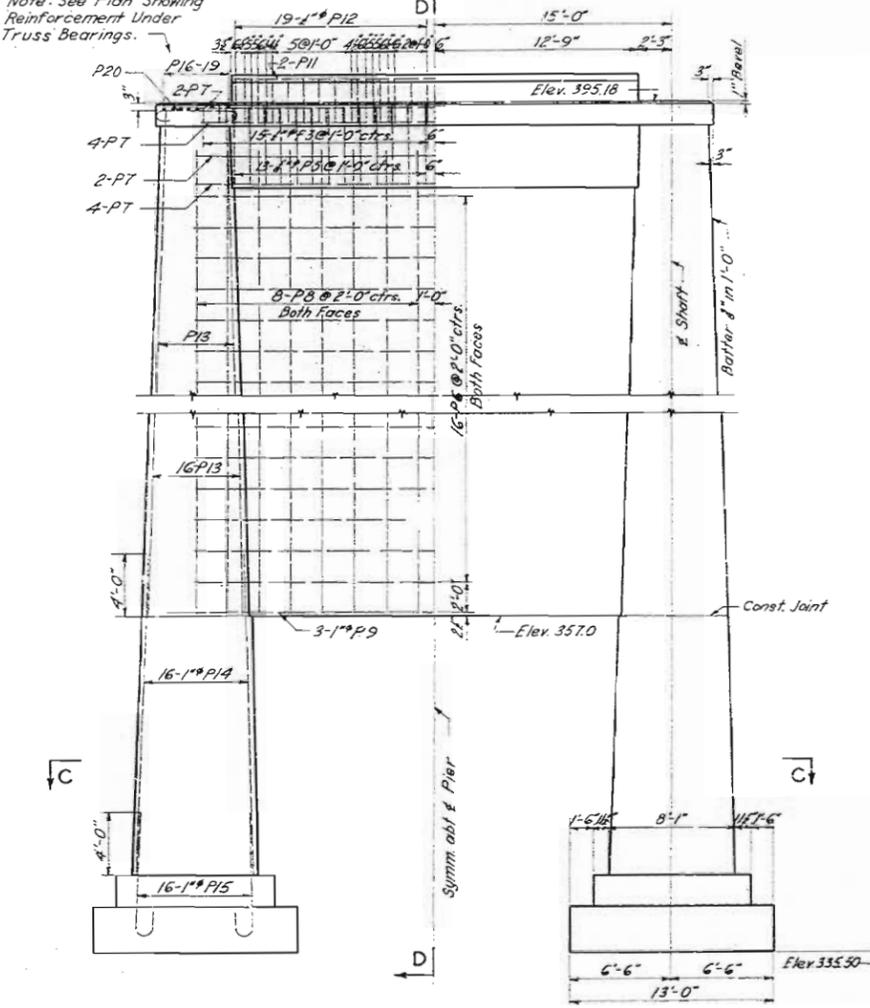


ELEVATION

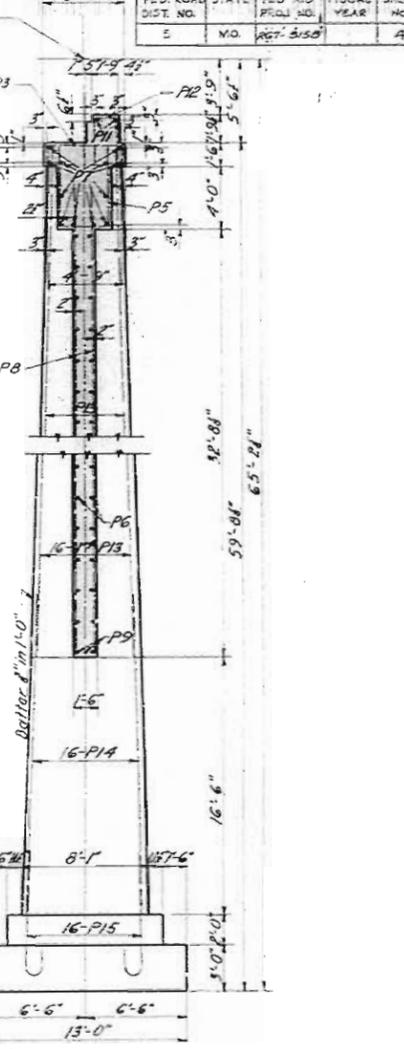


SECTION B-B

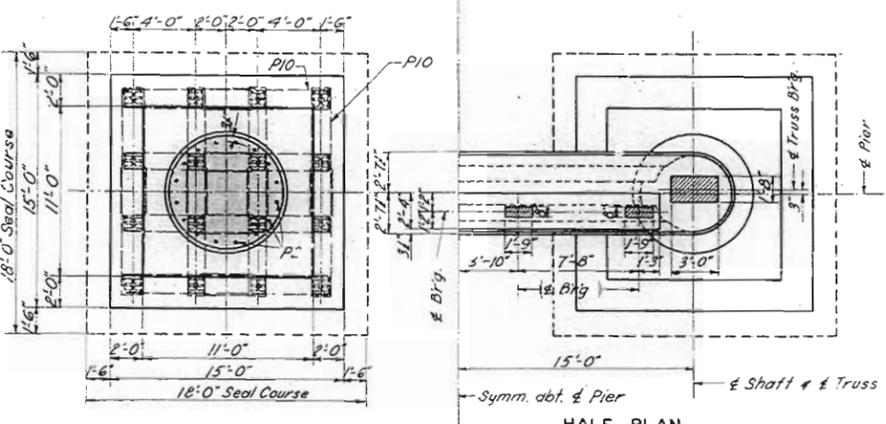
Note: See Plan Showing Reinforcement Under Truss Bearings.



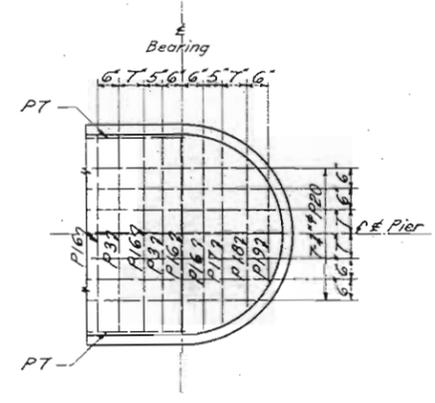
ELEVATION



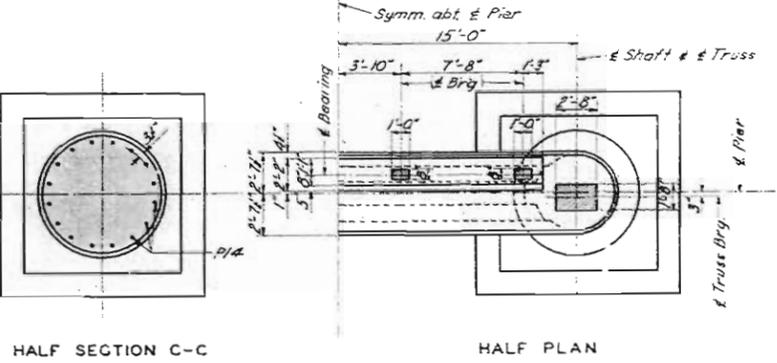
SECTION D-D



HALF PLAN



PLAN SHOWING REINFORCEMENT UNDER TRUSS BEARINGS FOR PIERS 10 & 11



HALF SECTION C-C

HALF PLAN

HALF SECTION A-A
 16 Piles per footing - 10" H @ 57" with pile caps & reinforced tips.
 See Sheet 5 for details of pile tips.
 See Sh. 2 for details of pile caps. Same except omit 8".

DETAILS OF PIER 10

DETAILS OF PIER 11

Note: This drawing is not to scale. Follow dimensions.

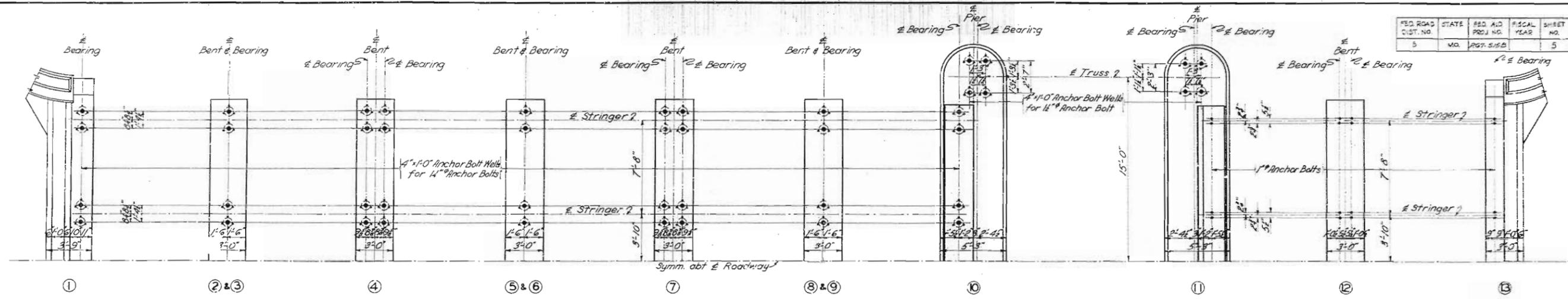
BRIDGE OVER ST. FRANCIS RIVER
 NEAR GREENVILLE, MISSOURI
 U.S. ROUTE 67-SBSTA 386 + 16
 WAYNE COUNTY

DETAILS OF PIERS 10 & 11

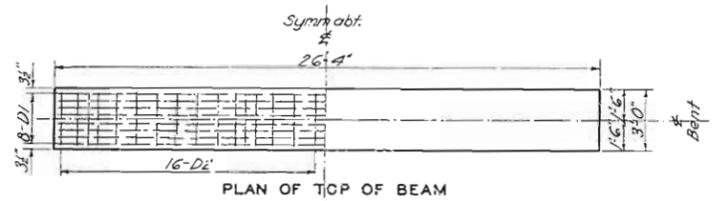
SVERDRUP AND PARCEL
 CONSULTING ENGINEERS
 ST. LOUIS, MO.
 SHEET NO. 4

209

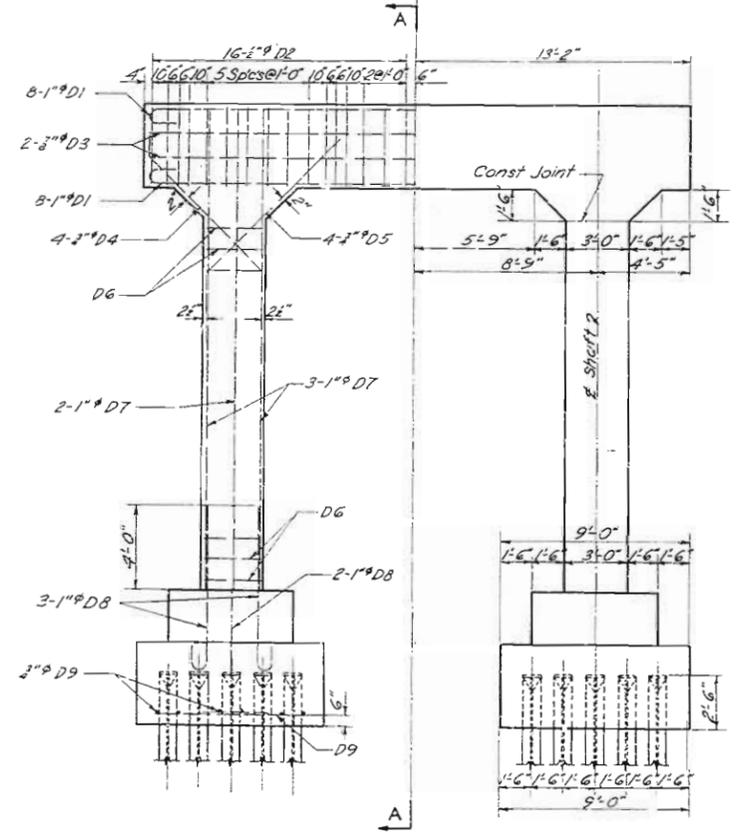
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	PGT. 5-15-B		5	11



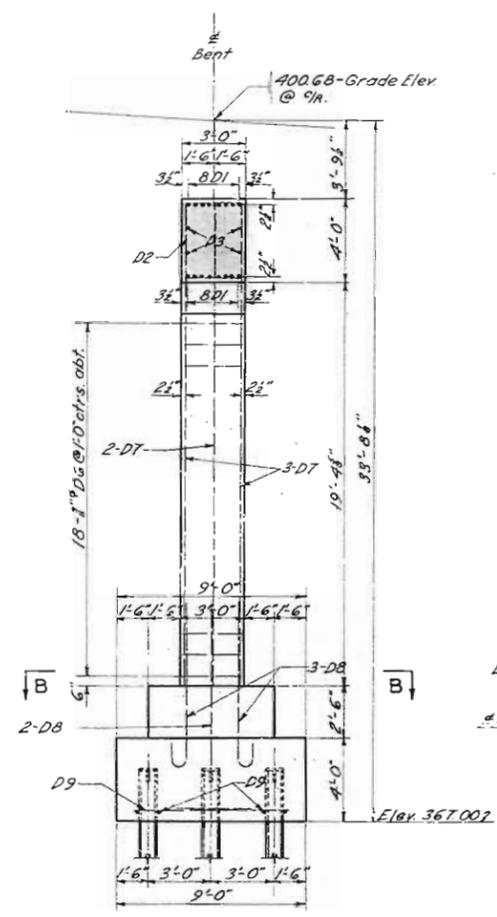
HALF ANCHOR BOLT PLAN



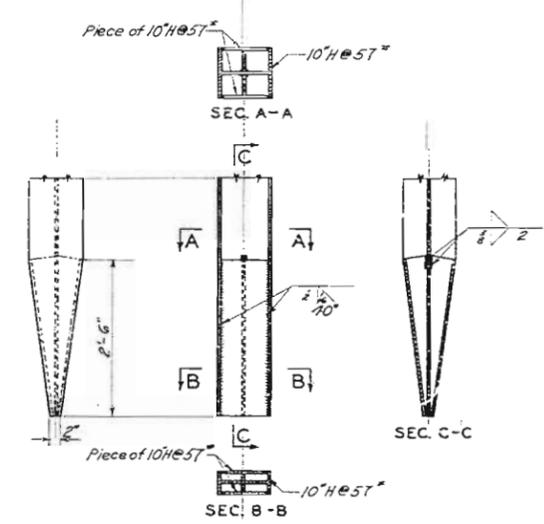
PLAN OF TOP OF BEAM



ELEVATION

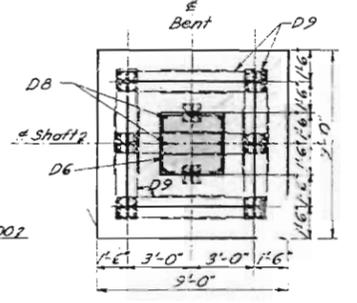


SECTION A-A



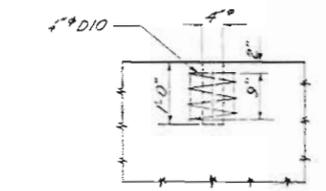
PILE TIP REINFORCING

Note: For Pile Cap Details see Sheet 2. Same except omit 8" L. For Pile Splice, if necessary, see Sheet 2.



SECTION B-B SHOWING FOOTING REIN. & LAYOUT

8 Piles per footing - 10" H # 5T with pile caps and reinforced tips. See Shee. 2 for details of Pile caps. Same except omit 8" L.



Note: Holes for Anchor Bolts in Abut. 1, Bents 2-9 incl., Pier 10 and for Truss Shoes on Pier 11 shall be formed in substructure by placing and setting with template, 4" wells of depth shown above.

PART SECTION SHOWING ANCHOR BOLT WELL

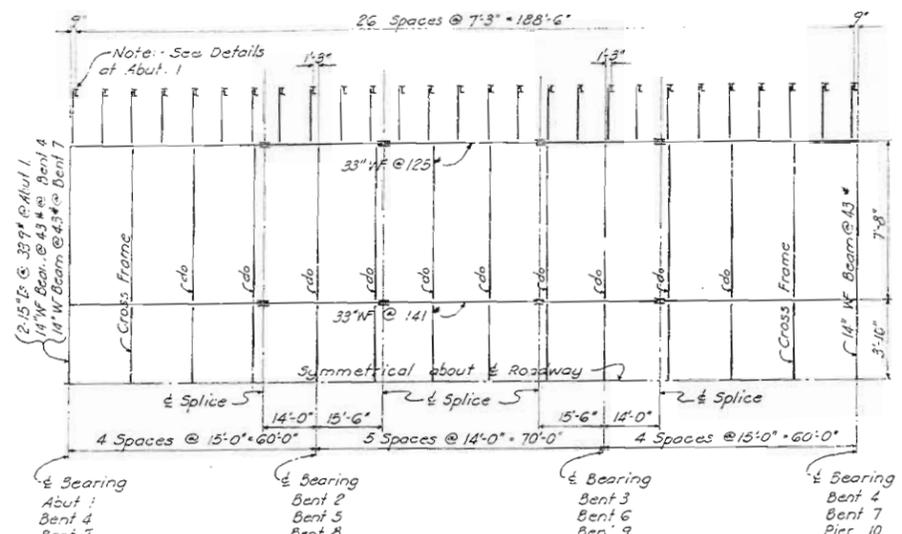
BRIDGE OVER ST. FRANCIS RIVER
NEAR GREENVILLE, MISSOURI
U. S. ROUTE 67-55D STA. 386 + 16
WAYNE COUNTY
DETAILS OF BENT 12
AND ANCHOR BOLT PLAN
SVERDRUP AND PARCEL
CONSULTING ENGINEERS
ST. LOUIS, MO.
SHEET NO. 5

DETAILS OF BENT 12

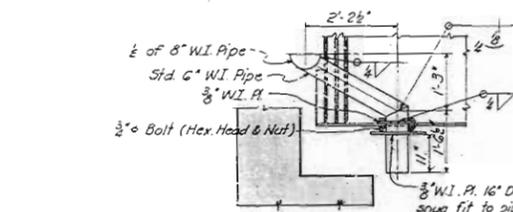
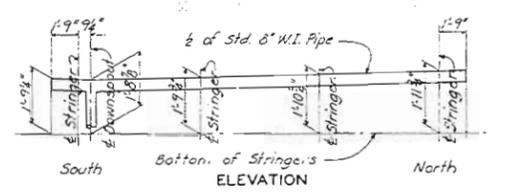
This drawing is not to scale. Follow dimensions

405
Drawn By L.E.B. Oct. 1940
Traced By L.E.B. Oct. 1940
Checked By L.F. Oct. 1940

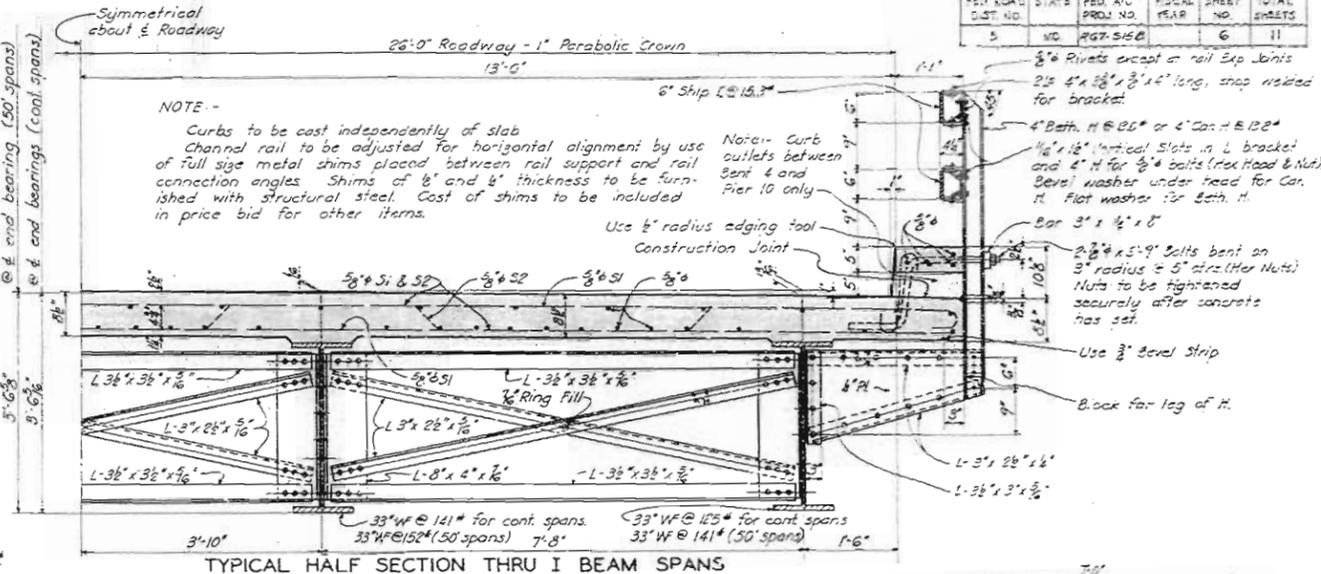
FED. ROAD DIST. NO.	STATE	FED. A.C. PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO	67-558		6	11



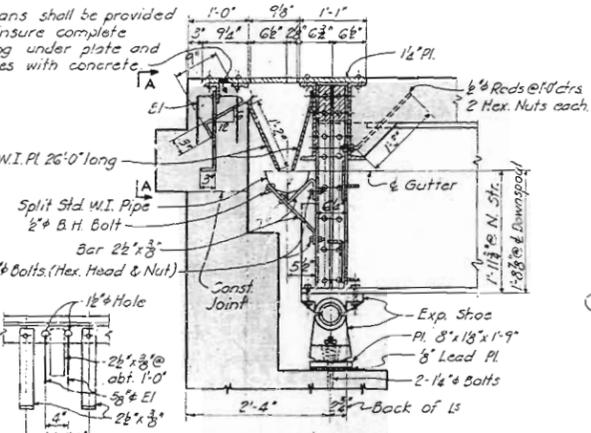
HALF PLAN OF STRUCTURAL STEEL FOR I BEAM SPANS BETWEEN ABUTMENT 1 AND PIER 10



DETAIL OF DOWNSPOUT AT ABUTMENT I
 Note: - All drainage pipes to be standard weight wrought iron pipe, plain ends, butt welded water tight. Weight per foot for 8" pipe to be approximately 24.7. See special provisions.

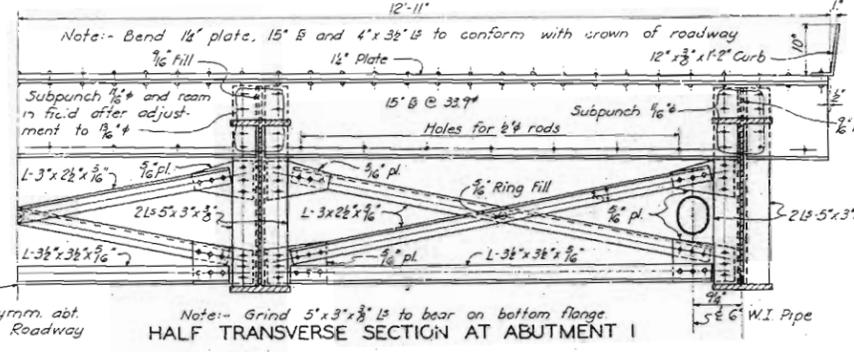


TYPICAL HALF SECTION THRU I BEAM SPANS

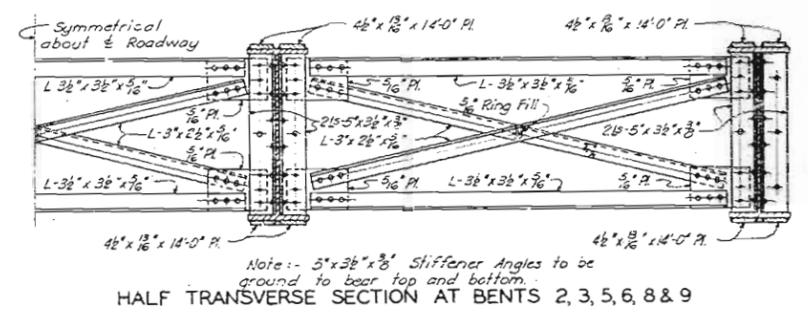


PART LONGITUDINAL SECTION ABUTMENT 1

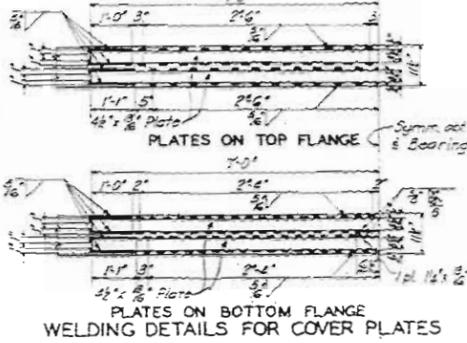
PART ELEVATION A-A Showing expansion device only.



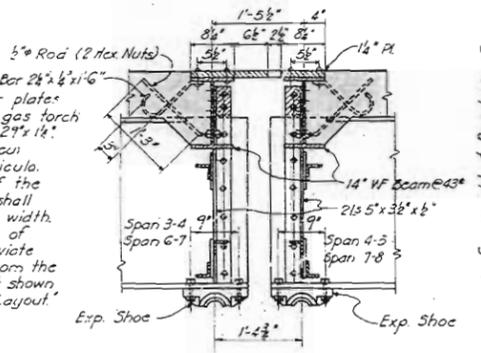
HALF TRANSVERSE SECTION AT ABUTMENT 1



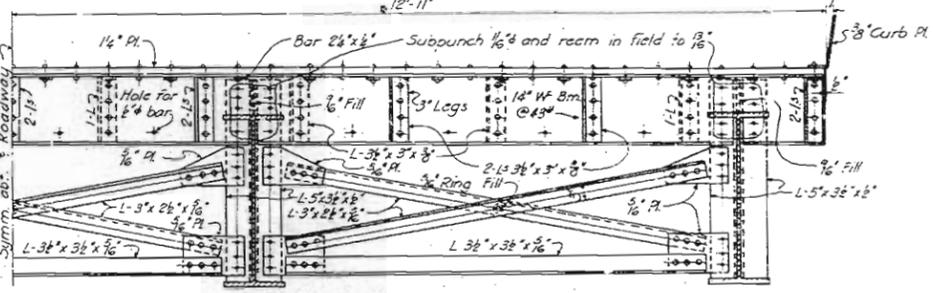
HALF TRANSVERSE SECTION AT BENTS 2, 3, 5, 6, 8 & 9



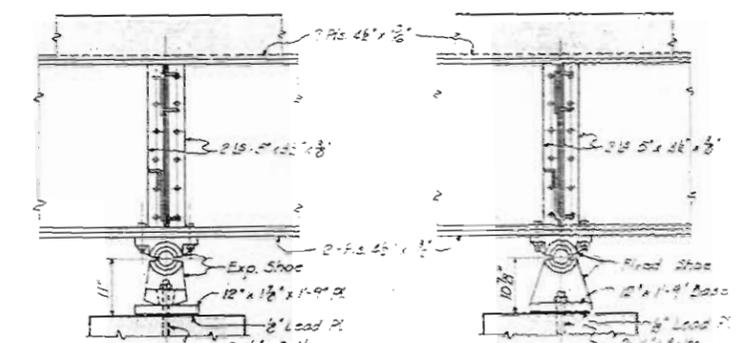
WELDING DETAILS FOR COVER PLATES



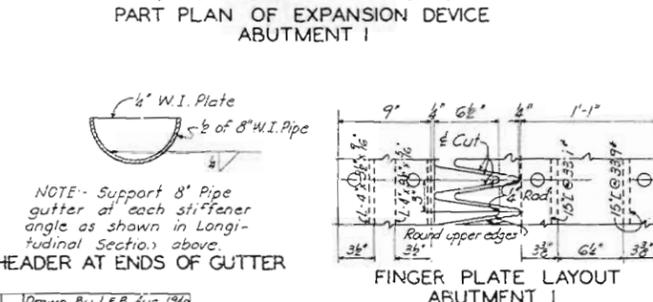
PART LONGITUDINAL SECTION BENTS 4 & 7



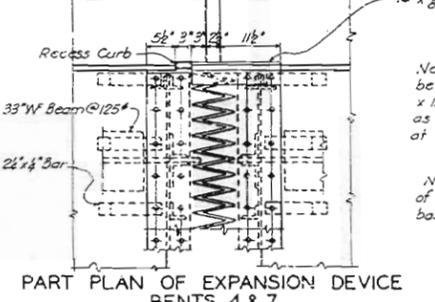
HALF TRANSVERSE SECTION AT BENTS 4 & 7
 Note: - Bend 1/2 pl. and 14" beam to conform with crown of roadway. Grind 3 1/2" x 3 1/2" angles to bear top and bottom. Grind 5" x 3 1/2" x 3/8" angles to bear on bottom flange



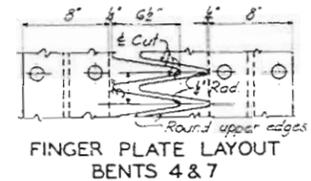
PART LONGITUDINAL SECTION BENTS 2, 5 & 8
 PART LONGITUDINAL SECTION BENTS 3, 6 & 9
 DETAILS AT BENTS 2, 3, 5, 6, 8 & 9



DETAILS AT ABUTMENT 1



DETAILS AT BENTS 4 & 7



FINGER PLATE LAYOUT BENTS 4 & 7

DETAILS AT BENTS 4 & 7 Note: - This drawing is not to scale. Follow dimensions.

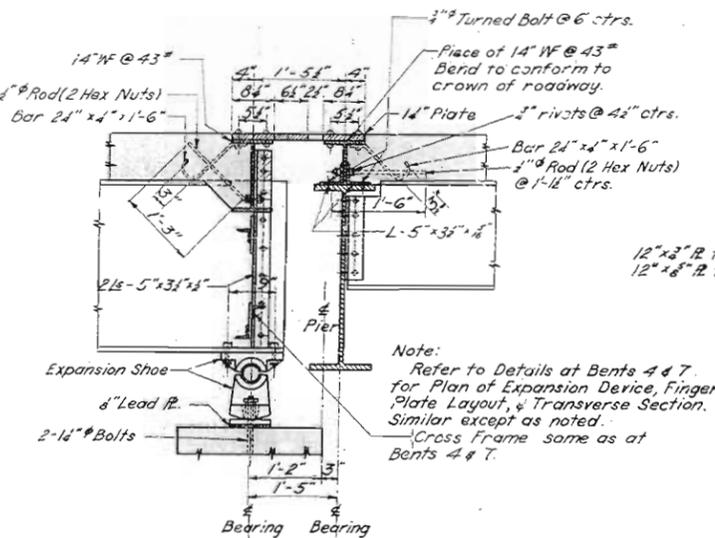
BRIDGE OVER ST. FRANCIS RIVER
 NEAR GREENVILLE, MISSOURI
 U.S. ROUTE 67-558 STA. 386 + 16
 WAYNE COUNTY
 DETAILS OF I-BEAM SPANS

SVERDRUP AND PARCEL
 CONSULTING ENGINEERS
 ST. LOUIS, MO.
 SHEET NO. 6

4-1781
 Drawn By LEB Aug. 1940
 Traced By LRB Sept. 1940
 Checked By L.F. Sept. 1940

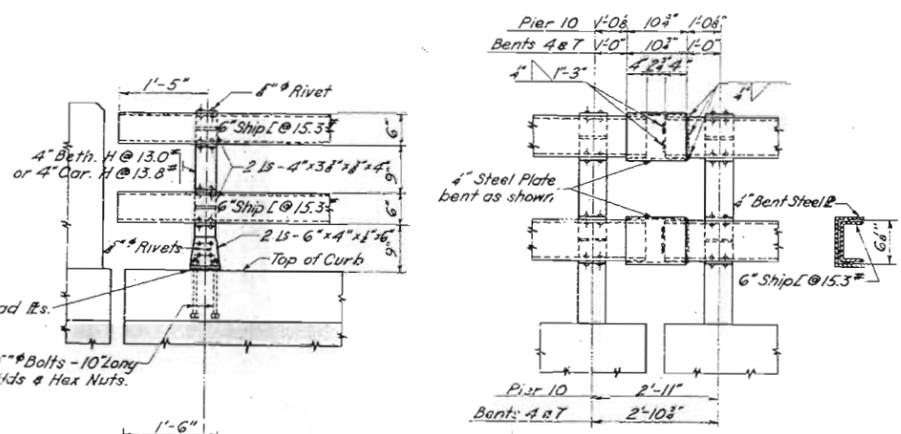
J-21R

DES. NO.	STATE	FED. AID	DIS. YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	267-5152		7	31

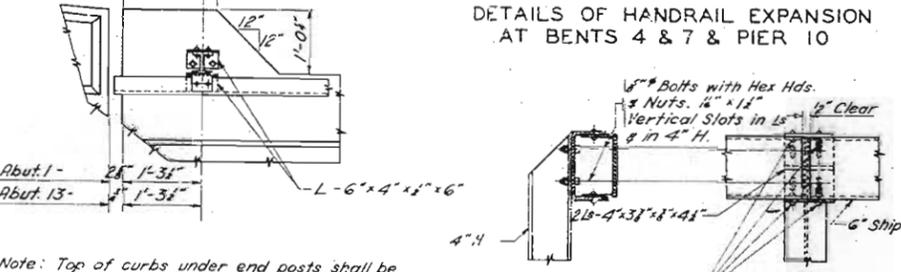


PART LONGITUDINAL SECTION AT PIER 10

DETAILS OF EXPANSION DEVICE AT PIER 10



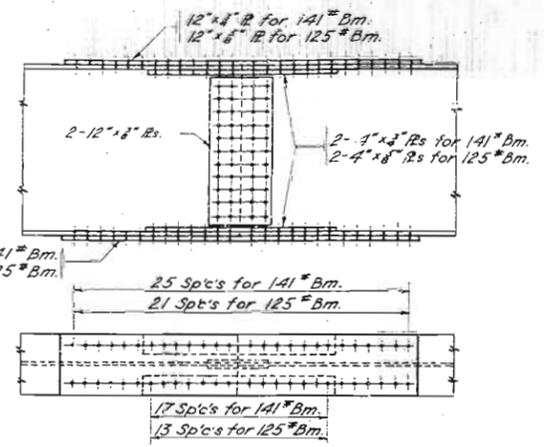
DETAILS OF HANDRAIL EXPANSION AT BENTS 4 & 7 & PIER 10



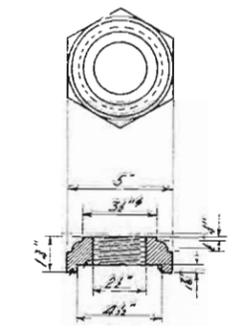
DETAILS OF HANDRAIL SPLICE

DETAILS OF END RAIL POST AT ABUTMENTS 1 & 13

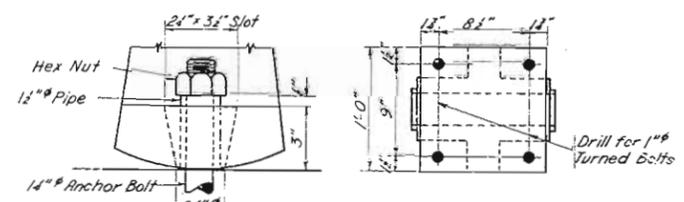
Drawn By L.E.B. Sept. 1940
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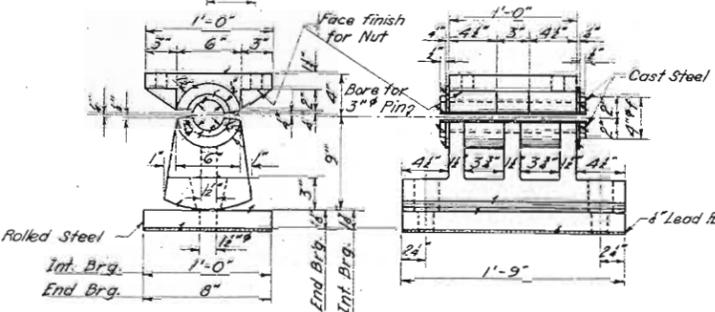
DETAILS OF BEAM SPLICE



CAST STEEL NUT
 48-3\"/>

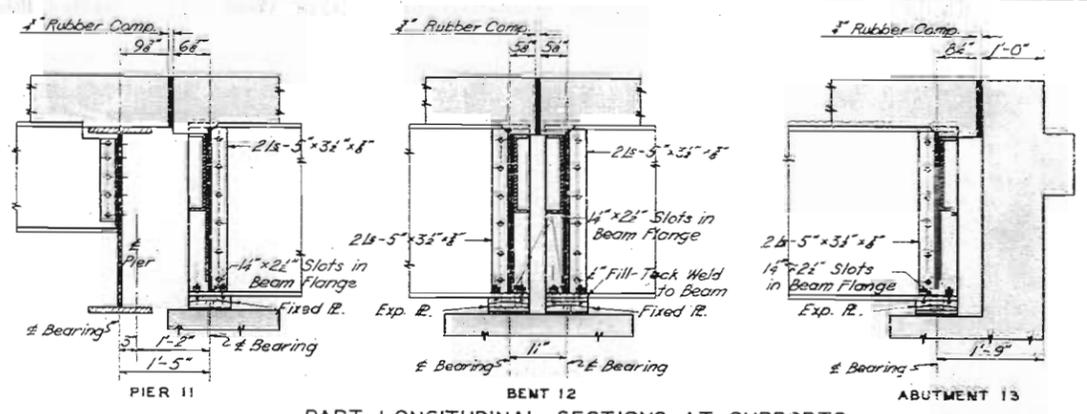


EXPANSION SHOE
 24 req'd @ End Bearings
 12 req'd @ Int. Bearings

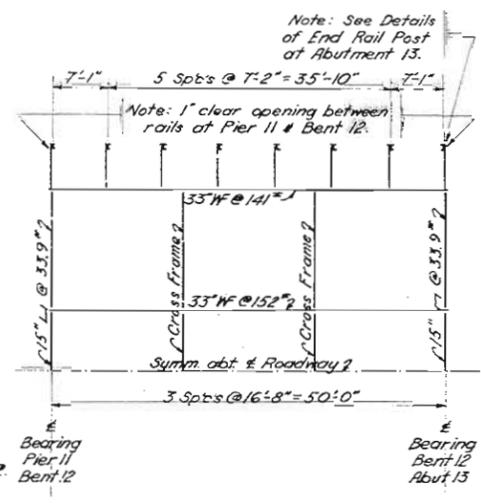


FIXED SHOE
 12 Required

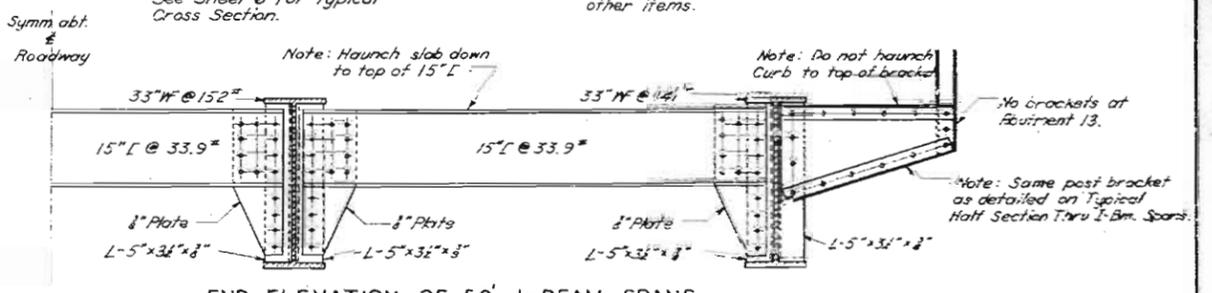
DETAILS OF BEARING SHOES
 Note: All fillats shall have 1/2\"/>



PART LONGITUDINAL SECTIONS AT SUPPORTS



HALF PLAN STRUCTURAL STEEL FOR 50' I-BEAM SPANS



END ELEVATION OF 50' I-BEAM SPANS

DETAILS OF BEARING PLATES
 8 Fixed Plates required each consisting of 1 top and 1 bottom plate.
 8 Expansion Pls. req'd each consisting of 1 top, 1 bottom and 1 float. E.

Note: Bearing plates may be either cast steel or gray iron alloy. Finish all surfaces marked f.
 All finished surfaces shall be painted with one coat of white lead and tallow.
 Anchor bolts shall be 1\"/>

BRIDGE OVER ST. FRANCIS RIVER
 NEAR GREENVILLE, MISSOURI
 U.S. ROUTE 67-565 STA. 386+16
 WAYNE COUNTY

DETAILS OF I-BEAM SPANS

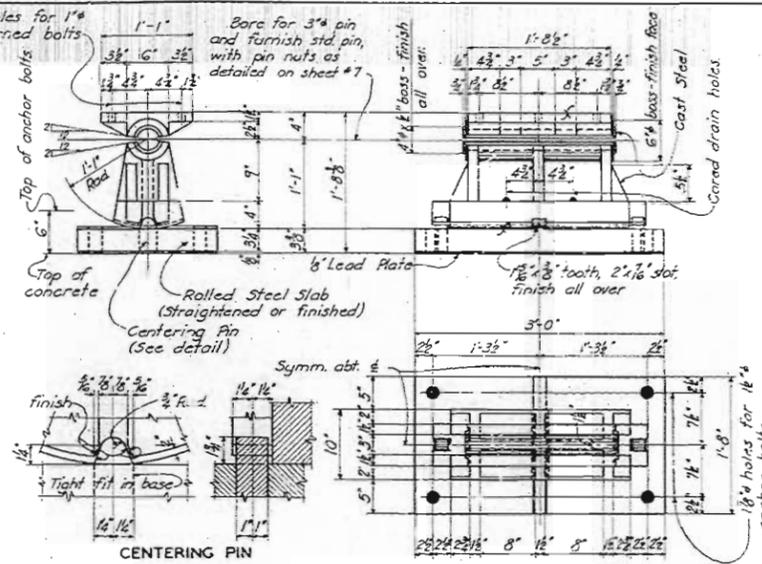
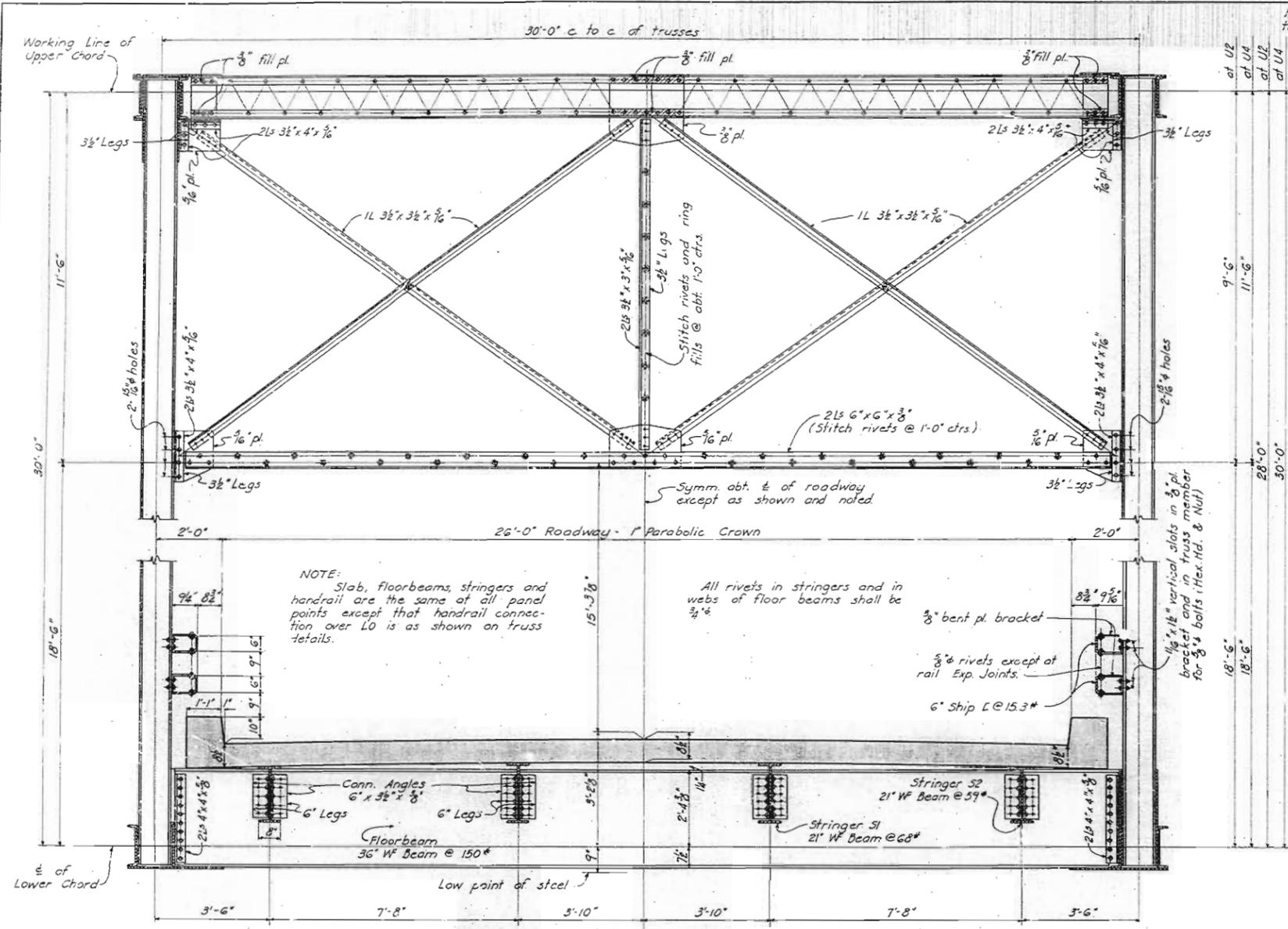
SVERDRUP AND BRUCE
 CONSULTING ENGINEERS
 ST. LOUIS, MO.
 SHEET NO. 7

Note: This drawing is not to scale. Follow dimensions.

212

J-21R

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	PG7-315B		9	11



NOTES

All fillets on castings shall have $\frac{3}{8}$ \"/>

Finish all surfaces marked *f*.

All pins, bolts and rolled plates will be paid for as structural steel.

All finished surfaces shall be shop painted with one coat of white lead and tallow.

Cast of lead plates shall be included in the price bid for other items.

Shop and field rivets may be interchanged where so desired for convenience in erection.

All rivets in truss span $\frac{3}{4}$ \"/>

unless noted.

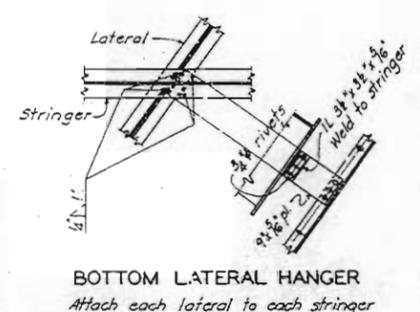
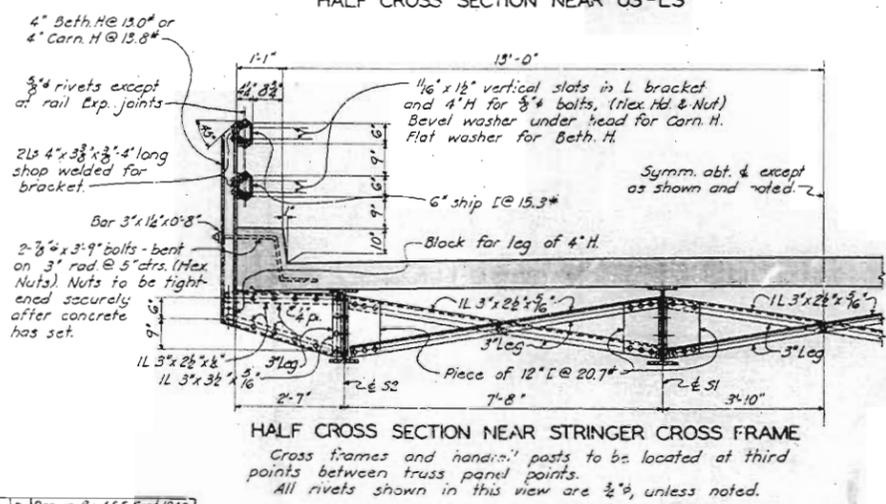
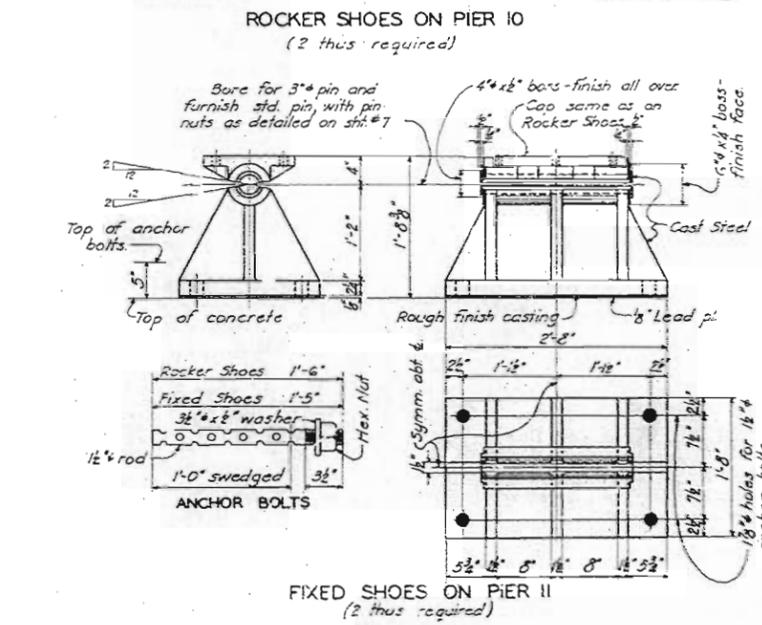
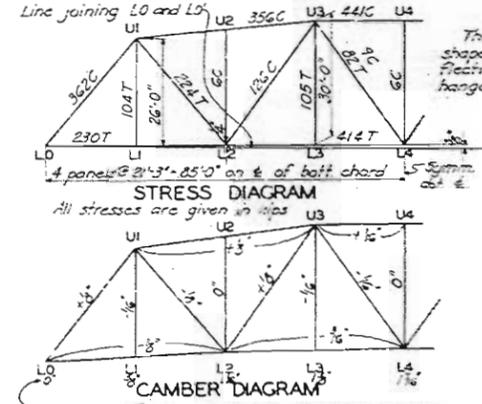


TABLE OF STRESSES

Member	D.L.	U.L.L.-I.	C.L.L.-I.	Total
L ₀ L ₁	162T	46T	22T	230T
L ₁ L ₂	301T	85T	28T	414T
U ₁ U ₂	259C	73C	24C	356C
U ₂ U ₃	321C	90C	30C	441C
L ₀ U ₁	256C	72C	34C	362C
U ₁ L ₂	4C	8C		
U ₂ L ₂	151T	47T	26T	224T
L ₂ U ₃	11T	14T		
U ₃ L ₄	74C	32C	20C	126C
U ₂ L ₃	15C	15C		
U ₃ L ₃	35T	25T	19T	82T
U ₁ L ₁	52T	18T	34T	104T
U ₂ L ₂	6C			6C
U ₃ L ₃	53T	18T	34T	105T
U ₄ L ₄	6C			6C

All stresses are given in kips.



This stress diagram shows normal shape of truss after calculated deflections have occurred. Posts and hangers to be on radial lines.

BRIDGE OVER ST. FRANCIS RIVER
 NEAR GREENVILLE, MISSOURI
 U. S. ROUTE 67S55 ST. 386 + 16
 WAYNE COUNTY

CROSS SECTIONS & MISC. DETAILS - 170' SPAN

SVERDRUP AND PARCEL
 CONSULTING ENGINEERS
 ST. LOUIS, MO.
 SHEET NO. 9

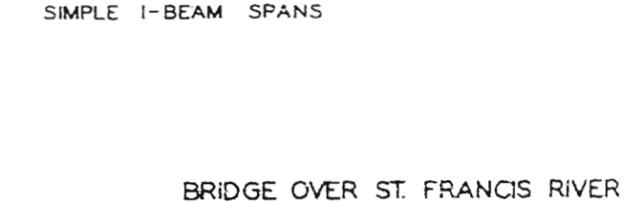
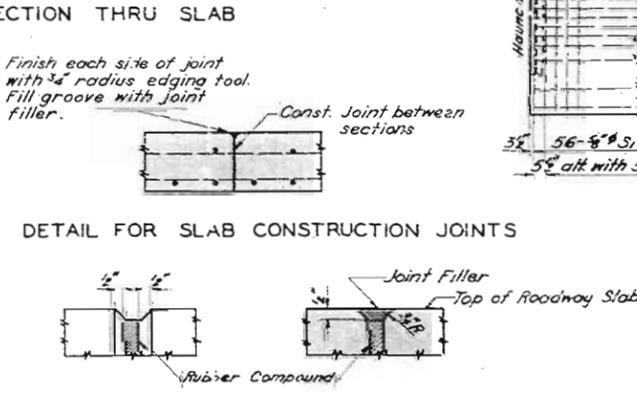
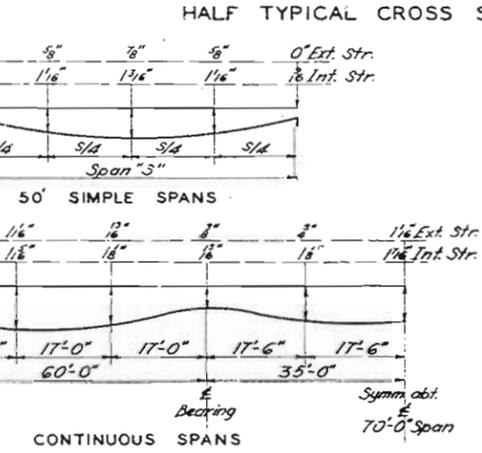
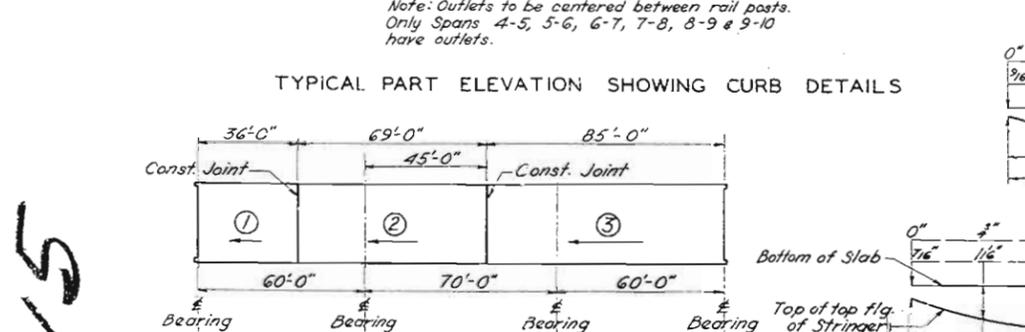
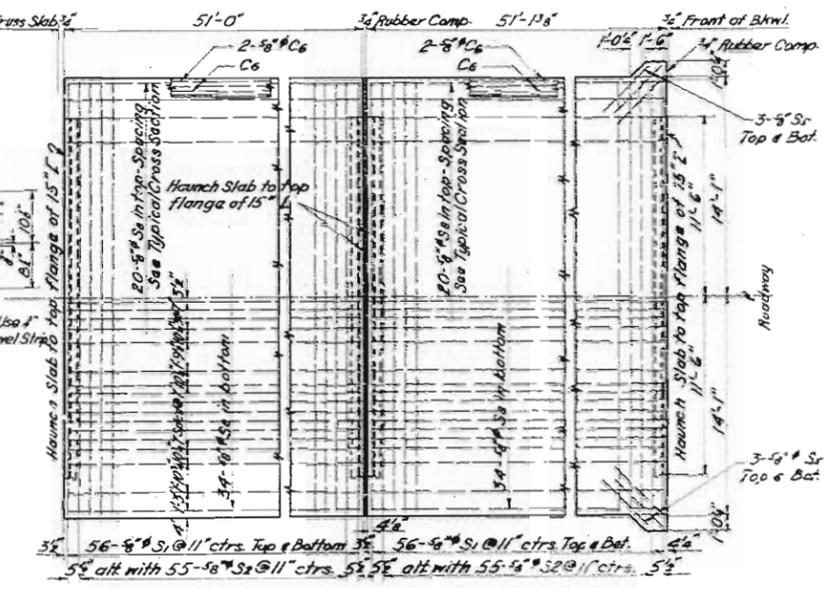
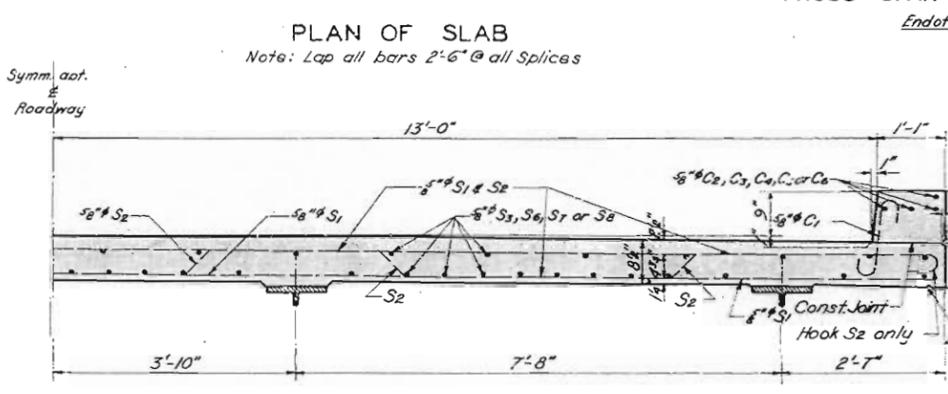
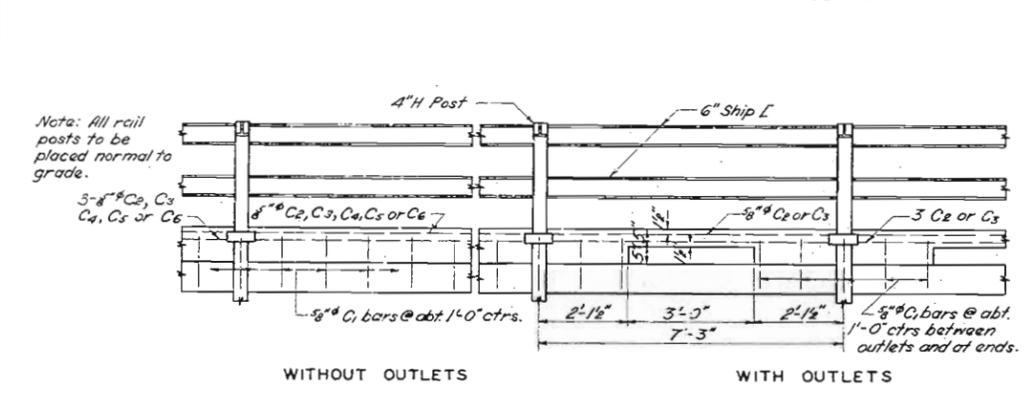
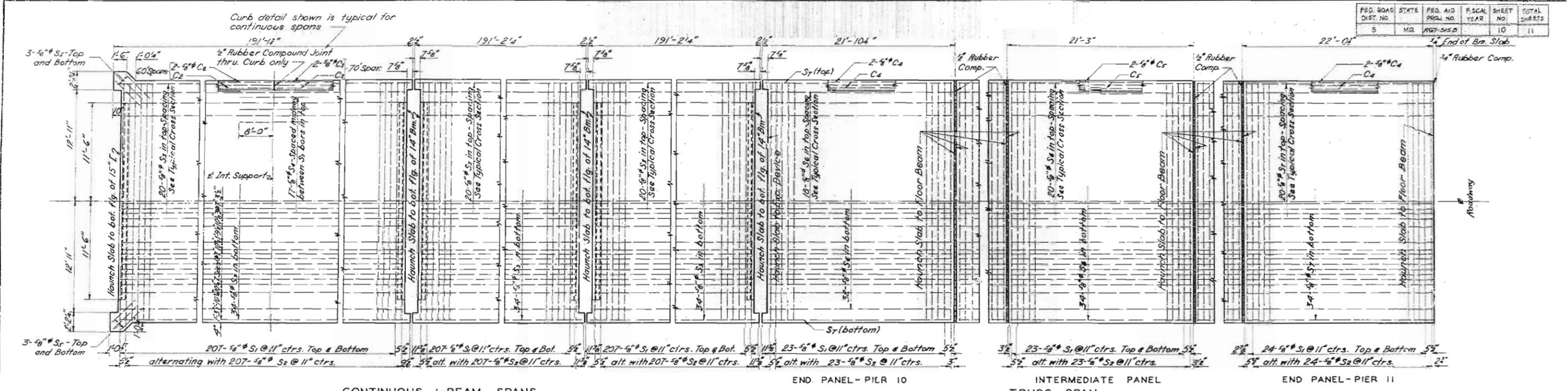
Note: - This drawing is not to scale. Follow dimensions.

214

405
 Drawn By A.E.F. Sept. 1940
 Traced By L.R.B. Sept. 1940
 Checked & L.F. Oct. 1940

J-21R

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO.	RGT-545-D		10	11



BRIDGE OVER ST. FRANCIS RIVER
NEAR GREENVILLE, MISSOURI
U. S. ROUTE 57S58 STA. 386 +15
WAYNE COUNTY
DETAILS OF ROADWAY SLAB

SHERDUP AND PARCEL
CONSULTING ENGINEERS
ST. LOUIS, MO.
SHEET NO. 10

215

Drawn By L.F.B. Sept. 1944
Traced By L.F.B. Sept. 1944
Checked By L.F. Sept. 1944

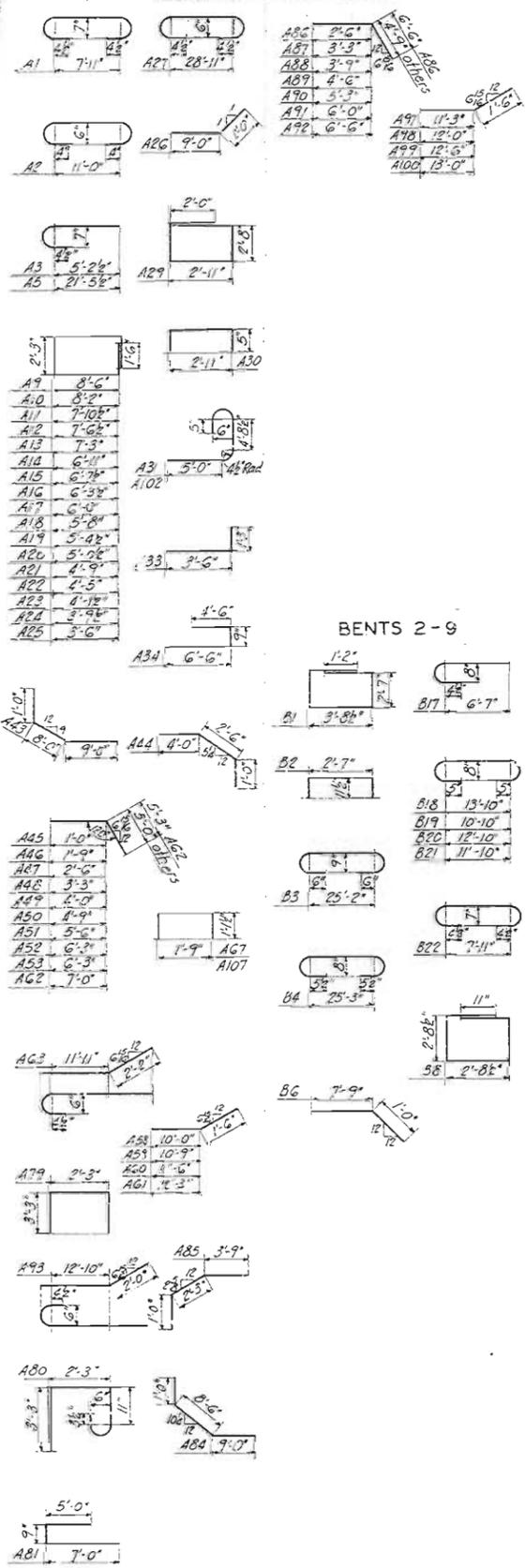
SLAB HAUNCHING DIAGRAMS
Note: Trusses will be cambered to take care of Dead Load Deflection. See Sheet 9.

Note: This drawing is not to scale. Follow dimensions.

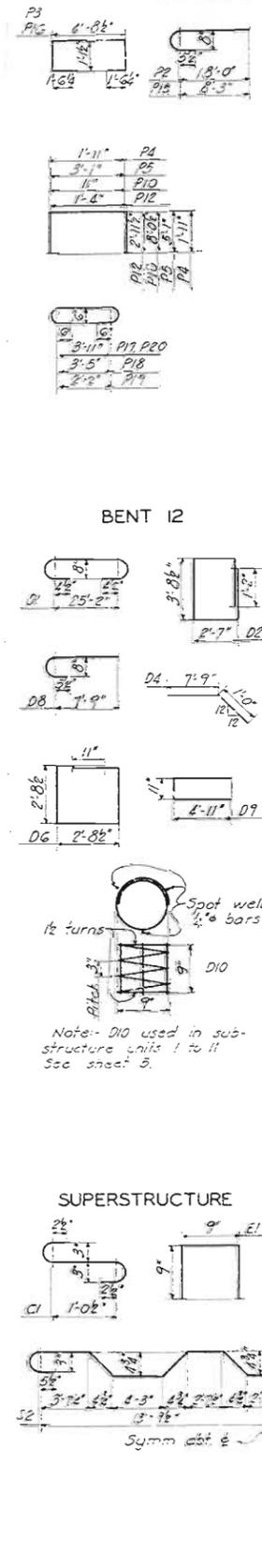
ABUTMENTS I AND 13 ABUTMENTS I AND 13 PIERS 10 & 11

Mark	Size	Length	Shape	Location	Mark	Size	Length	Shape	Location	Mark	Size	Length	Shape	Location
A1	59	10'-6"	Bent	Footing	A97	2	12'-9"	Bent	Wing	P1	32	1'-0"	Straight	Shaft
A2	30	15'-3"	do	do	A93	2	13'-6"	do	do	P2	32	19'-6"	Bent	Footing
A3	30	6'-6"	do	do	A99	2	14'-0"	do	do	P2	60	10'-0"	do	Cap
A4	18	21'-3"	Straight	Leg	A100	4	16'-6"	do	do	P5	38	5'-9"	do	do
A5	12	22'-3"	Bent	do	A101	14	8'-0"	Straight	do	P5	52	13'-3"	do	do
A6	6	21'-0"	Straight	do	A102	6	11'-6"	Bent	do	P6	64	30'-0"	Straight	Web
A7	6	14'-6"	do	do	A103	4	6'-3"	Straight	do	P7	24	1'-0"	do	Cap
A8	6	8'-3"	do	do						P8	64	35'-0"	do	Web
A9	3	22'-3"	Bent	do	A105	2	7'-6"	do	Curb	P9	6	1'-0"	do	do
A10	3	21'-6"	do	do	A106	4	6'-0"	do	do	P10	32	17'-0"	Bent	Footing
A11	3	21'-0"	do	do	A107	16	4'-0"	Bent	do	P11	4	2'-5"	Straight	Cap
A12	3	20'-3"	do	do	A108	2	6'-0"	Straight	do	P12	38	7'-3"	Bent	do
A13	3	19'-9"	do	do	A109	2	7'-6"	do	do	P13	32	1'-0"	Straight	Shaft
A14	3	19'-0"	do	do	A110	6	5'-0"	do	Wing	P14	32	20'-6"	do	do
A15	3	18'-6"	do	do	A111	10	5'-6"	do	do	P15	32	9'-9"	Bent	Footing
A16	3	17'-9"	do	do	A112	4	7'-0"	do	do	P16	16	13'-0"	do	do
A17	3	17'-5"	do	do	A113	4	6'-3"	do	do	P17	4	6'-6"	do	do
A18	3	16'-6"	do	do	A114	4	5'-6"	do	do	P18	4	6'-0"	do	do
A19	3	16'-0"	do	do	A115	4	3'-9"	do	do	P19	4	4'-9"	do	do
A20	3	15'-3"	do	do	A116	4	2'-9"	do	do	P20	28	6'-6"	do	do
A21	3	14'-9"	do	do										
A22	3	14'-0"	do	do										
A23	3	13'-6"	do	do										
A24	3	12'-9"	do	do										
A25	3	12'-3"	do	do										
A26	16	10'-0"	do	Haunches										
A27	10	31'-3"	do	Cross Beam										
A28	4	12'-0"	Straight	do										
A29	33	12'-3"	Bent	do										
A30	16	3'-9"	do	do										
A31	6	11'-6"	do	End Seat										
A32	4	6'-6"	Straight	do										
A33	27	4'-9"	Bent	Backwall										
A34	27	11'-9"	do	do										
A35	6	29'-3"	Straight	do										
A36	2	29'-3"	do	do										
A37	14	8'-0"	do	Wing										
A38	4	7'-3"	do	do										
A39	4	6'-6"	do	do										
A40	4	5'-9"	do	do										
A41	4	4'-0"	do	do										
A42	4	3'-0"	do	do										
A43	4	18'-0"	Bent	do										
A44	4	7'-6"	do	do										
A45	2	6'-0"	do	do										
A46	2	6'-9"	do	do										
A47	2	7'-6"	do	do										
A48	2	8'-3"	do	do										
A49	2	9'-0"	do	do										
A50	2	9'-9"	do	do										
A51	2	10'-6"	do	do										
A52	2	11'-3"	do	do										
A53	2	11'-9"	Straight	do										
A54	2	10'-6"	do	do										
A55	2	11'-3"	do	do										
A56	2	12'-0"	do	do										
A57	2	11'-6"	Bent	do										
A58	2	12'-3"	do	do										
A59	2	13'-0"	do	do										
A60	2	12'-9"	do	do										
A61	2	12'-3"	do	do										
A62	2	15'-3"	do	do										
A63	6	5'-0"	Straight	do										
A65	10	5'-0"	Straight	do										
A66	8	5'-6"	do	do										
A67	16	4'-0"	Bent	Curb										
A68	2	6'-0"	Straight	do										
A69	2	7'-6"	do	do										
A70	2	7'-6"	do	do										
A71	4	6'-0"	do	do										
A73	12	6'-0"	Straight	End Post										
A74	12	6'-9"	do	do										
A75	56	3'-9"	do	do										
A76	6	29'-3"	do	Footing										
A77	20	4'-6"	do	do										
A78	4	29'-3"	do	Seat										
A79	28	12'-9"	Bent	do										
A80	4	7'-6"	do	do										
A81	27	12'-9"	do	Backwall										
A82	4	29'-3"	Straight	do										
A83	2	29'-3"	do	do										
A84	4	18'-6"	Bent	Wing										
A85	4	7'-0"	do	do										
A86	2	9'-0"	do	do										
A87	2	8'-0"	do	do										
A88	2	8'-6"	do	do										
A89	2	9'-3"	do	do										
A90	2	10'-0"	do	do										
A91	2	10'-7"	do	do										
A92	4	11'-3"	do	do										
A93	6	16'-0"	do	do										
A94	2	11'-9"	Straight	do										
A95	2	12'-6"	do	do										
A96	2	13'-3"	do	do										

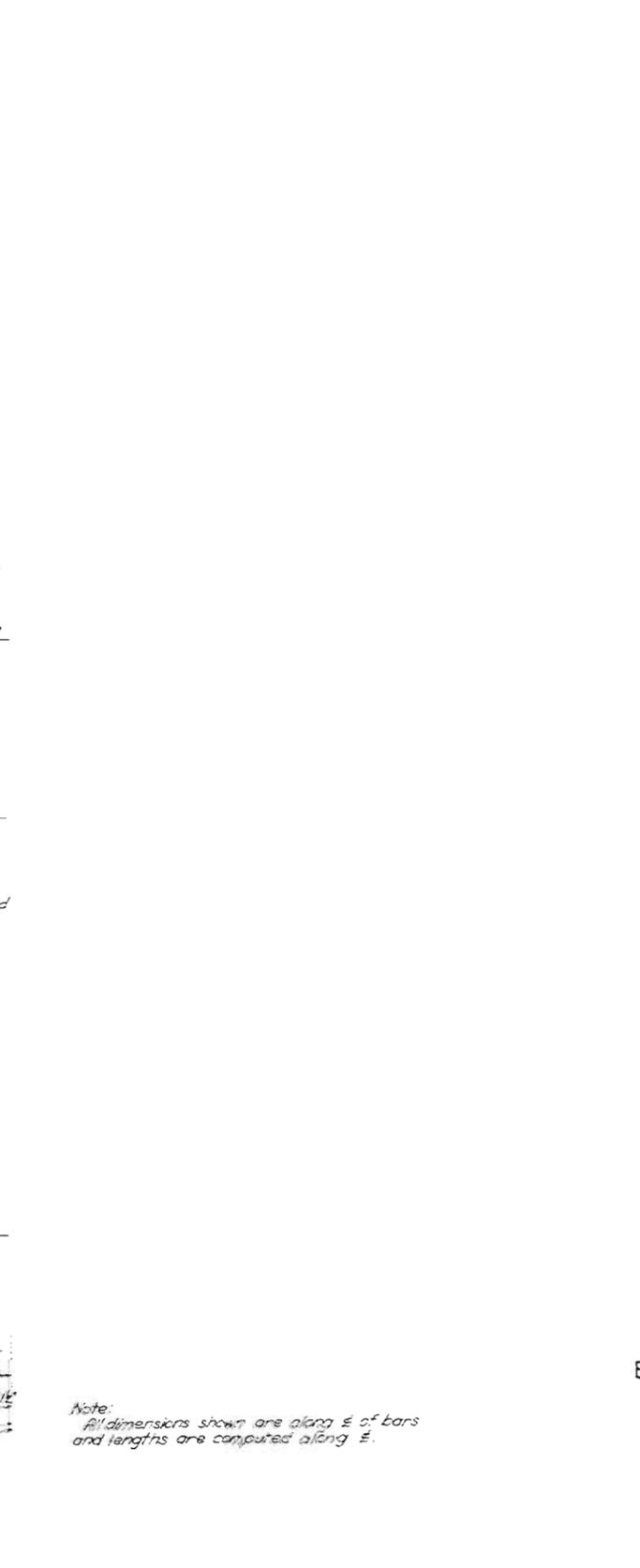
ABUTMENTS I AND 13 ABUTMENTS I AND 13 PIERS 10 & 11



PIERS 10 & 11



ABUTMENTS I AND 13 ABUTMENTS I AND 13 PIERS 10 & 11



FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	MO	1927-5152		11	11

BRIDGE OVER ST. FRANCIS RIVER
NEAR GREENVILLE, MISSOURI
U. S. ROUTE 67550 STA 356 +16
WAYNE COUNTY

BAR LIST
SVERDRUP AND PARZEL
CONSULTING ENGINEERS
ST. LOUIS, MO

Note: All dimensions shown are along E of bars and lengths are computed along E.

216

Drawn By L.P.B. Oct. 1940
Traced By L.P.B. Oct. 1940
Checked By C.E. Oct. 1940

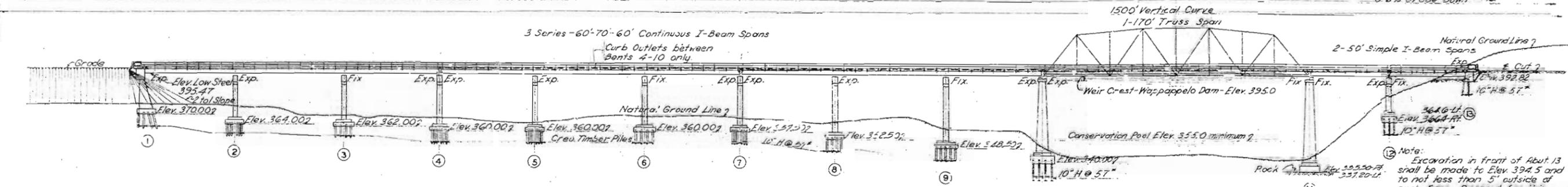
FED. ROAD DIST. NO.	STATE	FEDERAL AID DIST. NO.	PROJECT NO.	SHEET NO.	TOTAL SHEETS
5	MO	106-558		1	5

FINAL PLANS

Truss Span
 P.I. Sta. 392+77.54
 P.I. Elev. 403.00
 1/4" Elev. 400.75

-0.6% Grade Up

-0.6% Grade Down

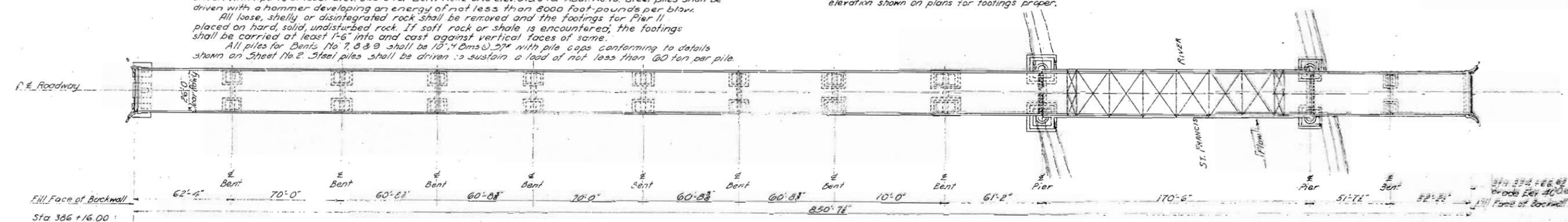


GENERAL ELEVATION

Note: All piles for Abut. No. 1 and Bents No. 2 to No. 6 inclusive, shall be cross-tied timber piles and shall be driven to a minimum penetration of 3' below bottom of footings and to sustain a load of not less than 30 ton per pile.
 All piles for Pier No. 10, Bent No. 12 and Abut. No. 13 shall be 10" H Bms @ 57" with pile caps and reinforced tips conforming to details shown on Sheets No. 2 & 5. Steel piles shall be driven to sustain a load of not less than 60 ton per pile. Steel piles shall be driven with tips to at least Elev. 345.0 for Bent No. 12 and Elev. 373.0 for Abut. No. 13. Steel piles shall be driven with a hammer developing an energy of not less than 8000 foot-pounds per blow.
 All loose, shelly or disintegrated rock shall be removed and the footings for Pier II placed on hard, solid, undisturbed rock. If soft rock or shale is encountered, the footings shall be carried at least 1'-6" into and cast against vertical faces of same.
 All piles for Bents No. 7, 8 & 9 shall be 10" H Bms @ 57" with pile caps conforming to details shown on Sheet No. 2. Steel piles shall be driven to sustain a load of not less than 60 ton per pile.

Note: All seal courses were omitted during construction by authority of the Engineer, the bottom of footings were built to elevation shown on plans for footings proper.

Note: Excavation in front of Abut. 13 shall be made to Elev. 394.5 and to not less than 5' outside of curb lines. Payment for this excavation outside of limits of excavation for structures will be made at unit contract price for Roadway Excavation.



P-2

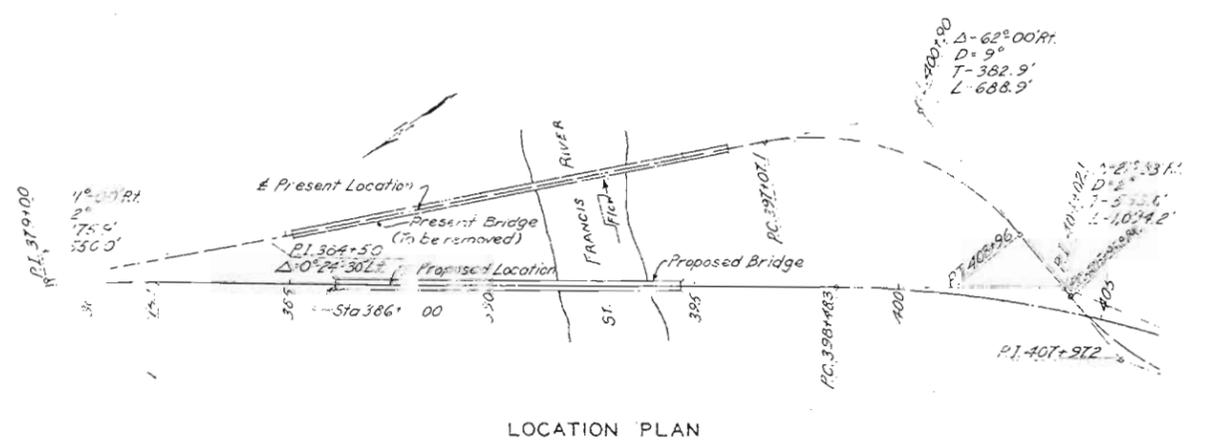
ESTIMATED QUANTITIES			
Item	Unit	Quantity	Total
Class 1 Excavation for Structures	Cu Yds	157.5	157.5
Class 2 Excavation for Structures	Cu Yds	92.3	92.3
Class 1 Excavation for Struc. (Below Piers)	Cu Yds	43.5	43.5
Class 2 Excavation	Cu Yds	1170.9	1170.9
Fabricated Structural Steel (Truss Span)	Lbs.	621,000	621,000
Fabricated Structural Steel (I-Beam Spans)	Lbs.	620,000	620,000
Steel Castings	Lbs.	10,000	10,000
Reinforcing Steel	Lbs.	20,000	20,000
Cross-tied Timber Piles in Place	Lin. Ft.	1,071	1,071
Steel Piles in Place	Lin. Ft.	3,023	3,023
Fabricated Wrought Iron	Lbs.	500	500
8" Corrugated Metal Pipe	Lin. Ft.	40	40
Gray Iron Flange Castings	Lbs.	1,000	1,000

Note: Excavation for bridge made above Elev. 355.0 will be paid for as Class 1 Excavation for Structures.
 Excavation for bridge made below Elev. 355.0 will be paid for as Class 2 Excavation for Structures.
 The 8" on steel piles of Abut. 13 will be paid for at the unit price bid for Fabricated Structural Steel (I-Beam Spans).

B.M. Elev. 399.54 1/2" in top of curb on N end of W wing of Bent #1
 B.M. Elev. 401.35 1/2" in top of curb on S end of E wing of Bent #3

GENERAL NOTES

Design Specifications A.P.S.H.O. - 1935 edition
 Loading H-15 A.P.S.H.O.
 Structural Steel Stress 18,000 psi
 Reinforcing Steel Stress 18,000 psi
 Concrete Class "B" 900 psi
 All concrete shall be Class "B"
 Qualification of all welding operators and electrodes will be required in accordance with Specifications, except that a proper certification of electrodes previously qualified will be acceptable.
 Rivets 4" except as noted. All field connections riveted except as noted.
 Paint: Shop, one coat of red lead. Field, surfaces inaccessible after erection two coats of red lead. All exposed surfaces, one coat brown and final coat aluminum. Payment for cleaning and painting will be included in unit price bid for material painted.
 Excavation for the structure shall be in accordance with the Standard and Supplemental specifications, except that the maximum horizontal limits of excavation paid for will be based upon the footings proper and not upon the seal courses under them. Quantities will be computed from Water Elevation 355.0 where existing ground line is below this elevation.
 All rubber compound shall be gray in color.



LOCATION PLAN

BRIDGE OVER ST. FRANCIS RIVER
 NEAR GREENVILLE, MISSOURI
 U.S. ROUTE 67-558 STA. 386+16
 WAYNE COUNTY

GENERAL PLAN AND ELEVATION

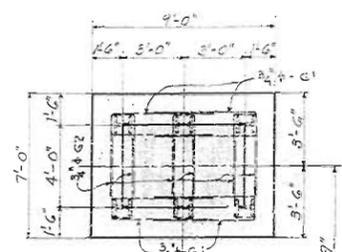
SYNOPSIS AND PARCEL
 CONSULTING ENGINEERS
 ST. LOUIS, MO.
 SHEET NO. 19

FINAL PLANS

This drawing is not to scale. Follow dimensions.

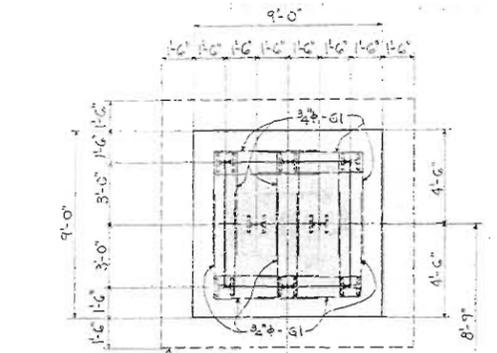
Sheet No. 19 of 5.

J-218

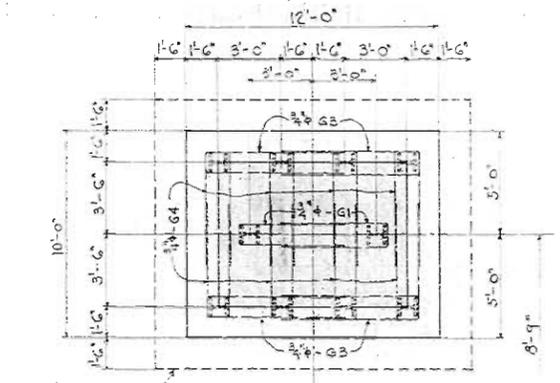


SECTION A-A
(Dowels G7 not shown.)

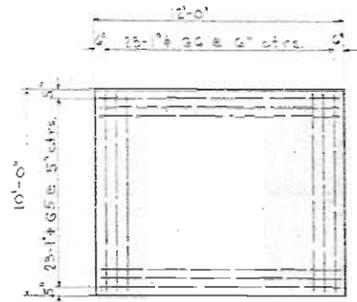
Symm. abt. & of Bridge



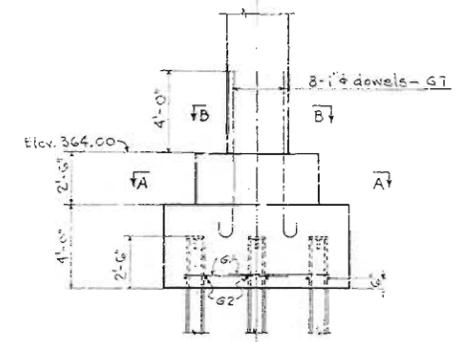
SECTION C-C
(Dowels G7 not shown.)



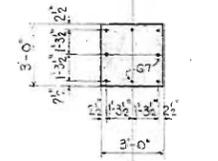
SECTION E-E
(Dowels G8 and Bars G5 and G6 not shown.)



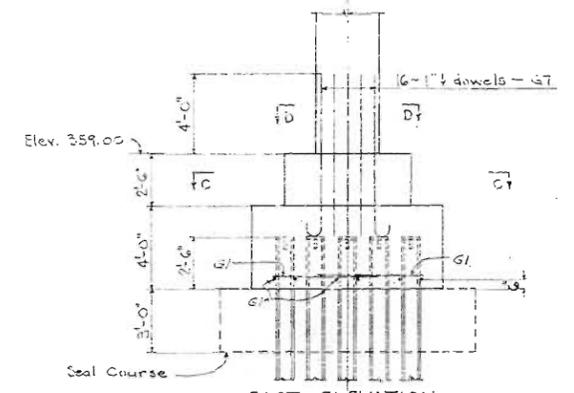
SECTION G-G



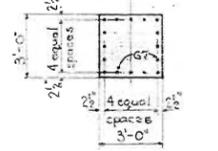
EAST ELEVATION
(6 Piles per footing)



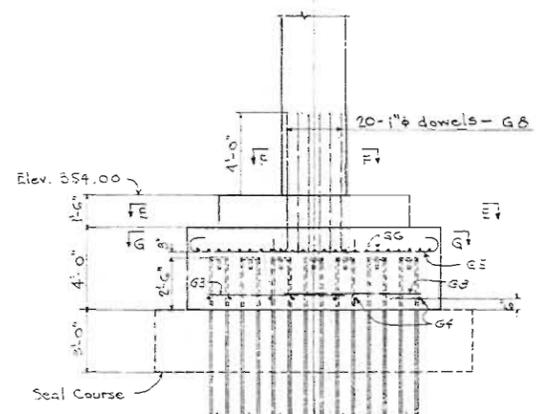
SECTION B-B
BENT 7



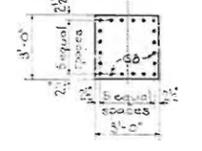
EAST ELEVATION
(8 Piles per footing)



SECTION D-D
BENT 8



EAST ELEVATION
(10 Piles per footing)



SECTION F-F
BENT 9

BAR LIST					
Mark	Qty	Size	Length	Stops	Location
G1	32	3/8"	10'-9"	Bent	Pile Ties
G2	12	do	8'-9"	do	do
G3	8	do	13'-9"	do	do
G4	16	do	11'-9"	do	do
* G5	40	1"	13'-9"	do	Bent 9
G6	40	"	11'-9"	do	do
G7	48	"	9'-0"	do	Dowels
G8	40	"	7'-0"	do	do

* G5 is the same as B19, detailed in original footings for Bent 7 and Bent 8.

NOTE:
The following bars are shown in original bar lists and are superseded by bars shown in Bar List.

- 88 bars B17
- 32 " B18
- * 68 " B19
- 150 " B22

NOTE:
Piles indicated are 10" H Piles @ 57." Points are not required on steel piles on Bents 7, 8, & 9. Pile caps to be as shown on sheet #2.

FINISHED

BRIDGE OVER ST. FRANCIS RIVER
NEAR GREENMILLE, MISSOURI
U.S. ROUTE 67 STA 384 + 16
WAYNE COUNTY

REVISED FOOTINGS FOR BENTS 7, 8, & 9

FINISHED

SVERDRUP AND PARCEL
CONSULTING ENGINEERS
ST. LOUIS, MO.
SHEET NO. 34

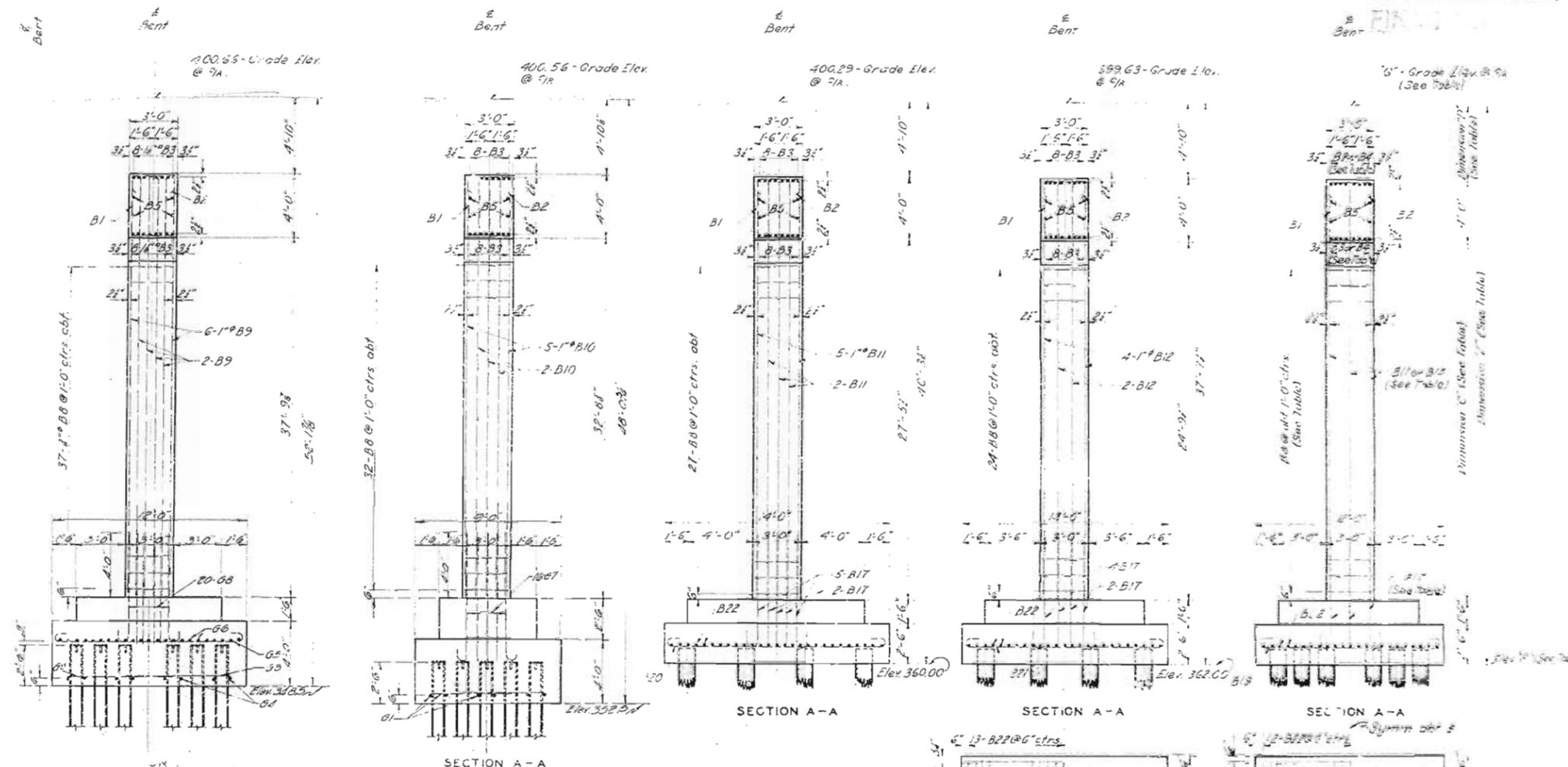
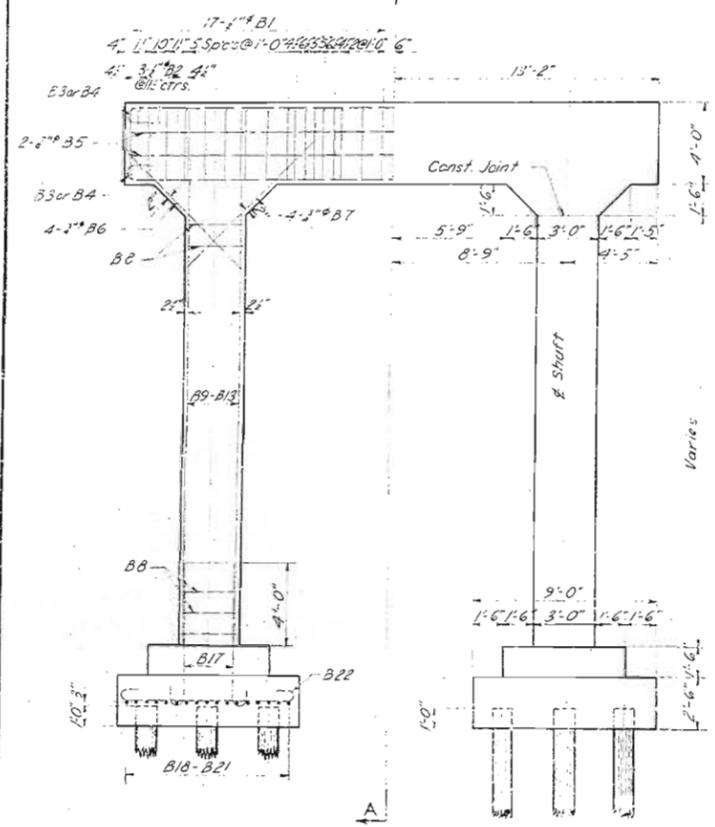
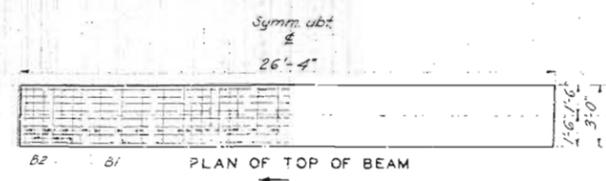
218

405
11/10
Drawn By A.E.P. Mar. 1921
Checked By J.J. Mac Mill

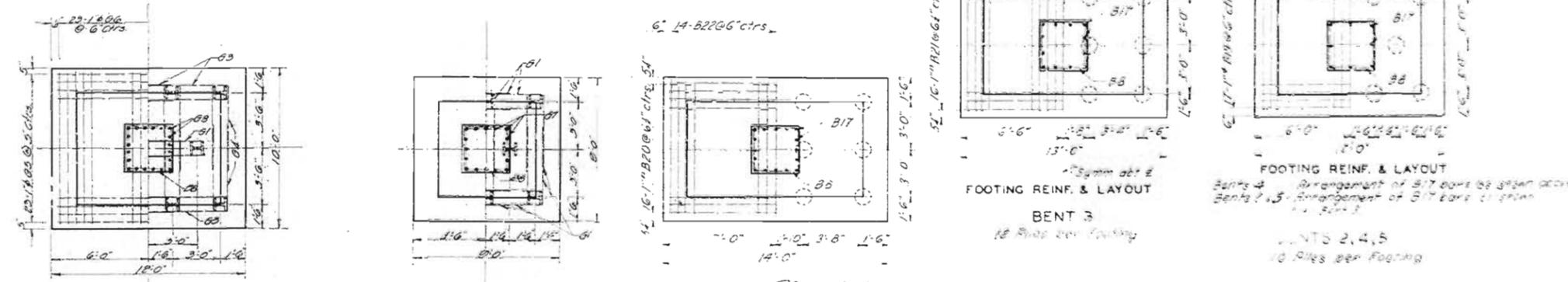
Scale 1/4" = 1'-0"

J-21R

DES. NO.	DATE	REV. NO.	REVISION	BY	CHKD.
5	10/15/40	1			



Bent No.	Elevations	Dimensions	Number of Reinf. Eirs per Bent									
No.	"G"	"F"	"C"	"D"	"E"	16" B3	18" B4	20" B5	22" B6	24" B7	26" B8	28" B9
2	399.11	364.00	22'-5"	4'-10"	33'-3"	16	44	24	24			
4	399.87	362.00	27'-18"	4'-8"	35'-10"	16	52	16	16			
5	400.83	400.00	27'-2"	4'-10"	40'-1"	16	52	24	24			



DETAILS OF BENTS 2-9 INCLUSIVE
For details of Bent 7, see Sheet 5.

BRIDGE OVER ST. FRANCIS RIVER
NEAR GREENVILLE, MISSOURI
U.S. ROUTE 67-556 STA. 366+16
WAYNE COUNTY, MISSOURI

DETAILS OF BENTS 2-9 INCL.

Note: For bearing values and dimensions of actual location of all piling see Sheet No. 5.

This drawing is not to scale. Follow dimensions.

Sheet No. 3 of 5

219

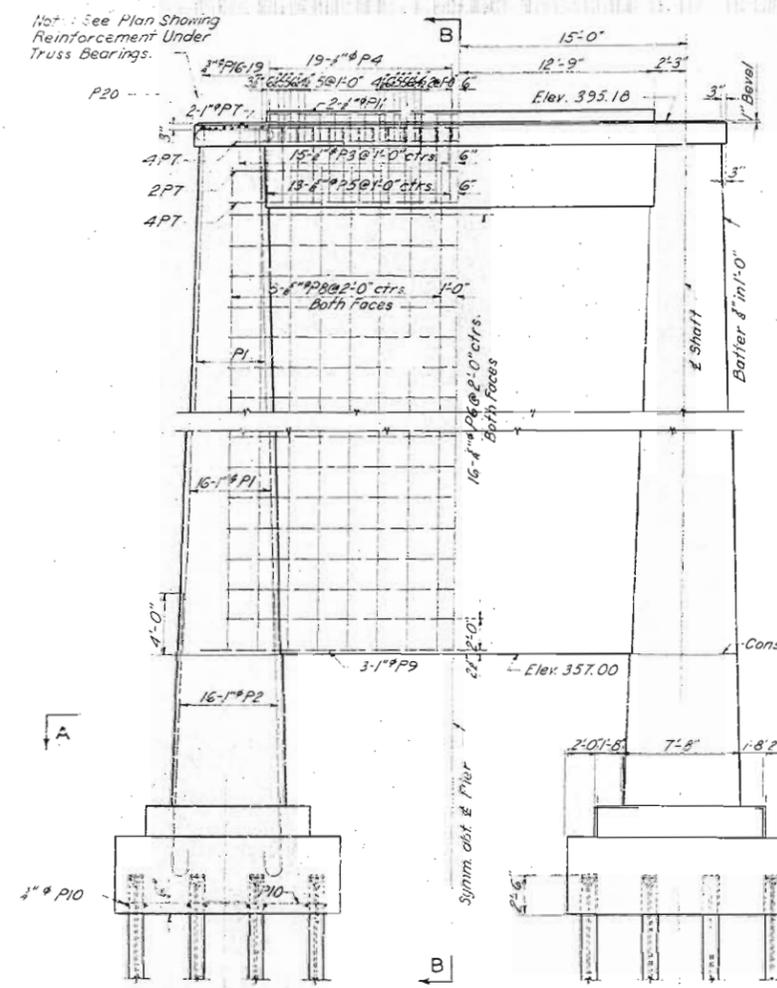
Drawn by L.E.B. Oct. 1940
Checked by L.E.B. Oct. 1940
Checked by L.F. Oct. 1940

FIN.

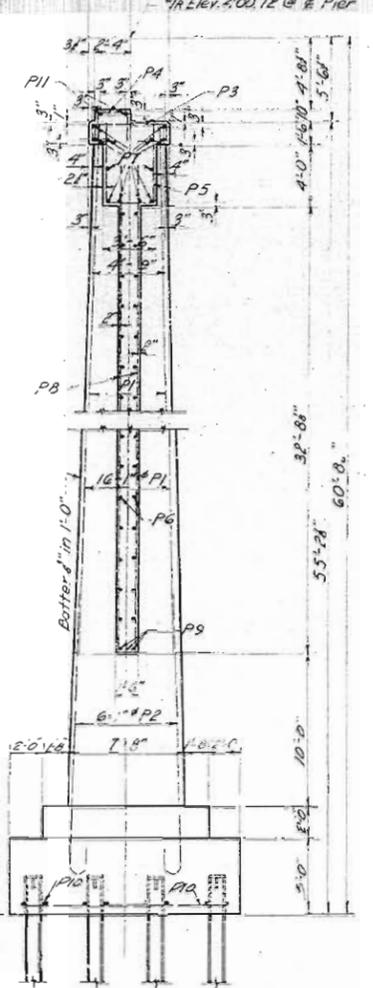
1-11

PROJ. ROAD DIST. STATE	APP. AD. FISCAL YEAR	SHEET NO.	TOTAL SHEETS
B 1 MO	1937-1938	4	11

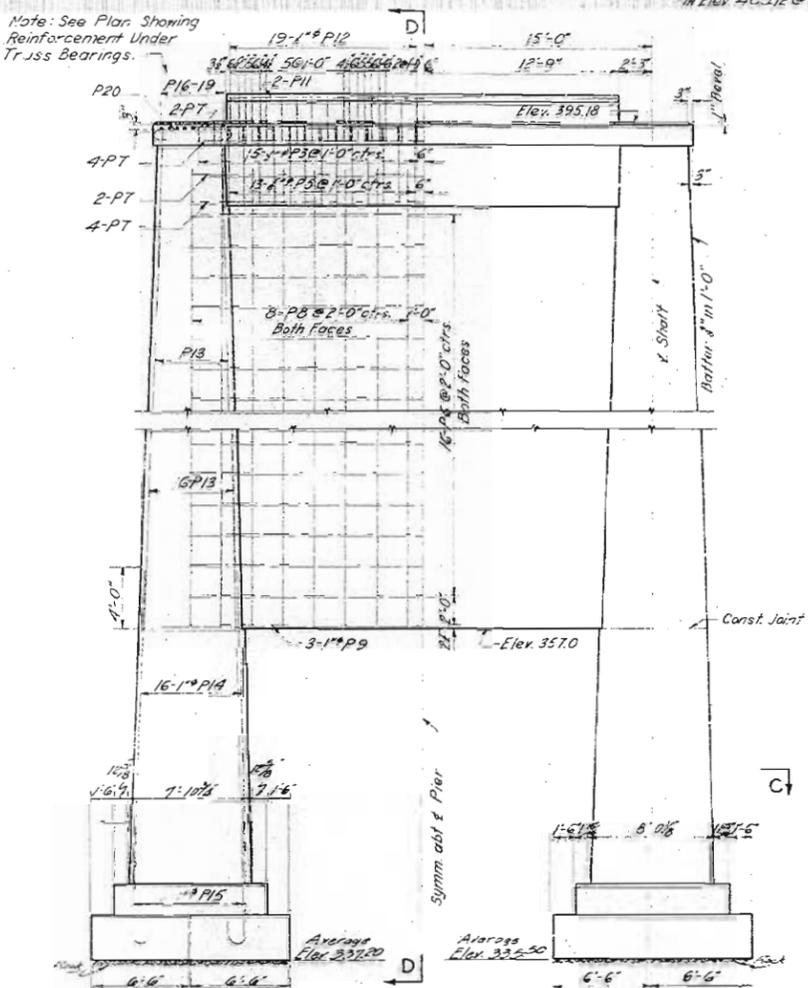
FINAL PLANS



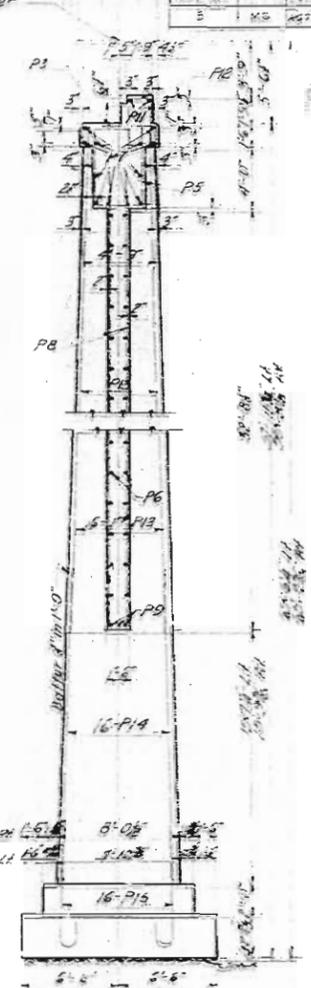
ELEVATION



SECTION B-B

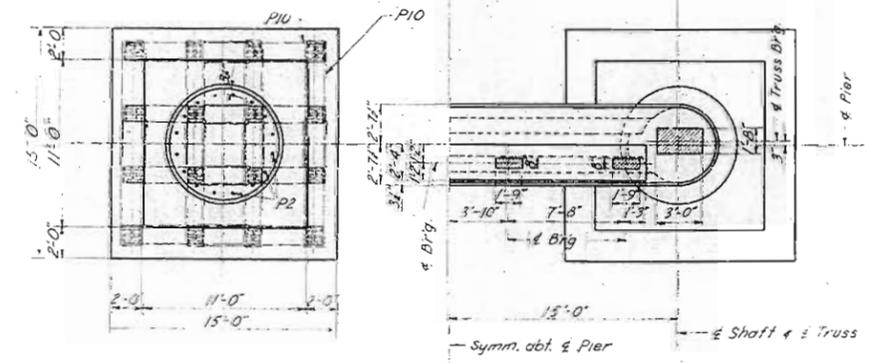


ELEVATION



SECTION D-D

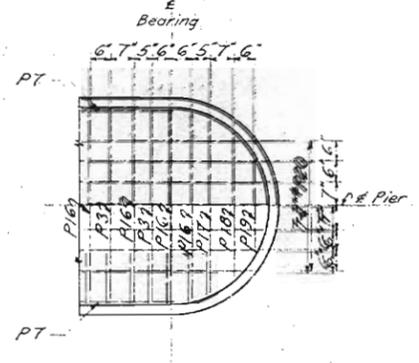
Note: For bearing and dimensions of actual location of piling, see Sheet No. 5-A.



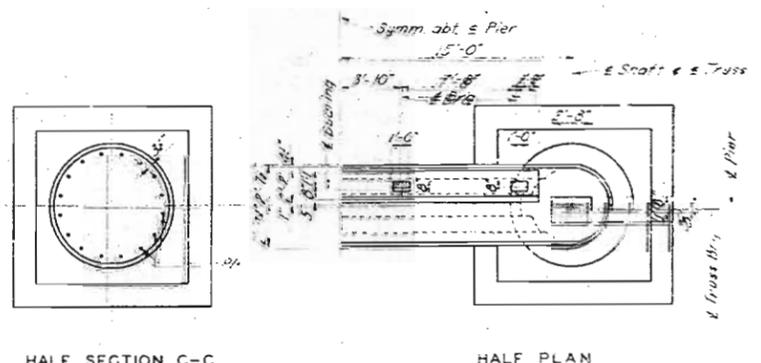
HALF PLAN

HALF SECTION A-A
16 Piles per footing - 10" H @ 57" with pile caps & reinforced tips. See Sheet 5 for details of pile tips. See Sh. 2 for details of pile caps. Same except omit 8" I.

DETAILS OF PIER 10



PLAN SHOWING REINFORCEMENT UNDER TRUSS BEARINGS FOR PIERS 10 & 11



HALF SECTION C-C

HALF PLAN

BRIDGE OVER ST. FRANCIS RIVER
NEAR GREENVILLE, MISSOURI
U.S. ROUTE 67-56557A 365 P.F.E.
WAYNE COUNTY

DETAILS OF PIERS 10 & 11

OVERDRUP AND PARSONS
CONSULTING ENGINEERS
ST. LOUIS, MO.

DETAILS OF PIER 11

Sheet No. 4.5 of 5.

FINAL PLANS

220

Note: This drawing is not to scale. Follow dimensions.

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

SEC/SUR 13 TWP 28N RGE 5E



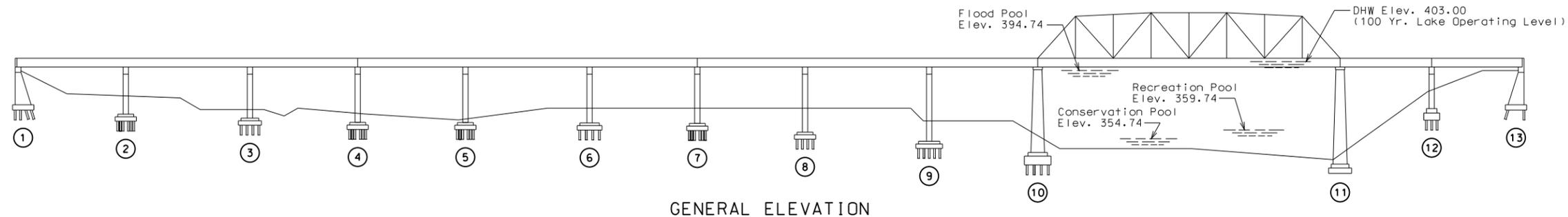
THIS SHEET HAS BEEN SIGNED, SEALED AND DATED ELECTRONICALLY.

DATE PREPARED 2/22/2011

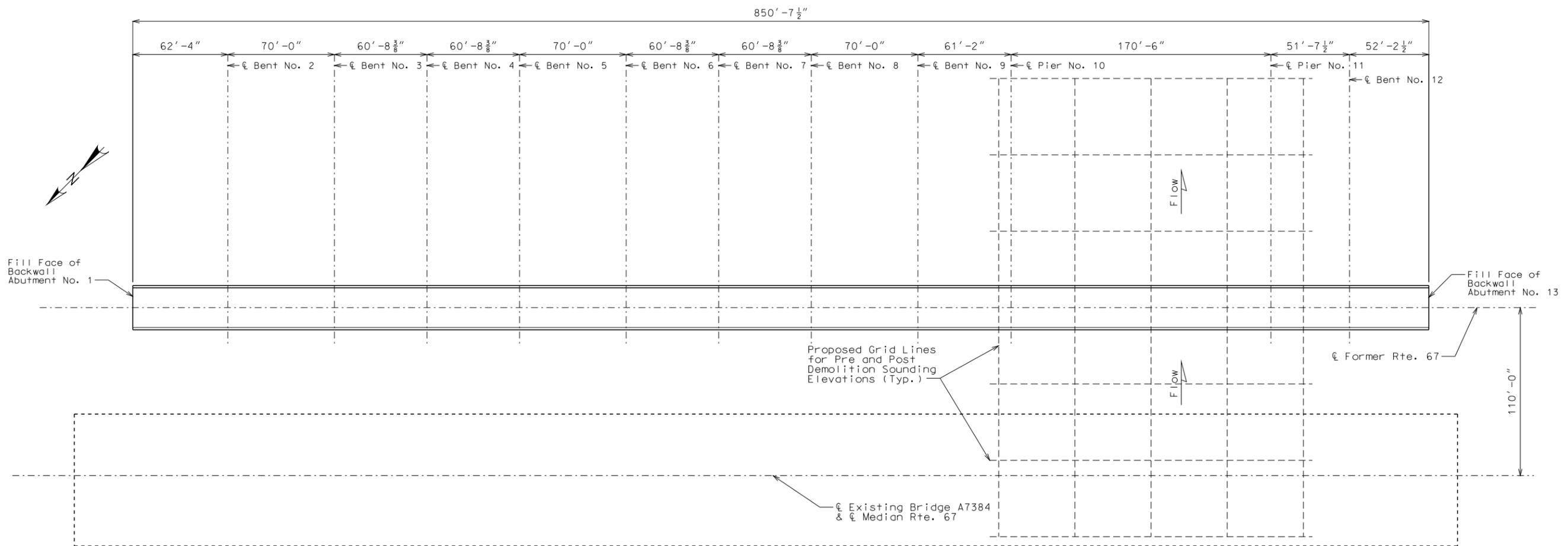
ROUTE 67 STATE MO
DISTRICT BR SHEET NO. 1

COUNTY WAYNE
JOB NO. JOPO931F
CONTRACT ID.

PROJECT NO.
BRIDGE NO. J0021R



GENERAL ELEVATION



PLAN

Estimated Quantities		
Item		Total
Removal of Bridges (J0021R)	lump sum	1

DEMOLITION PLAN FOR FORMER ROUTE 67
BRIDGE J0021R OVER WAPPAPELLO LAKE (ST. FRANCIS RIVER)
WAYNE COUNTY, MISSOURI

DEMOLITION PLAN FOR
BRIDGE OVER WAPPAPELLO LAKE
(ST. FRANCIS RIVER)

STATE ROAD FROM RTE 34 TO RTE 60
NEAR GREENVILLE
STA. 386+16.00±

DESCRIPTION DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

SHOP DRAWINGS FOR STEEL STRUCTURE

Wayne COUNTY BRIDGE NO. J-21

PROJECT NO. USR 67-515-A

INDEX

ERECTION SHEET NOS. _____ THRU _____

GENERAL MATERIALS SHEET NOS. 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57

BOLT LIST SHEET NOS. _____ THRU _____

BEARING DETAILS SHEET NOS. _____ THRU _____

BRIDGE RAILING DETAILS SHEET NOS. _____ THRU _____

PAINT DETAILS SHEET NOS. _____ THRU _____

BLOCKING DIAGRAM SHEET NOS. _____ THRU _____

EXPANSION DEVICE DETAILS SHEET NOS. _____ THRU _____

SHOP WELDED SPLICE DETAILS SHEET NOS. _____ THRU _____

WEB AND FLANGE CUTTING DETAILS SHEETS NOS. _____ THRU _____

DRAIN DETAILS SHEET NOS. _____ THRU _____

DRAINAGE SYSTEM DETAILS SHEET NOS. _____ THRU _____

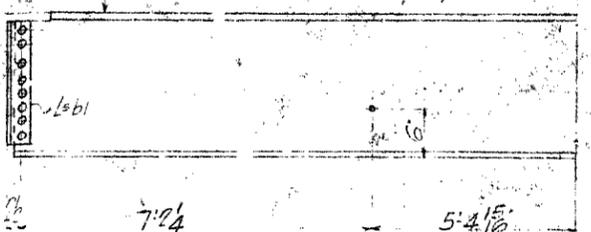
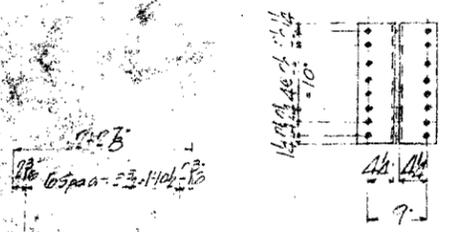
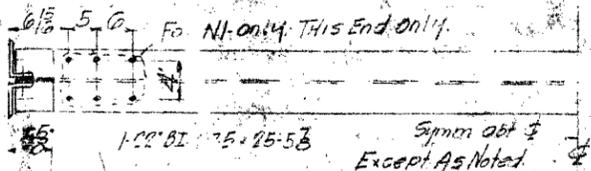
STEEL GRID FLOORING DETAILS SHEET NOS. _____ THRU _____

PEDESTRIAN FENCE DETAILS SHEET NOS. _____ THRU _____

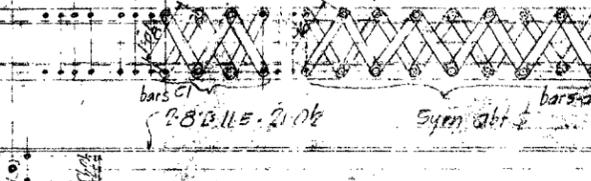
871
148

149

+13/16 25-7 1/2 Back To Back of Ls



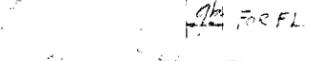
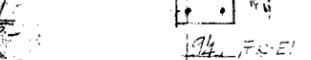
7-333 6-333 1-72 3-3-3 17-Equal Spacing = 10-1/2



Info For 18" Pin

10-1 1/2 PI 2

CI 3/2

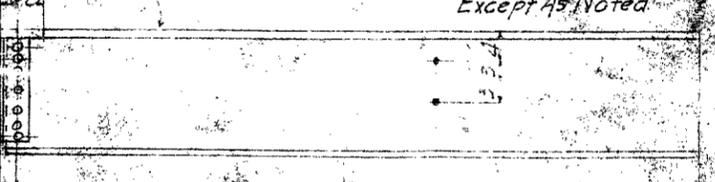


DI 1/8

EI 8 FI 4

+13/16 25-7 1/2 Back To Back of Ls

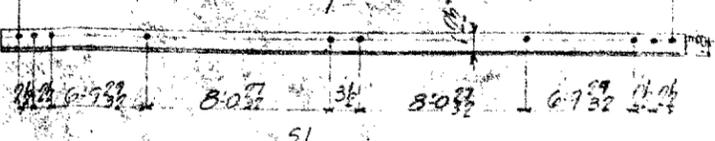
6-5/8 5-6 Fo NI ONLY THIS END ONLY



8-6 1/2 4-0 3/8

GI 10 KI 4

30-11



31-2

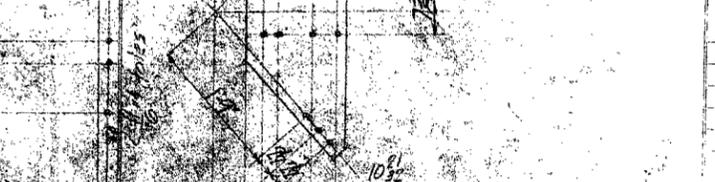
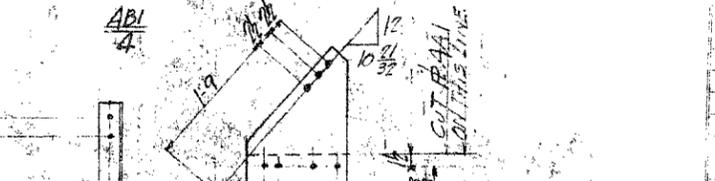
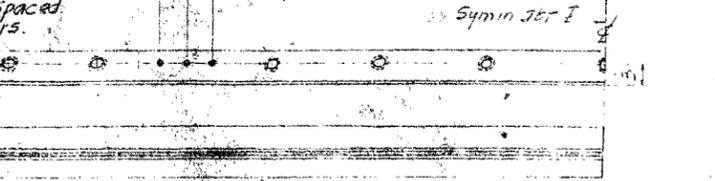
3-3-3-3 3-3-3-3 3-3-3-3 3-3-3-3



VI 5

WI 8

5-10 3/8 3-3 5-0 4



ABI 4

VI 5

SHOP BILL

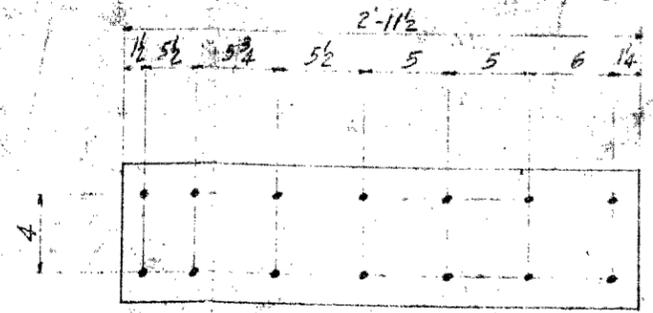
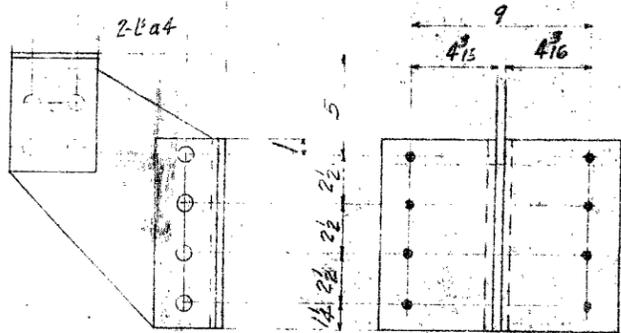
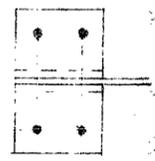
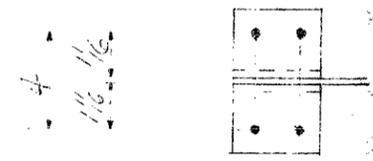
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31	1	31-2	DI		
32	1	32-1	EI		
33	1	33-1	EI		
34	1	34-1	CI		
35	1	35-1	DI		
36	1	36-1	EI		
37	1	37-1	CI		
38	1	38-1	DI		
39	1	39-1	EI		
40	1	40-1	CI		
41	1	41-1	DI		
42	1	42-1	EI		
43	1	43-1	CI		
44	1	44-1	DI		
45	1	45-1	EI		
46	1	46-1	CI		
47	1	47-1	DI		
48	1	48-1	EI		
49	1	49-1	CI		
50	1	50-1	DI		
51	1	51-1	EI		
52	1	52-1	CI		
53	1	53-1	DI		
54	1	54-1	EI		
55	1	55-1	CI		
56	1	56-1	DI		
57	1	57-1	EI		
58	1	58-1	CI		
59	1	59-1	DI		
60	1	60-1	EI		
61	1	61-1	CI		
62	1	62-1	DI		
63	1	63-1	EI		
64	1	64-1	CI		
65	1	65-1	DI		
66	1	66-1	EI		
67	1	67-1	CI		
68	1	68-1	DI		
69	1	69-1	EI		
70	1	70-1	CI		
71	1	71-1	DI		
72	1	72-1	EI		
73	1	73-1	CI		
74	1	74-1	DI		
75	1	75-1	EI		
76	1	76-1	CI		
77	1	77-1	DI		
78	1	78-1	EI		
79	1	79-1	CI		
80	1	80-1	DI		
81	1	81-1	EI		
82	1	82-1	CI		
83	1	83-1	DI		
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91	1	91-1	CI		
92	1	92-1	DI		
93	1	93-1	EI		
94	1	94-1	CI		
95	1	95-1	DI		
96	1	96-1	EI		
97	1	97-1	CI		
98	1	98-1	DI		
99	1	99-1	EI		
100	1	100-1	CI		

Weyerhaeuser Co.
U.S.P.O. - 3156
Sta. 385+10

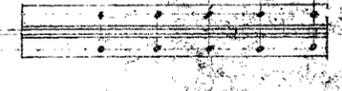
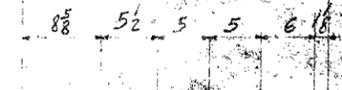
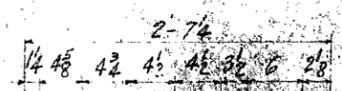
ST. LOUIS STRUCTURAL STEEL COMPANY
ST. LOUIS, MISSOURI

Rev. 1	1/10	CUSTOMER	S. J. Cohen
Rev. 2	1/10	OWNER	
Rev. 3	1/10	STRUCTURE	BRIDGE OVER FRANCIS RIVER
Rev. 4	1/10	LOCATION	CHERRY FIELD, MO.
Rev. 5	1/10	DATE	
Rev. 6	1/10	BY	
Rev. 7	1/10	CHECKED	
Rev. 8	1/10	APPROVED	

150



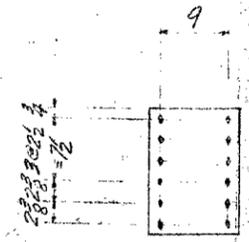
B3
4



F3
4



D3
28



E3
28

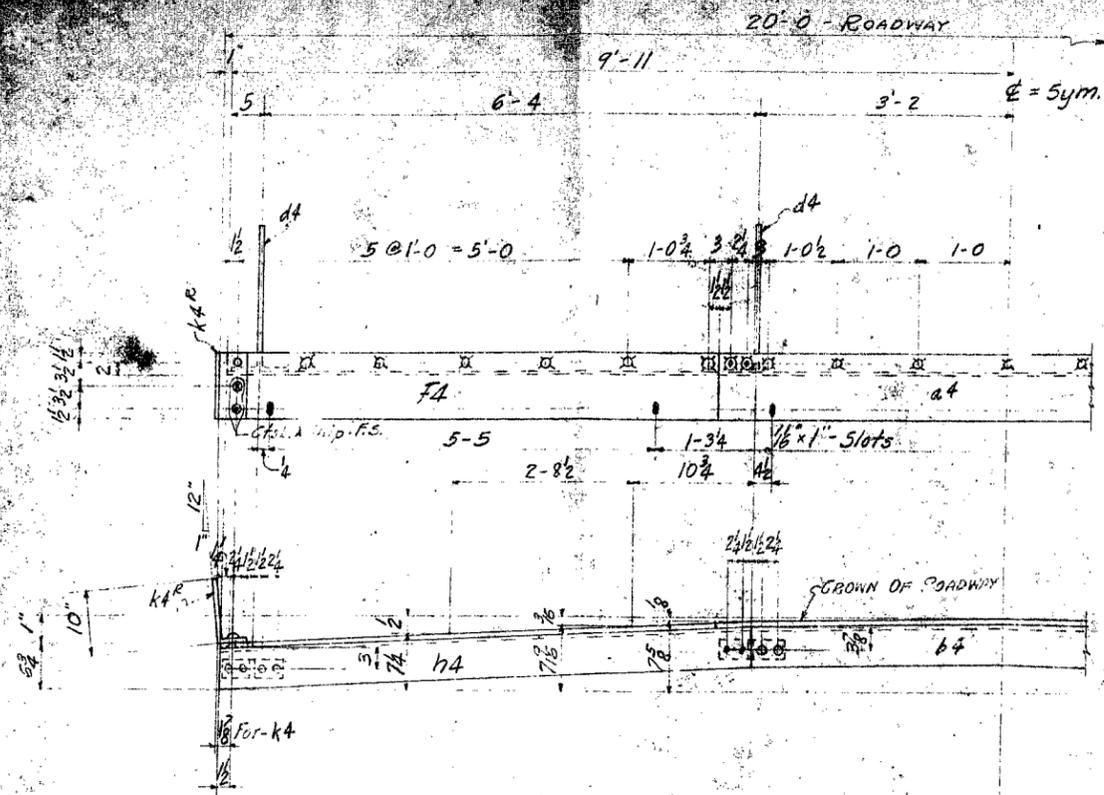
SHOP BILL

Line	No.	DESCRIPTION	QTY	UNIT	PRICE	TOTAL
		A3				
		4				
		4 B-15x8	1.06			
		8 F-2x3x2	0.86	d4		
		8 F-2x3x2	0.93	b4		
		80 Riv. (Shop)				
		A B-7x76	2.11	B3		
		28 B-13x58	1.42	D3		
		28 B-13x8	1.24	E3		
		F3				
		4				
		8 B-3x3x2	2.74			
		4 Fills-2x2	.83	d3		
		8 Riv. (Shop)				
<p>WAYNE CO. U.S. 267-515A OTA 385+108E</p>						

ST. LOUIS STRUCTURAL STEEL COMPANY
EAST ST. LOUIS, ILLINOIS

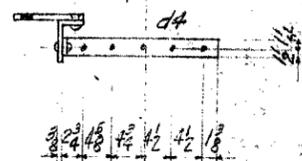
Spec. No.	Scale	DATE	CUSTOMER	CONTRACT
			W. S. GIBBY	285
Rev. Order	Rev. Order	Rev. Order	STRUCTURE	GREENFIELD, ILL.
Rev. Order	Rev. Order	Rev. Order	GREENFIELD, ILL.	3

151



AS SHOWN COMPLETE TO GROWN OF ROADWAY

A4 B4E
1 2



SHOP BILL

QTY	DESCRIPTION	WT. PER UNIT	REQ. LTH.	MARK	WEIGHT
A4					
BEND 1	10 x 3/4	7.22		a4	
BEND 1	L-6 x 3 1/2 x 3/8	6.4		d4	
	11 3/8 B.L. (SHOP)				
	2 B.L. - 24	245.0		d4	
B4E					
	2				
BEND 2	10 x 4	6.82		f4	
BEND 2	L-6 x 3 1/2 x 3/8	6.9		f4	
BEND 2	10 x 3/8	1.14		f4	
	10 3/8 B.L. (SHOP)				
	2 B.L. - 24	245.0		d4	
	34 BOLTS 3/4	12			

NOT INCLUDED IN STRUCT. STEEL WTS

WAYNE CO
U.S.R. 07-515A
OTA 383 + 10.00

Send Prints

ST. LOUIS STRUCTURAL STEEL COMPANY
EAST ST. LOUIS, ILLINOIS

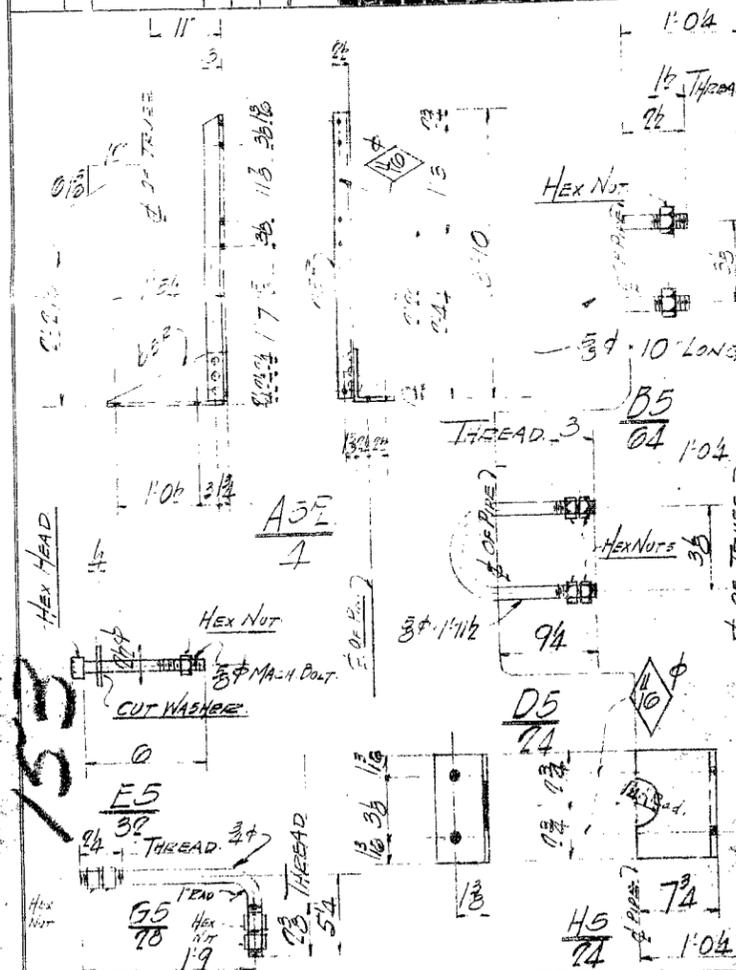
Job No.	116	CUSTOMER	S. J. CONER	CONTRACT	2865
Site		OWNER			
Struct.		STRUCTURE	BRIDGE OVER SPIRITUALS BRIDGE		
Loc.		LOCATION	GREENFIELD, MO.		
Drawn by		Checked by			

WORK WITH SHEET No. 13

SHOP BILL										WEIGHTS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
ITEM No.	QTY	DESCRIPTION	WT. PER UNIT	MARK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028

SHOP BILL

Notes	No. Pcs.	DESCRIPTION	Req. Lgh.		MARK	Temp.	Dn.	Ls.	Pcs.	Dn.	Dn.	Dn.	Dn.	Dn.	Dn.	Dn.	Dn.	Dn.	WEIGHTS	
			Fr.	In.															Pieces	Total
		A57																		
	1	3.75 x 4	3.75	4																
	1	1.75 x 7.5	1.75	7.5																
	1	2.5 x 10 P.C.S.	2.5	10																
	6	5/8"	0	10	D5															
	120	3/8 Hex Nuts																		
	10	5/8"	1	10	D5															
	90	3/8 Hex Nuts																		
	30	3/8 x 1.0 M.D.	0	6	F5															
	30	3/8 x 1.0 CUT WASHERS																		
	30	3/8 Hex Nuts																		
	13	5/8"	1	2	F5															
	112	3/8 Hex Nuts																		
	24	1/2 x 9/16	3	4	5/8 H5															

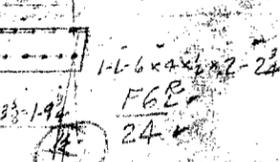
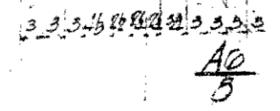
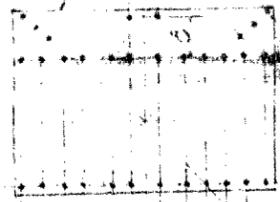


ST. LOUIS STRUCTURAL STEEL COMPANY
EAST ST. LOUIS, ILLINOIS

Rev. 310	Notes 127	S. OMER	3. J. SOWEN	CONTRACT	7855
Rev. Spacing	Exc. Noted				
Rev. Distance	Exc. Noted				
Paint 1/2" x 1/2"		STRUCTURE	BRIDGE OVER ST. FRANCIS RIVER	LOCATION	GREENFIELD, MO.
Inspector	Checked by	Revision 1	3	2	5
		Record 2	4	0	5

SHOP BILL

Item No.	Description	Qty	Unit	Weight	Price	Total
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
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46
47
48
49
50



ST. LOUIS STRUCTURAL STEEL COMPANY
EAST ST. LOUIS, ILLINOIS

Order No.	108	Customer	J. J. COHEN	Contract No.	9885
Div. Name	...	Owner	...	...	...
Job Name	...	Structure	ST. FRANCIS DRIVE	...	...
...	...	Location	...	...	...
...	...	Made by	...	...	...
...

SHOP DRAWINGS FOR STEEL STRUCTURE

Wayne COUNTY BRIDGE NO. J-21R

PROJECT NO. S-15B

INDEX

ERECTION SHEET NOS. E1 THRU E2

GENERAL MATERIALS SHEET NOS. 1, 1 THRU 2, 1 THRU 8
1859A

BOLT LIST SHEET NOS. R1 THRU _____

BEARING DETAILS SHEET NOS. M1 THRU M2

BRIDGE RAILING DETAILS SHEET NOS. _____ THRU _____

PAINT DETAILS SHEET NOS. _____ THRU _____

BLOCKING DIAGRAM SHEET NOS. _____ THRU _____

EXPANSION DEVICE DETAILS SHEET NOS. _____ THRU _____

SHOP WELDED SPLICE DETAILS SHEET NOS. _____ THRU _____

WEB AND FLANGE CUTTING DETAILS SHEETS NOS. _____ THRU _____

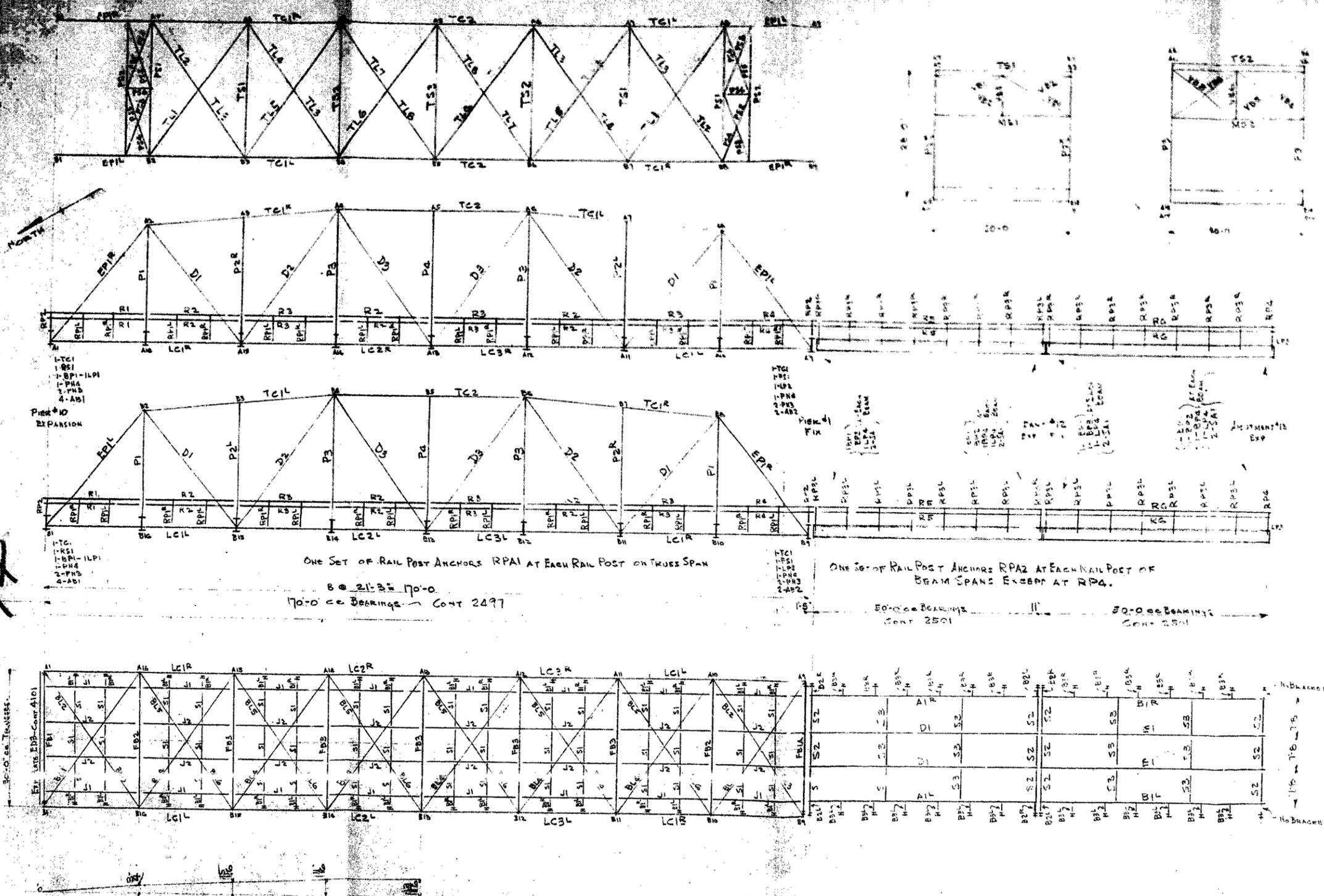
DRAIN DETAILS SHEET NOS. _____ THRU _____

DRAINAGE SYSTEM DETAILS SHEET NOS. _____ THRU _____

STEEL GRID FLOORING DETAILS SHEET NOS. _____ THRU _____

PEDESTRIAN FENCE DETAILS SHEET NOS. _____ THRU _____

93



GENERAL INFORMATION

WORK TO CONFORM TO MISSOURI SPECIFICATIONS
 HOLES IN TRUSS SPAN AND BEAMS UNLESS NOTED.

HOLES IN I-BEAM APPROXIMATE 3/4"
 HOLES FOR FIELD CONNECTIONS SHALL BE SUBPUNCHED AND BEAMS IN MATERIAL FORMING A PART OF THE SECTION OF MAIN MEMBERS, IF THE THICKNESS OF THE MATERIAL IS NOT GREATER THAN THE NOMINAL DIAMETER OF THE RIVETS. HOLES MAY BE PUNCHED FULL SIZE IN THE MATERIAL USED FOR LATERAL LONGITUDINAL AND SWAY BRACING, LACING BARS, GIRT PLATES AND DIAPHRAGMS NOT FORMING A PART OF THE SECTION OF MAIN MEMBERS. IF THE THICKNESS OF THE MATERIAL IS NOT GREATER THAN THE NOMINAL DIAMETER OF THE RIVETS, HOLES SHALL BE DRILLED IN MATERIAL HAVING A THICKNESS GREATER THAN THE NOMINAL DIAMETER OF THE RIVETS.

FOR 7/8" FIELD RIVETS SUBPUNCH 1/16"
 FOR 1" FIELD RIVETS SUBPUNCH 1/8"

BEAMS IN SHOP AFTER ASSEMBLING. MATCHMARK SHOP PANTS ONE COAT RED LEAD. FLOOR BEAM AND STRINGER CONNECTIONS SHALL BE SUBPUNCHED AND REWORKED TO A METAL TEMPLATE.

97

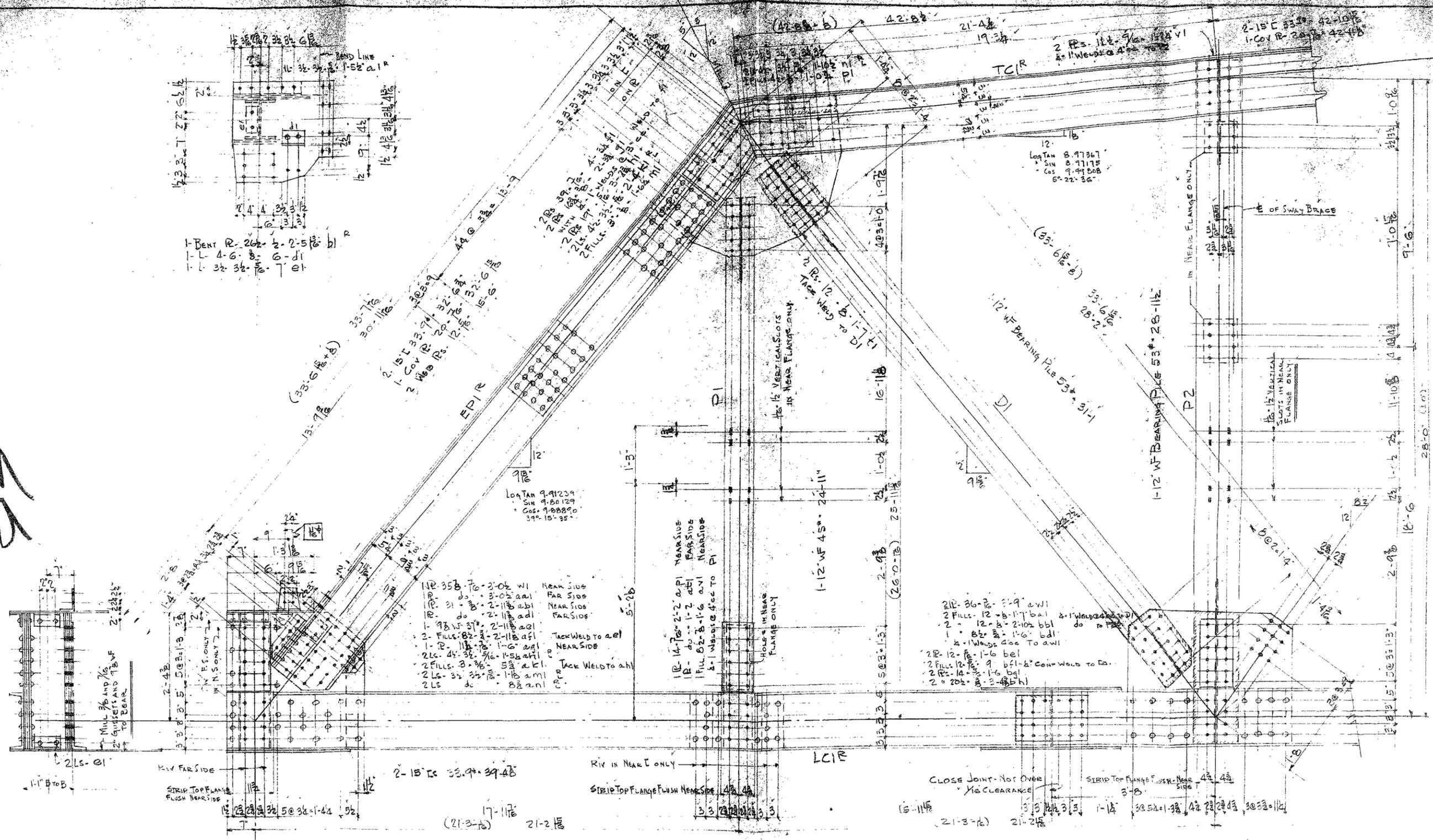
ONE SET OF RAIL POST ANCHORS RPA1 AT EACH RAIL POST ON TRUSS SPAN
 8 @ 21'-3" @ 170'-0"
 170'-0" @ BEARINGS - CONT 2497

ONE SET OF RAIL POST ANCHORS RPA2 AT EACH RAIL POST OF BEAM SPANS EXCEPT AT RPA.
 50'-0" @ BEARINGS - CONT 2501
 50'-0" @ BEARINGS - CONT 2501

ILLINOIS STEEL BRIDGE CO.
 JACKSONVILLE, ILLINOIS
 SHOP NO. 2497-2501

PROJECT U.S. 67 - ST. LOUIS BRIDGE
 WATSON, MO.
 MADE BY BILSON - JAN 1941
 CHK. BY

97



Log TAN 9.91239
 SIN 9.60129
 COS 9.88890
 34° 15' 35"

1R 35B 76-3-02 W1 NEAR SID
 1R 21 do 3-02 aal FAR SID
 1R 21 do 2-11B a bi NEAR SID
 1R 21 do 2-11B a di FAR SID
 1R 14 1/2 31 2-11B a al JACK WELD TO a al
 2 FILL 82-3 2-11B a al NEAR SID
 1 R 11 1/2 10 1-6 a al
 2 LG 4-3 3/8 1-5 a al
 2 FILL 3 3/8 5 1/2 a al
 2 LS 3 3/8 1-6 a al
 2 LS d 1-6 a al

2R 36-76 3-9 a w 1
 2 FILL 12-B-17-1 a l 1/2 WELD TO DI
 2 12-B-2-102 b b l do P2
 1 82 3/8 1-6 b d l
 1/2 WELD TO a w 1
 2R 12-1/2 1-6 b e l
 2 FILL 12-1/2 1-6 b e l
 2 R 14-1/2 1-6 b a l
 2 202 3/8 1-6 b h l

- MAKE- 4- END POSTS EP
- 4- TOP CHORDS TP
- 4- POSTS P1
- 4- DIAGONALS DI
- 4- LOWER CHORDS LC

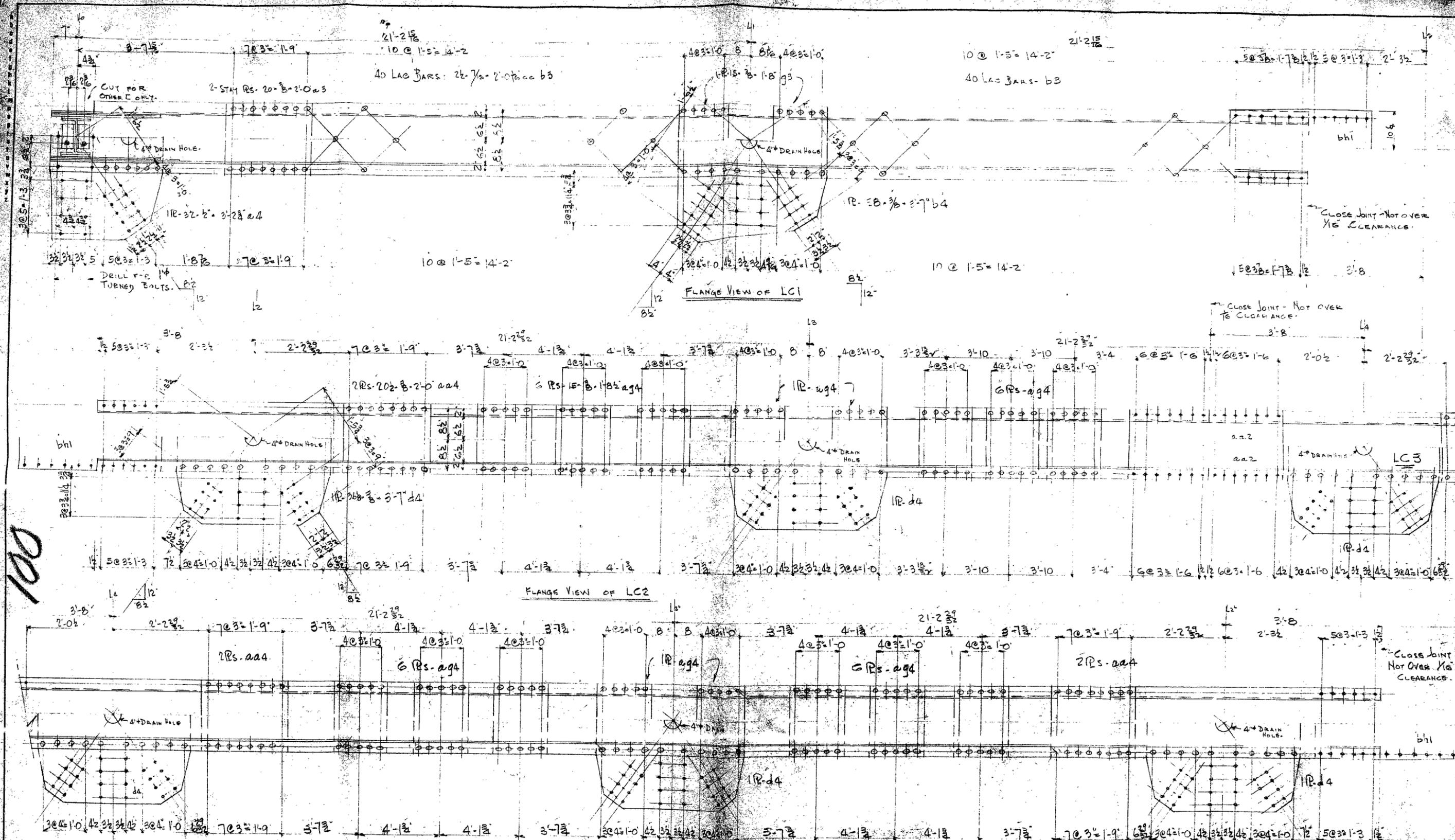
Rivets 7/8" UNLESS NOTED
 HOLES 3/16"
 SEE SHEET E1 FOR REAMING NOTES

ILLINOIS STEEL BRIDGE CO
 JACKSONVILLE, ILLINOIS

SHOP NO. 2497

PROJECT U.S. RT 67 - SIEB - STA 386+115
 WATNECO Mo.

MADE BY D. J. JAN 1961
 CHK. BY
 SHEET OF 2



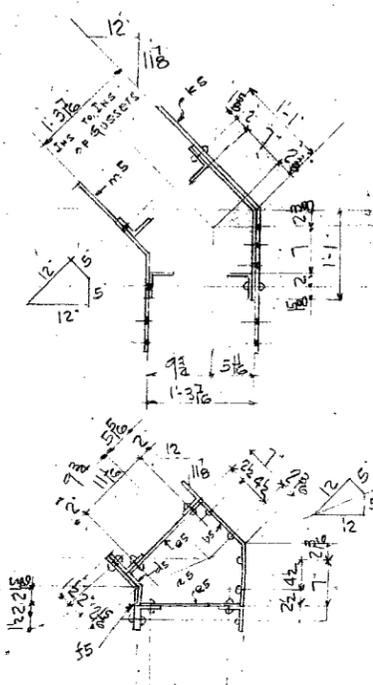
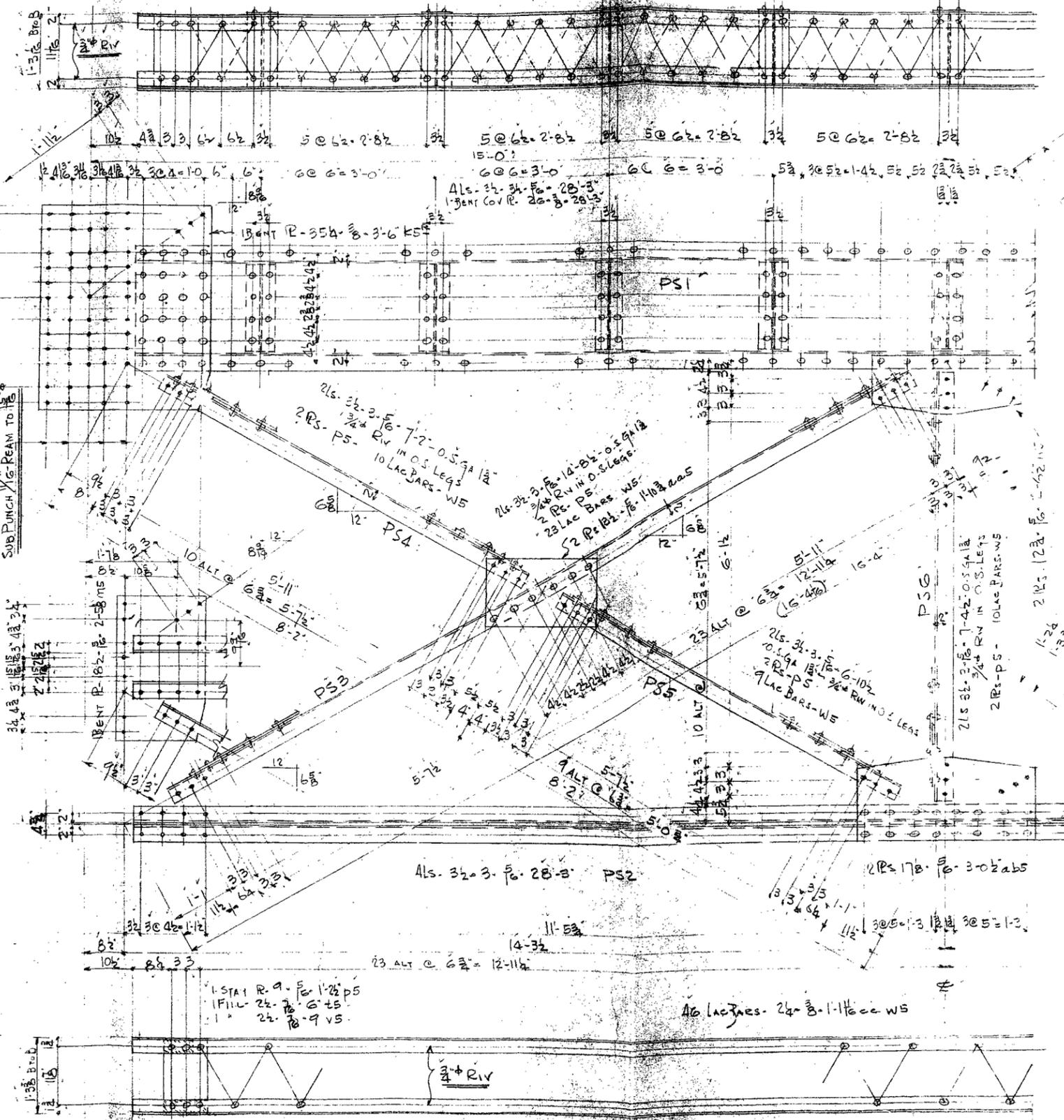
100

Riv $\frac{7}{8}$ UNLESS NOTED
 HOLES $\frac{1}{16}$
 SEE SHEET E1 FOR REAMING NOTE

ILLINOIS STEEL BRIDGE CO. JACKSONVILLE, ILLINOIS	
SHOP NO. 2497	
PROJECT D.S. BT 67-515B-308016	
WARRICK CO. MO.	
MADE BY DIXON - JAN 1941	SHEET 26
CHK BY	OF 25

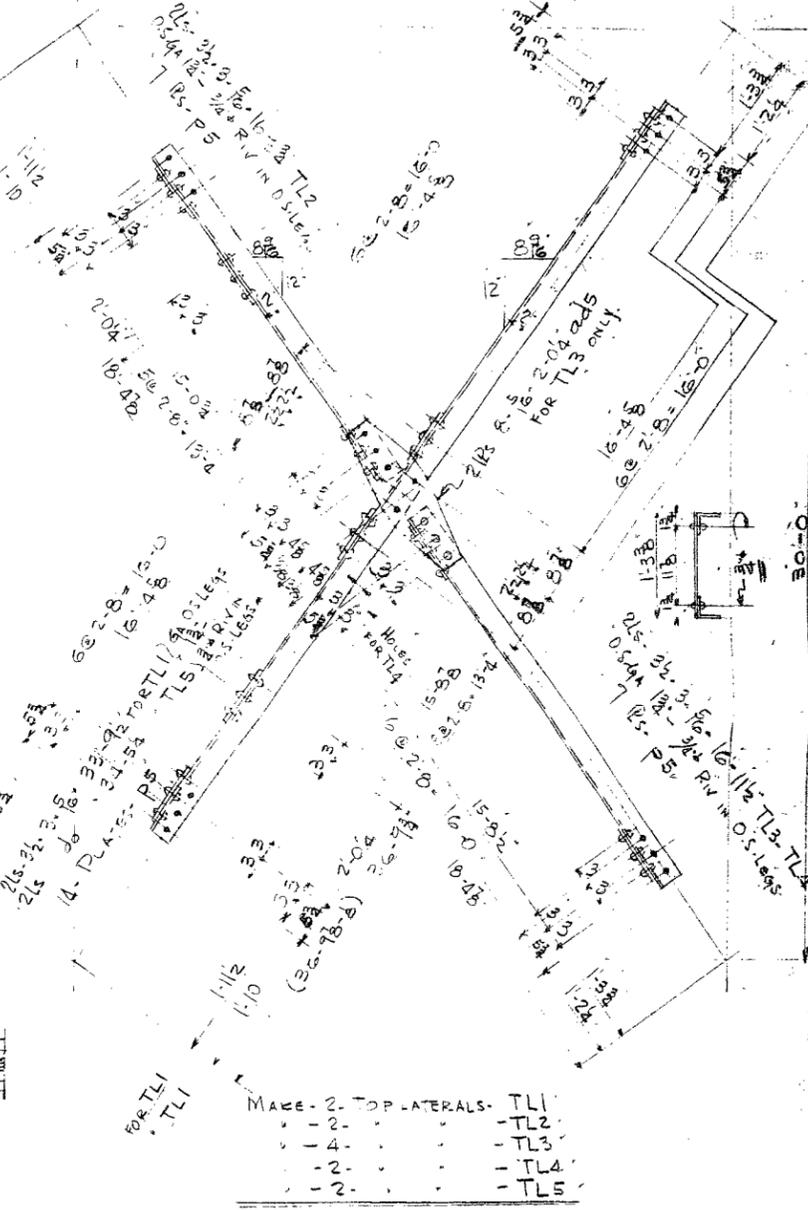
9 DIAPHRAGMS 'A'
 9 BENT RIS - 6 @ 30'-10" B⁵
 4 STAT RIS - 4 @ 30'-10" B⁵
 88 LAC BARS - 24 @ 3'-10" @ 115

21-44



MATERIAL IN DIAPHRAGM 'A'
 1R-10.5 @ 3'-10" B⁵
 1BENT RIS - 6 @ 30'-10" B⁵
 2 PL PS - 3 @ 11" @ 5
 WEAR FLANGE PS TO AS
 WITH 3/8" NUBS 4 @
 BOTH SIDES.

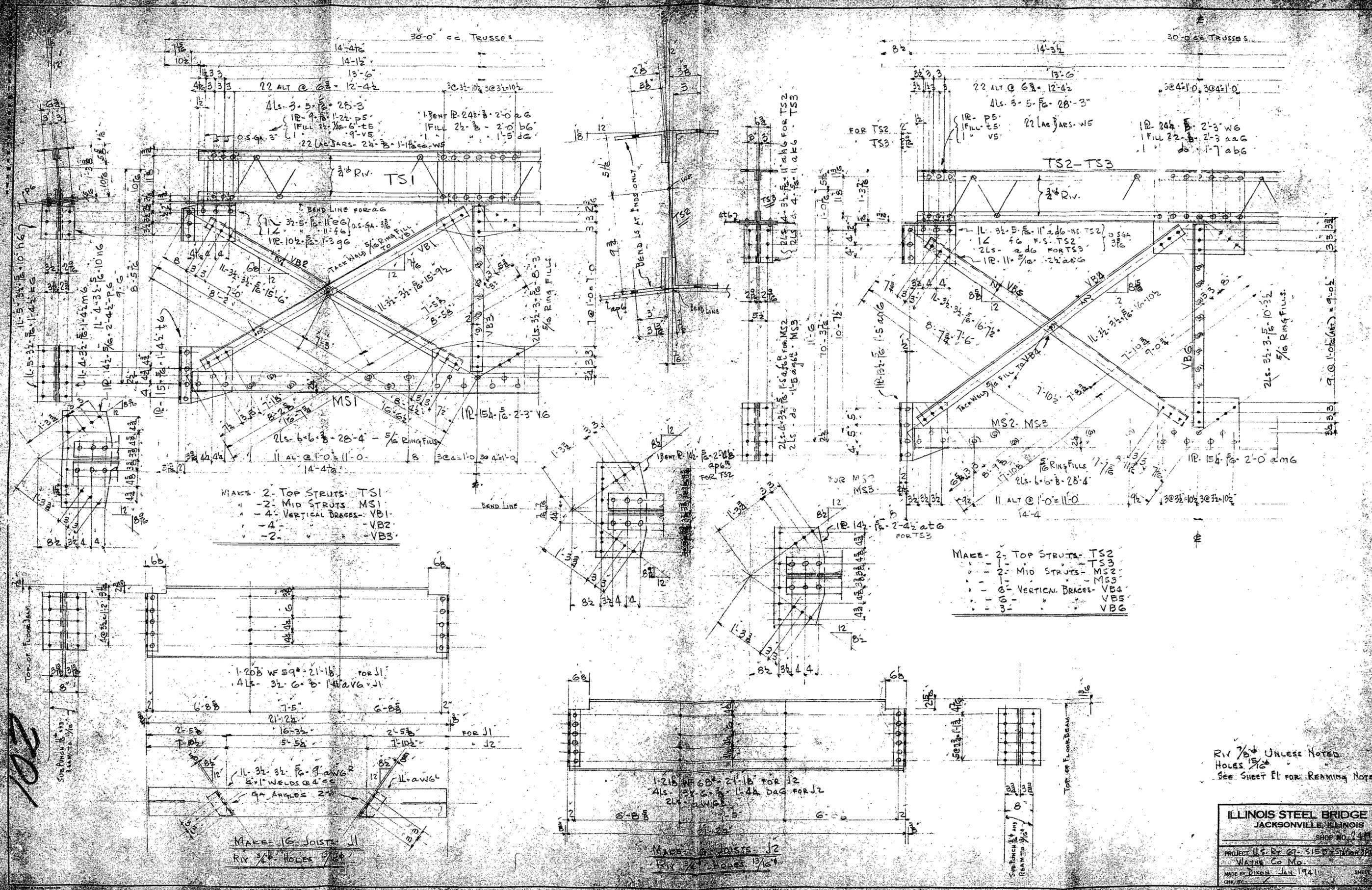
MAKE 2 PARTIAL SECTIONS - PS1
 - 2 - PS2
 - 4 - PS3
 - 4 - PS4
 - 4 - PS5
 - 2 - PS6



MAKE 2 TOP LATERALS - TL1
 - 2 - TL2
 - 4 - TL3
 - 2 - TL4
 - 2 - TL5

RIVETS 7/8" UNLESS NOTED
 HOLES 15/16"
 REAMING AS NOTED

ILLINOIS STEEL BRIDGE CO.
 JACKSONVILLE, ILLINOIS
 SHOP NO. 2497
 PROJECT U.S. R. 67 - SIB - STATION 384+10
 WAYNE Co. Mo.
 MADE BY DIXON - JAN. 1941
 CHECK BY



- MAKE - 2 - TOP STRUTS - T1
 - 2 - MID STRUTS - MS1
 - 4 - VERTICAL BRACES - VB1
 - 4 - VB2
 - 2 - VB3

- MAKE - 2 - TOP STRUTS - T2
 - 2 - MID STRUTS - MS2
 - 6 - VERTICAL BRACES - V4
 - 3 - V5
 - 3 - V6

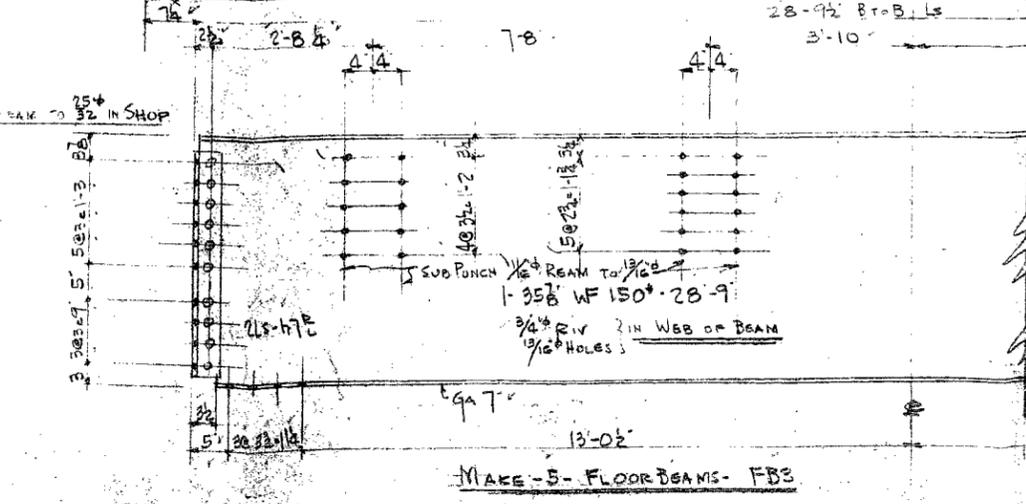
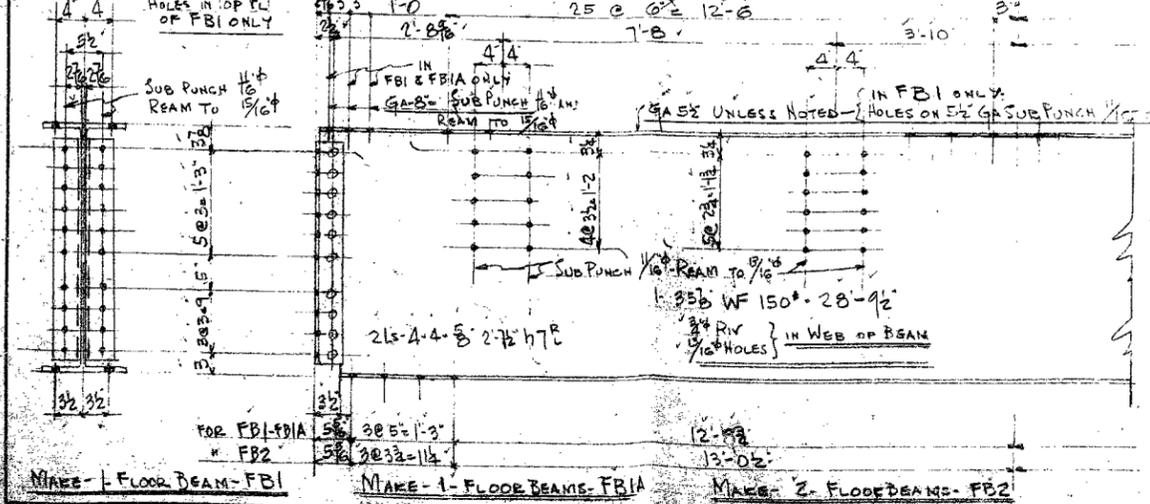
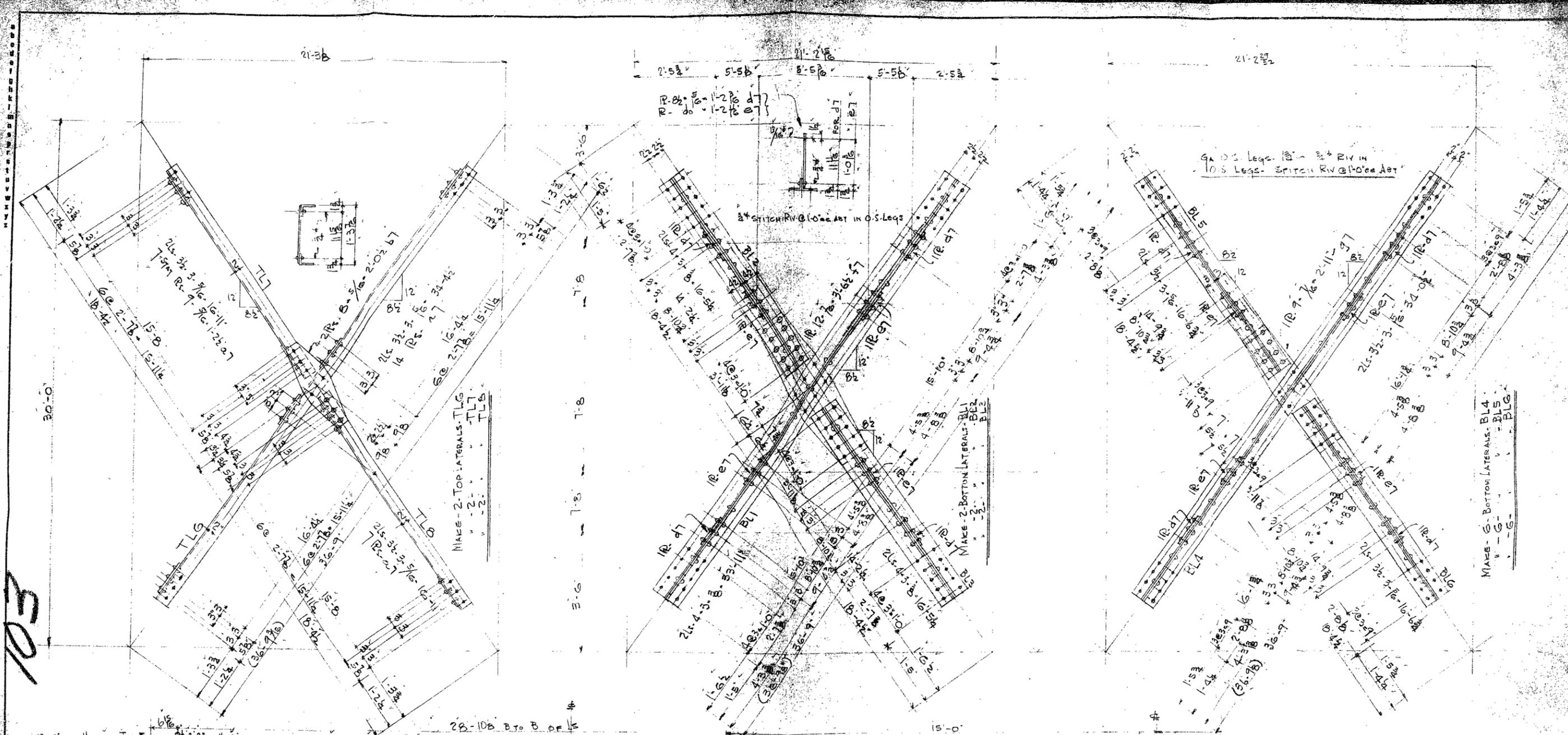
MAKE 16 JOISTS J1
 Riv 3/8" HOLES 13/16"

MAKE 16 JOISTS J2
 Riv 3/8" HOLES 13/16"

Riv 7/8" UNLESS NOTED
 HOLES 15/16"
 SEE SHEET E1 FOR REMAINING NOTES

ILLINOIS STEEL BRIDGE CO
 JACKSONVILLE, ILLINOIS
 SHOP NO. 24477
 PROJECT U.S. Rt. 67 - SIB. ST. BRIDGE
 VITALE Co. Mo.
 MADE BY DIXON JAN 1941

102



RIV 3/8" UNLESS NOTED
HOLES 1/16"
SEE SHEET E1 FOR REAMING NOTE

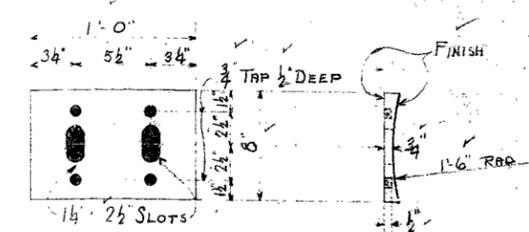
ILLINOIS STEEL BRIDGE CO.
JACKSONVILLE, ILLINOIS
SHOP NO. 2497

PROJECT U.S. RT 67 - SIEM STATION 284+16
WAYNE CO. MO.

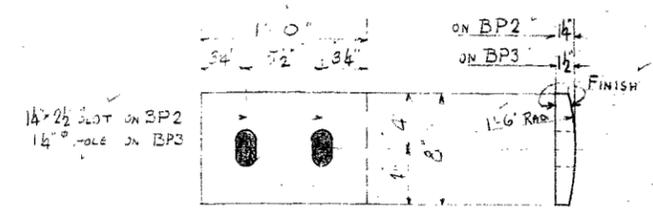
MADE BY DEON - JAN 1941
CHK. BY _____ SHEET OF 8

103

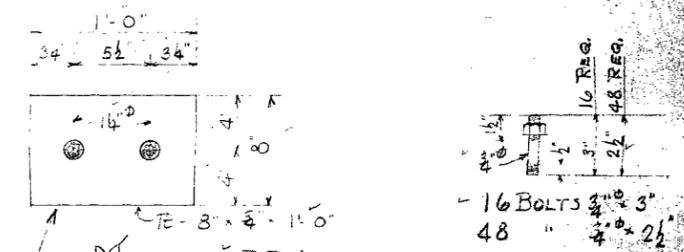
SP1



MAKE-16-BP1
(CAST STEEL OR GRAY IRON ALLOY)



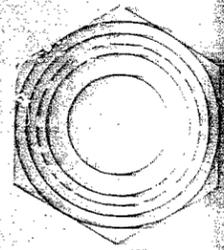
MAKE-8-BP2
" - 8-BP3
(CAST STEEL OR GRAY IRON ALLOY)



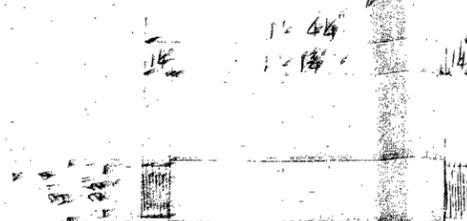
MAKE-8-BP4
(CAST STEEL OR GRAY IRON ALLOY)
FINISH BOTH SIDES

BRG. DEVICES FOR 2-50' I SPANS

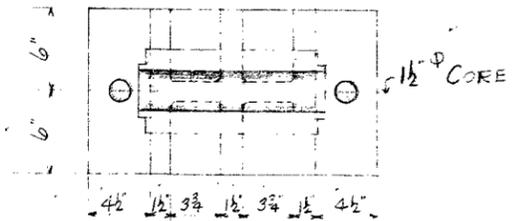
ILLINOIS STEEL BRIDGE CO. JACKSONVILLE, ILLINOIS	
SHOP NO.	
PROJECT U.S. RT. 67-515B, STA. 3+50+16	
WAYNE COUNTY, MO.	
MADE BY S.N.C. 12-16-40	SHEET 11
CHK BY EEL	OF 11



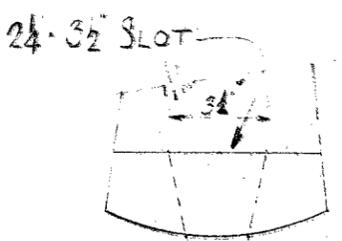
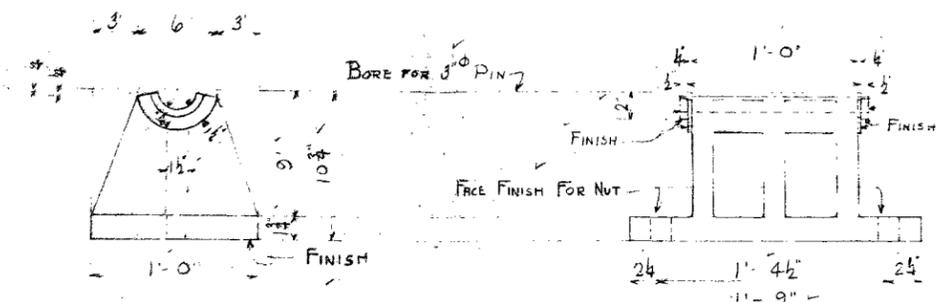
MAKE-36-N1
(CAST STEEL NUTS)



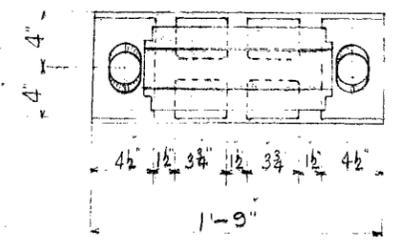
MAKE-48-PIN-PN2
(ROLLED STEEL)



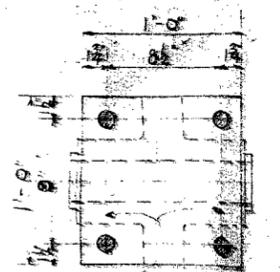
MAKE-12-FS2
(CAST STEEL)



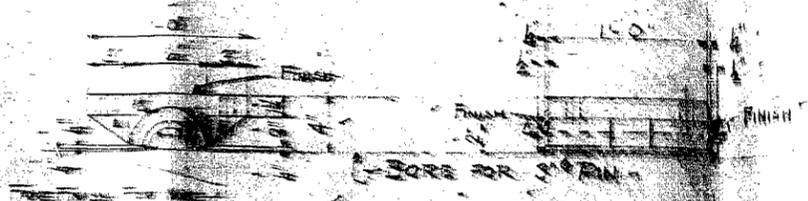
DETAIL OF SLOT IN ROCKER
SCALE 4" = 1'-0"



MAKE-36-RS2
(CAST STEEL)



DRILL FOR 1/2" TURNED BOLTS



MAKE-48-TC2
(CAST STEEL)

-NOTE-

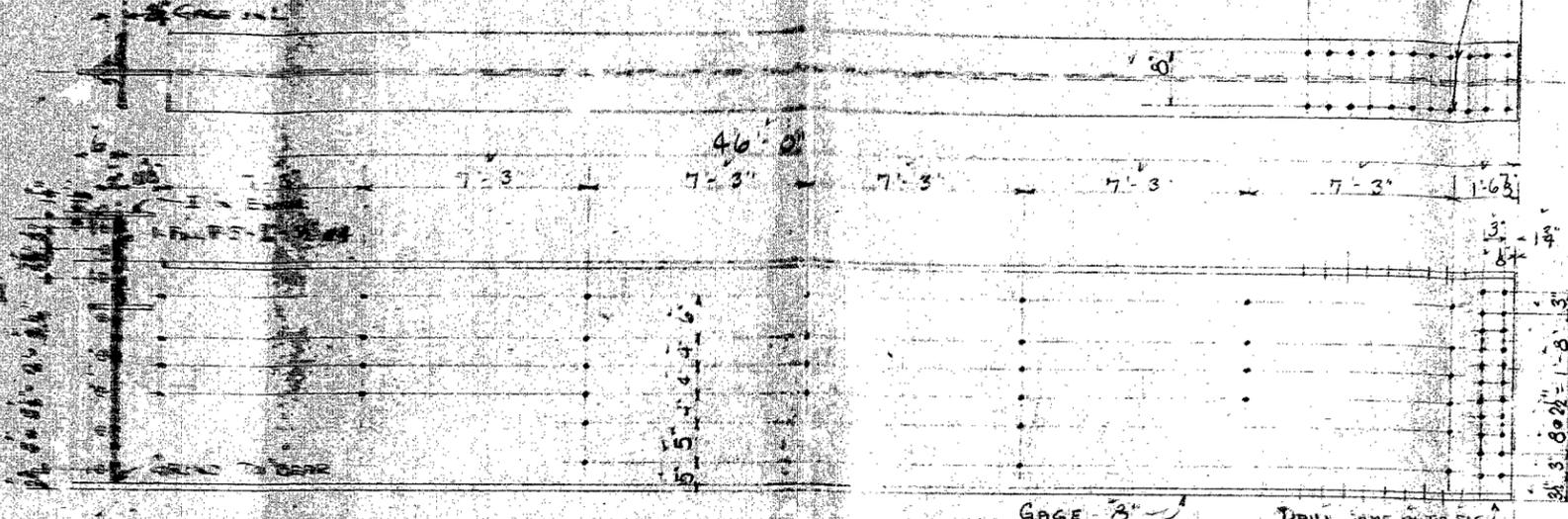
ALL FLETS SHALL HAVE 1/4" RADIUS.
FINISH ALL SURFACES AS MARKED.
ALL FINISHED SURFACES SHALL BE PAINTED
ONE COAT OF WHITE LEAD AND TALLOW AS PER
MISSOURI SPECIFICATIONS.

101

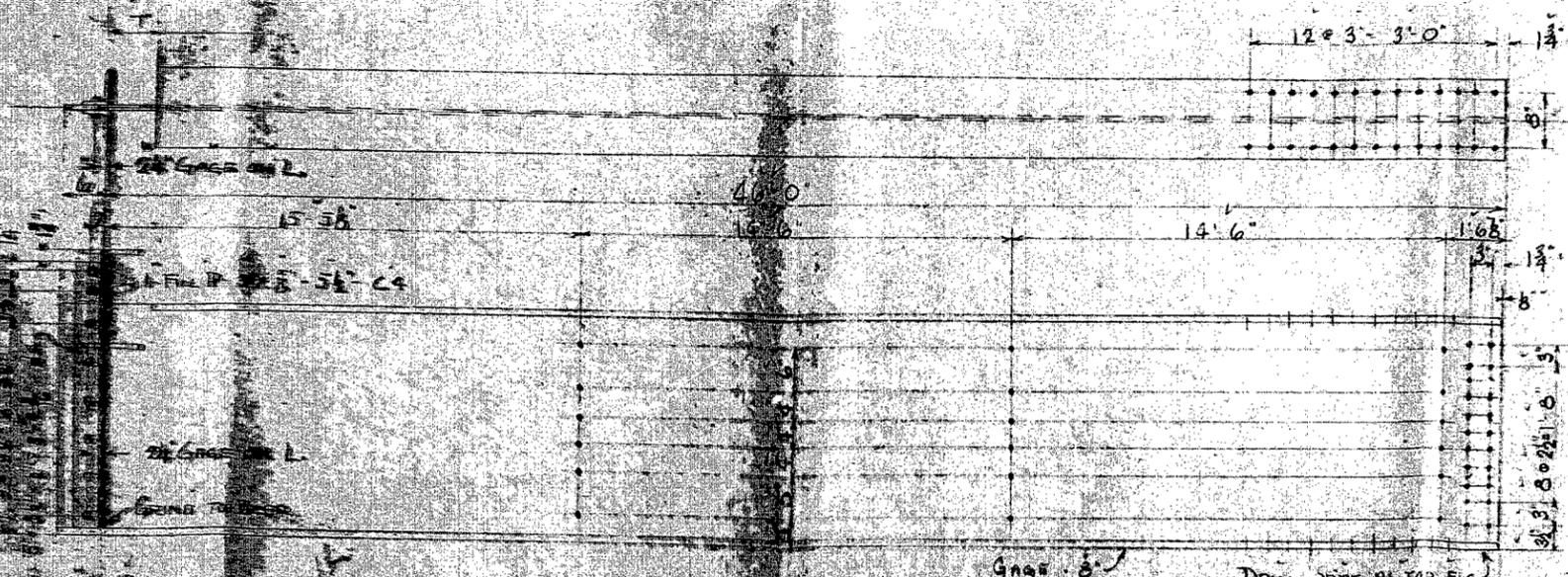
ILLINOIS STEEL BRIDGE CO.
JACKSONVILLE, ILLINOIS
SHIP NO. 4101
ROBERT C. GILBERT, CHAS. E. GILBERT, JR.
MANUFACTURED BY THE ILLINOIS STEEL BRIDGE CO.
JACKSONVILLE, ILLINOIS

BRG. DEVICES FOR CURVED SLABS

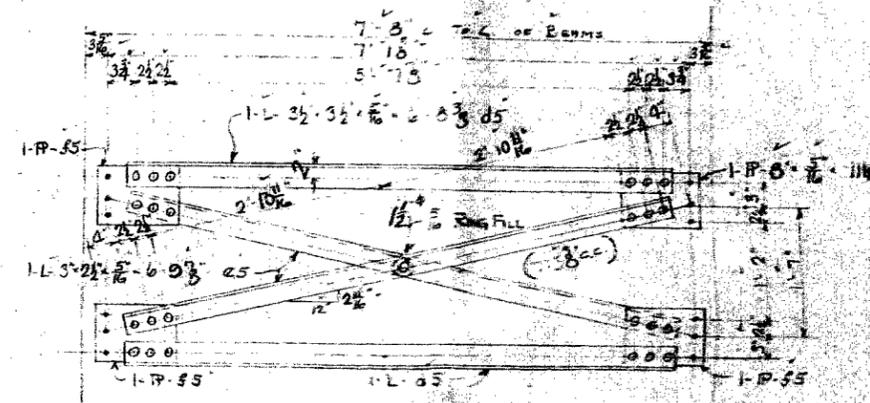
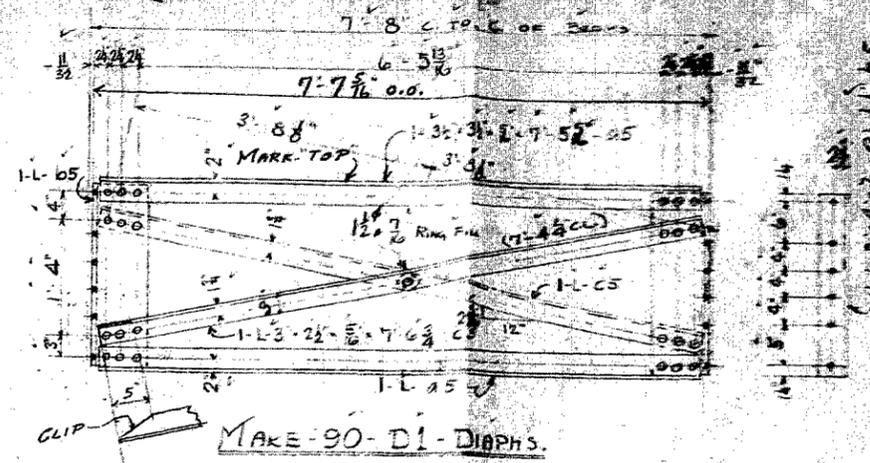
SUB-DRILL FLGS 4" Ø REAM TO 3" Ø IN SHOP
 WHILE I ARE ASSEMBLY MATCHMARK
 CALL BEAMS



MAKE 2 - S13^R - 33" W x 125" x 46' - 5 3/8" AS SHOWN
 2 - S13^L - D. - 46' - 5 3/8" OFF HAND

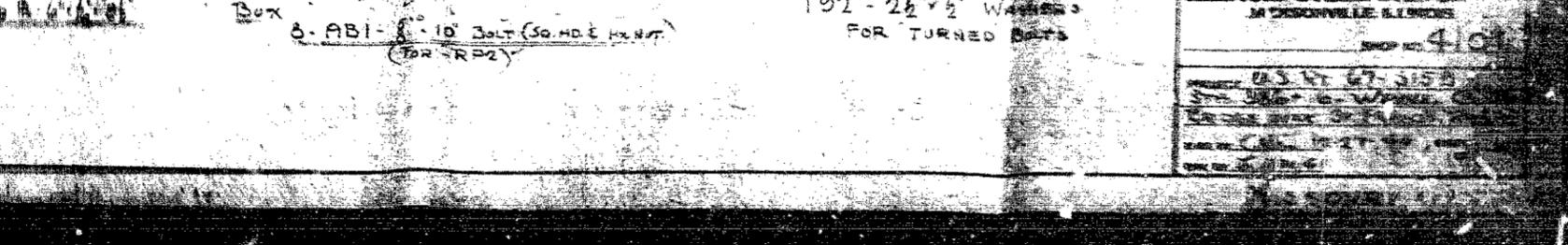
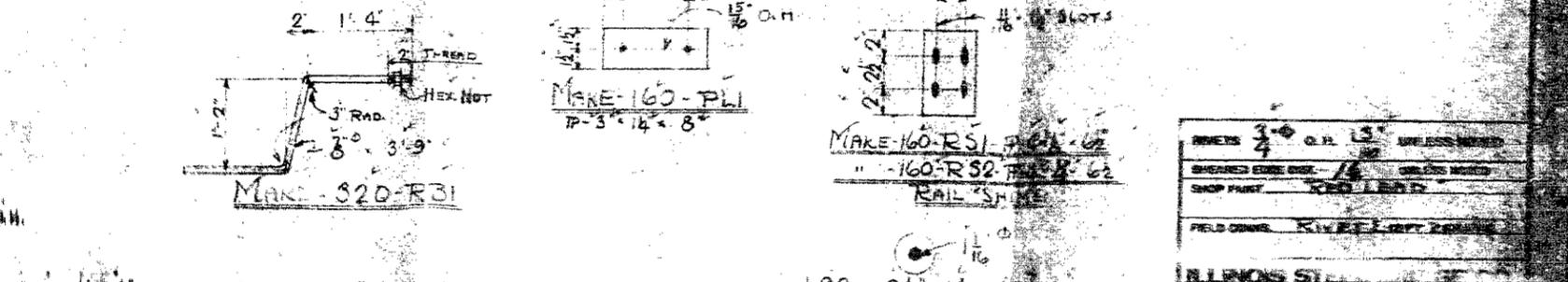
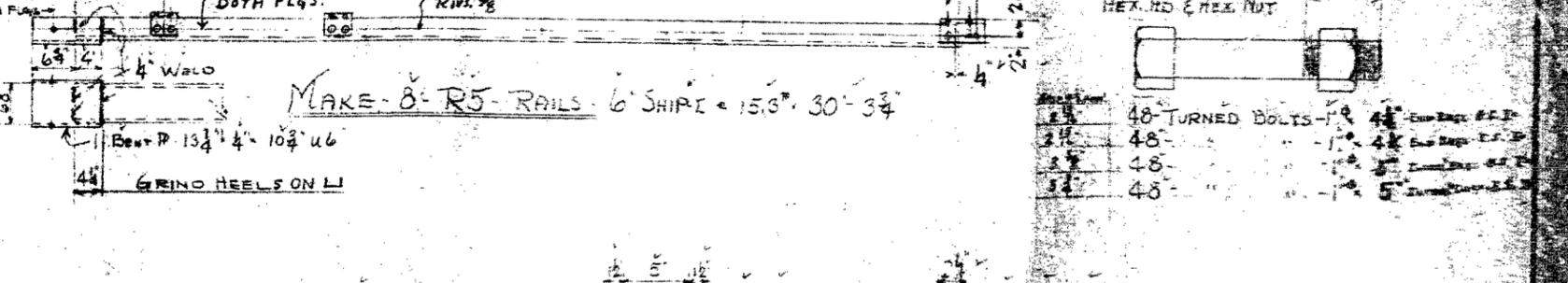
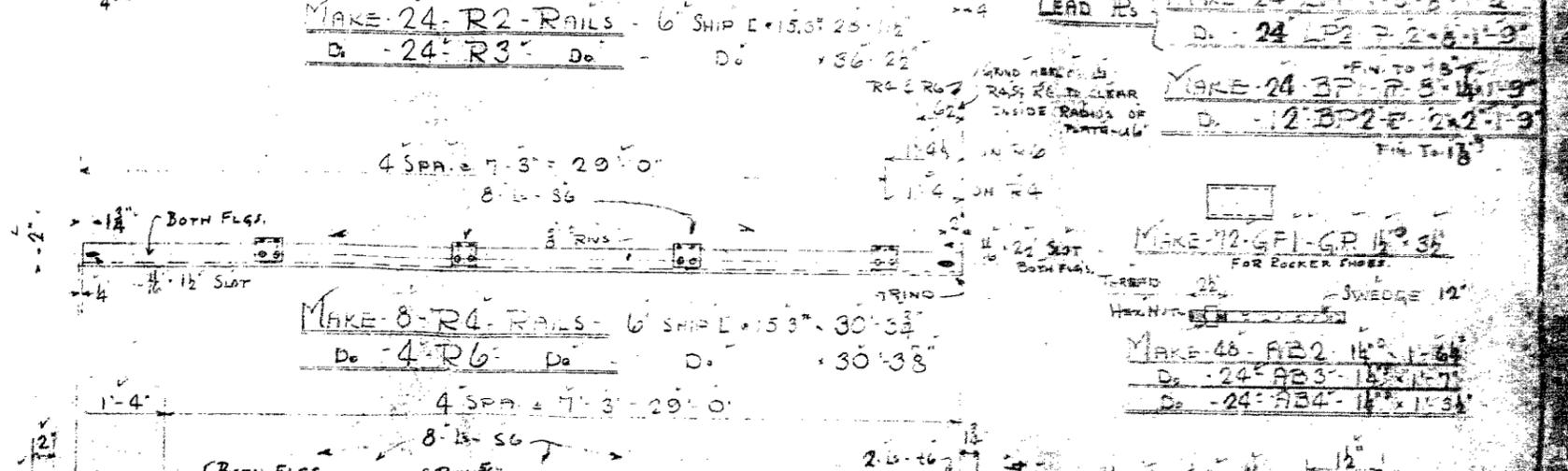
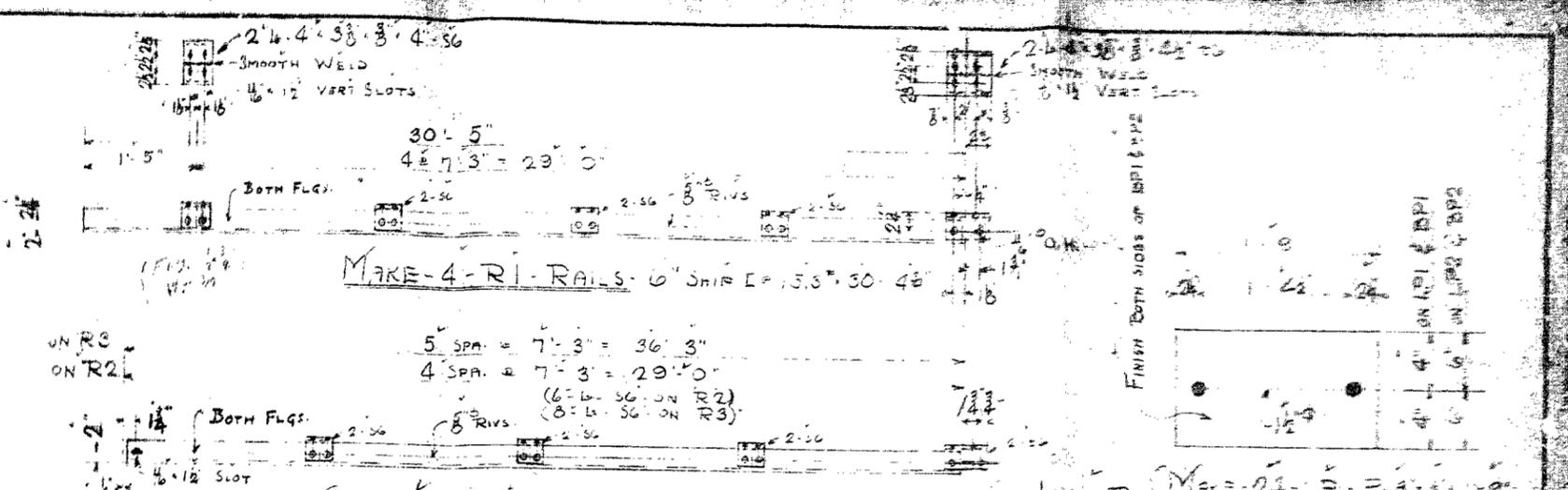
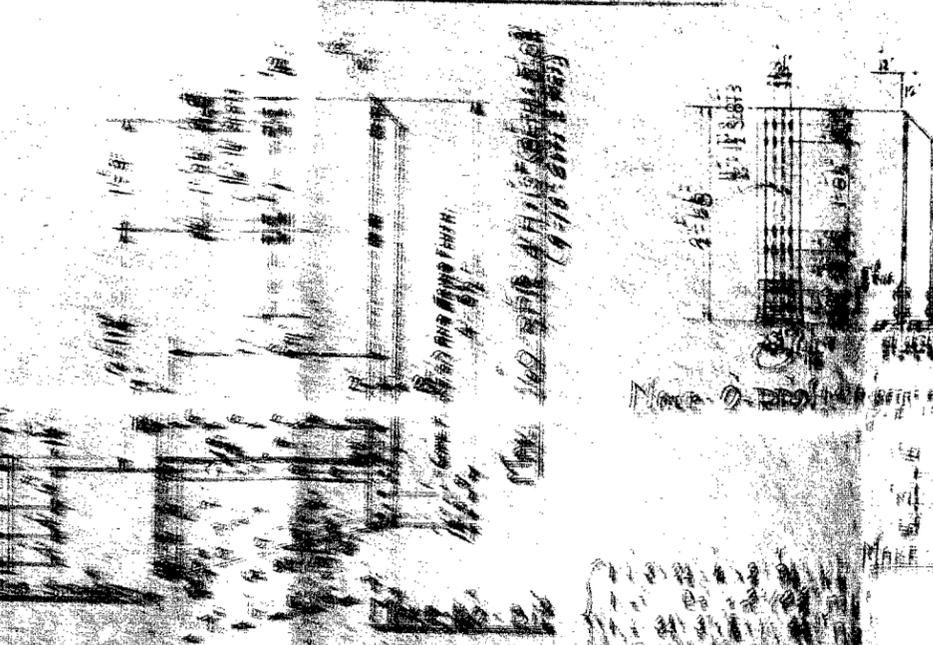
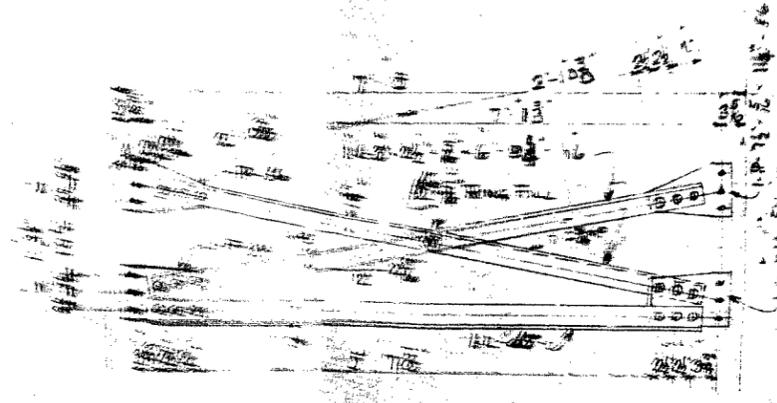
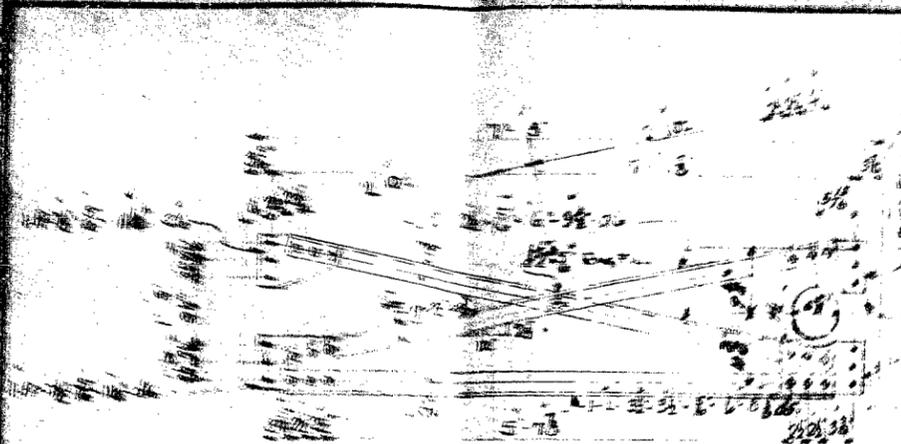


MAKE 4 - S14 - 33 1/2" W x 141" x 46' - 5 3/8" AS SHOWN

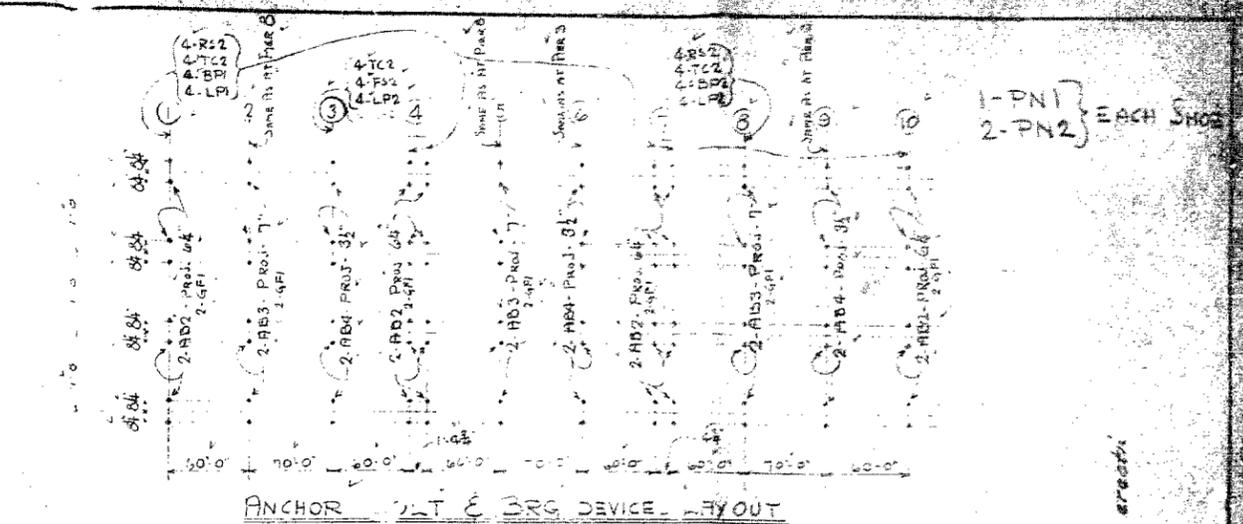
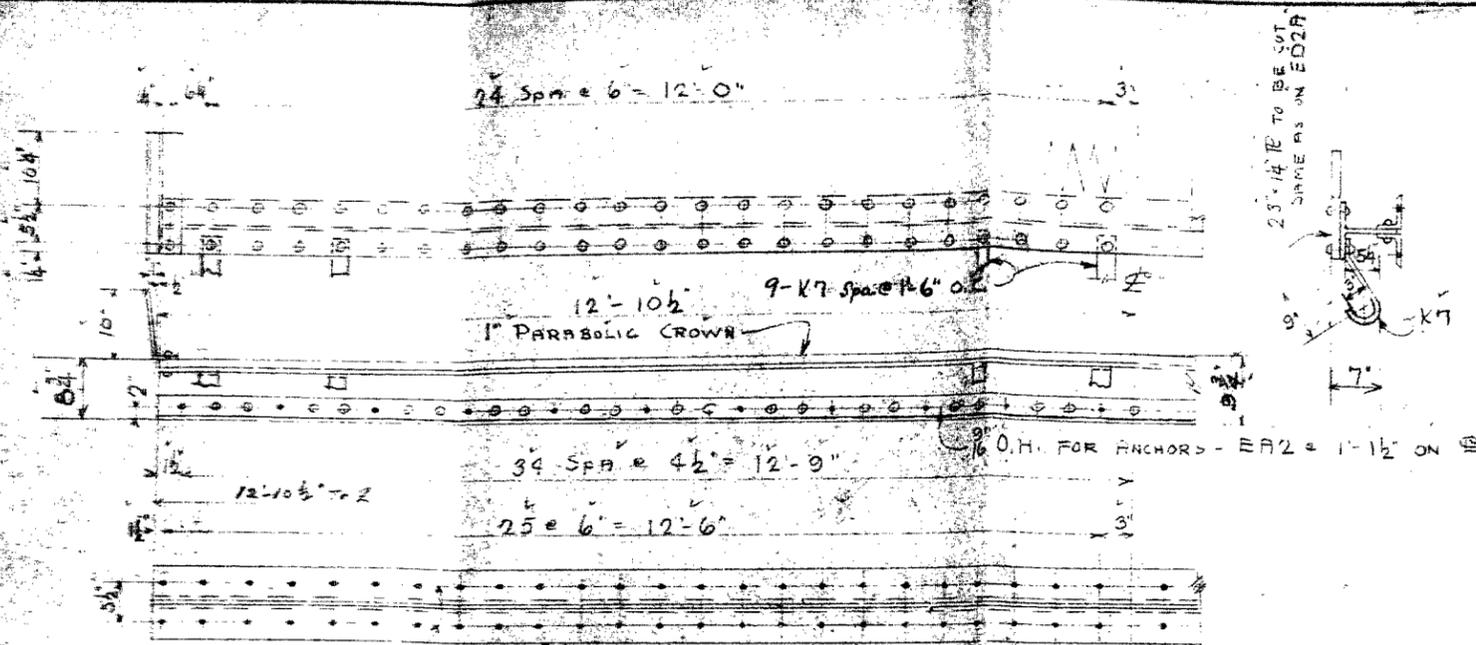


MAKE 18-DI DIAPHS

RIVETS	O. R.	UNLESS NOTED
SHEARED EDGE RIVETS		UNLESS NOTED
SHOP PAINT	120	LEAD
FIELD CORNER	15	15
ILLINOIS STEEL BRIDGE		
JACKSONVILLE, ILLINOIS		
DRAWING NO. 100		
PROJECT		
DATE		
DRAWN BY		
CHECKED BY		



DIAMETER	3/4"	O.R.	1 1/2"	UNLESS NOTED
SHARPENED EDGE DIST.	1/4"			UNLESS NOTED
SNAP POINT				FOR LEADS
FIELD DRIVE				KNIFE POINT DRIVE
BLINOS STILL IN USE AT MCDONVILLE LIGN				
SHOP NO. 410				
SPEC. U.S. ST. 67-3155				
SPEC. U.S. ST. 67-3155				
SPEC. U.S. ST. 67-3155				
SPEC. U.S. ST. 67-3155				



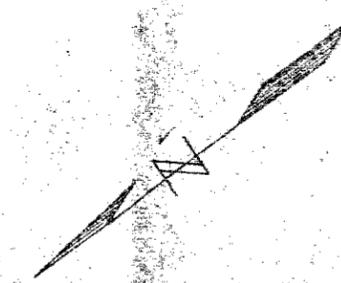
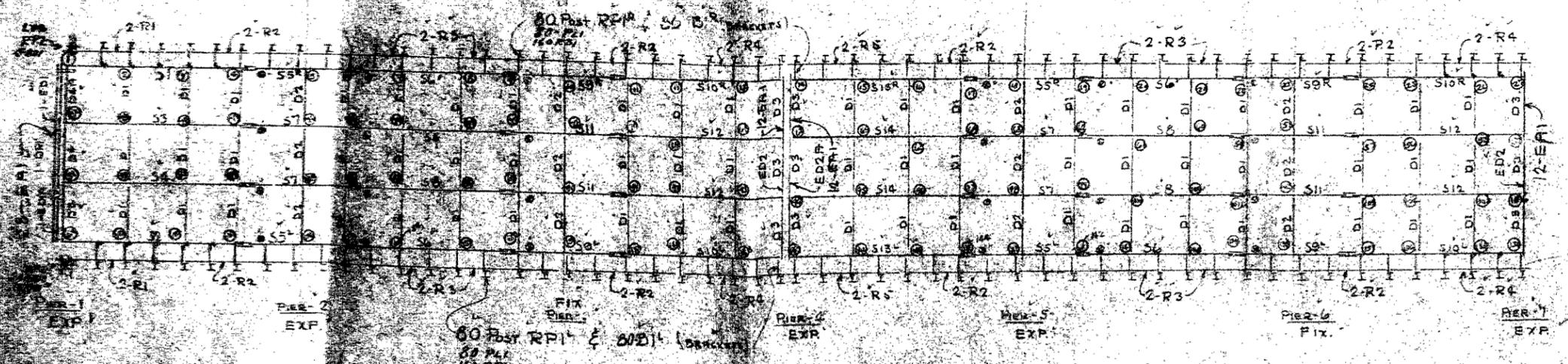
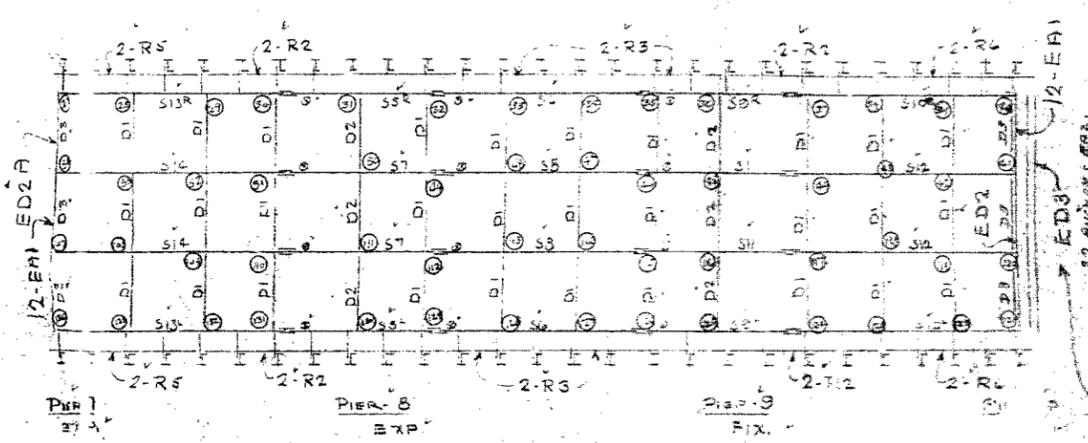
Sub-Pack to and return to
Field for Turned Bolts BEFORE ERECTION
Turned bolts to be furnished by others.

MAKE 1-ED3
AT PIER 10.

1-Ps. of 138 WP @ 43" x 25'-0" (BEND)
2-10 3/8" x 25'-0" - AB
2-1" x 3" x 1'-2" - TP
18-ANCHORS - 24 @ 4" - 1-6 KN

2-Hex NUTS

MAKE 22-EA2 1/2" x 18"



Turned Bolts for Castings TC2 - Detailed on sheet No. 6.
Field Rivets & Bolts listed on sheet R1.
Bolt Connect. Parts to be 3/4" Bolts Hex. Nut with
cut washer under head & nut.
Bolt Splices to have 3" from end of bolt with cut
washer under nut.
ED3 to be connected to this design with 1/2" diameter bolts
etc. to be furnished by fabricator of Truss.
Exam ED3 For Turned Bolts before erection.

RIVETS	3"	O.H. - 13"	UNLESS NOTED
SHALLAS EDGE WIT.			UNLESS NOTED
FIELD BOLTS	3/4"	UNLESS NOTED	
ILLINOIS STEEL BRIDGE CO. JACKSONVILLE, ILLINOIS			
DRAWN BY R. J. GILES			
CHECKED BY J. W. GILES			
APPROVED BY J. W. GILES			
DATE: 11-1-11			

ILLINOIS STEEL BRIDGE COMPANY

ERECTOR'S LIST
FIELD RIVETS AND BOLTS

Work BRIDGE OVER ST. FRANCIS RIVER, WAYNE Co, Mo. RTE. 67 - S. 156
S.P.A. 386 + 16

Shop No. 4101

Sheet No. R1

Made by C.N.C. 1-2-41

Checked by E. 1/22/41

No. Pieces	Diam.	RIVETS		BOLTS		METAL CONNECTED		LOCATION	
		S. H.	Col.	Lech U. H.	Head	Nut	Washer		GRIP
1056	3/8"	2 1/2"							SPICES TO WEBS OF EXT. IS
768	"	3"							" TO FLGS OF "
1344	"	3 3/4"							" " " " "
1056	"	2 3/4"							" " WEBS OF INT. IS
768	"	3 1/2"							" " FLGS " " "
1728	"	4 1/2"							" " " " "
216	"	2 1/2"							D2 TO STIFF L
36	"	2 1/2"							D4 & D4A TO " "
180	"	2 1/2"							D3 TO " "
360	"	3"							D1 TO WEB OF INT. IS
240	"	2 3/4"							D1 & B1 TO WEB EXT. IS
120	"	2 3/4"							D1 TO " " "
400	"	2 1/2"							B1 TO EXT. IS
160	"	1 1/2"							Post TO BRACKET
320	"	2 1/2"							" " " "
64	"	2 1/2"							ED1 & A TO STRINGERS
160	"	2 1/2"							ED2 & A TO " "

FIELD BOLTS

1296	8"	1 3/4"		Hx	Hx				RAILING TO POST
136	"	2 1/2"		BUTTON HEAD BOLTS (2 HEX NUTS)					RAIL SPLICES
8	3/4"	1 3/4"		Hx	Hx	3/4"			DRI TO IS
2	"	2 1/2"		Hx	Hx	1 1/2"			" TO S1

2728 8" CUT WASHERS