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ILLINOIS CENTRAL RAILROAD OVERPASS
Iowa Bridges Recording Project
Over the Illinois Central Railroad
on U.S. Highway 20
Ackley
Hardin County
Iowa

HAER No. IA-81

BLACK & WHITE PHOTOGRAPHS
WRITTEN HISTORICAL & DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Department of the Interior
P.O. Box 37127
Washington, D.C. 20013-7127

HISTORIC AMERICAN ENGINEERING RECORD
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Location: Spanning the Illinois Central Railroad (briefly the Chicago, Central & Pacific Railroad) on U.S. Highway 20 in Ackley, Hardin County, Iowa
UTM: 15.296170.4711650
USGS: Section 2, Township 89 North. Range 19 West

Date of Construction: 1932

Designers: Iowa State Highway Commission

Builders: Welden Brothers Construction Company, Iowa Falls, Iowa

Fabricators: Unknown

Present Owner: Iowa Department of Transportation

Present Use: Roadway bridge

Significance: Designed by the Iowa State Highway Commission, the continuous steel plate girder of two asymmetric spans is broken into two unequal lengths with an interesting detail off-center of the middle pier.

Historians: Richard Vidutis, James Hippen

Project information: This document was prepared as part of the Iowa Historic Bridges Recording Project performed during the summer of 1996 by the Historic American Engineering Record (HAER). The project was sponsored by the Iowa Department of Transportation (IDOT). Preliminary research on this bridge was performed by Clayton B. Fraser of Fraserdesign, Loveland, Colorado.

EVENTS SCHEDULE

1903 - railroads at Ackley lower the grade of their road thus requiring overpasses to be built at two crossings. Wooden timber trestles are installed.

1928-29 - road (future highway 20) paved east of Ackley.

1932 - state builds highway 20 and replaces rickety wooden overpass with a continuous deck girder.

1984-85 - controversy erupts between city and railroad over who has maintenance of overpass. Railroad wanted to raise height of bridge in order to run taller locomotives through.

INTRODUCTION

Located on the northern edge of Ackley in Etna Township on the county line dividing Franklin and Hardin Counties, the Illinois Central (IC) Railroad Overpass is on U.S. Highway 20. It spans railroad tracks which were instrumental in the rapid development of Ackley particularly in the 1860s to 1880s and which are still used today. In 1932 the IC Overpass replaced an old wooden viaduct built in 1903. When it was built in 1932 the road which it carried was also upgraded from a local gravel road to a paved interstate highway. The new overpass is a continuous steel plate deck through girder 334' long. It is of unorthodox design having to fit at an acute angle to the railroad line. In terms of its construction, it represents the era's response to the demands of speedier and heavier motor vehicles and the highways which had to be redesigned to accommodate them.

I. REGIONAL HISTORY

The state of Iowa was admitted to the union in 1846, and by the act of the General Assembly, Hardin County was created in 1851. In 1853 settlers met and voted to make Eldora the county seat of Hardin County. As the county grew most of the first cities were founded along the river, where flour and saw mills were established. The most important event in Hardin County spurring its growth was the arrival of the railroad. The first railroad across the state was completed to Council Bluffs in 1861. The first to enter Hardin County was at Ackley in 1865, and by 1866 the railroad was extended to Iowa Falls and then Alden.¹

The City of Ackley was founded through an act of speculation by a attorney named William J. Ackley who worked for the Dubuque and Pacific Railroad. He was well aware of the value of land along the rail routes being newly laid down across Iowa. Ackley decided on land in section 2 of Etna Township. It had high and dry prairie land, good timber in nearby 'Downs' Grove, and he knew that the Dubuque and Pacific would enter the area at its northeastern tip and cross its northern portion, just as the stage route already did at that time.² Purely as a speculative financial venture, in 1857 he had the town of Ackley surveyed and staked out. Yet Mr. Ackley never actually lived in Ackley. The

¹History of Hardin County, Iowa (Eldora, Iowa: Hardin County Historical Society, 1981), p. 5.

²Pioneer Ackley--A Bicentennial Tribute (Acklev. Iowa:

financial venture was not an instant success because the railroad did not come for another eight years during which time Ackley remained a paper-town. It was only when the Civil War came to an end that construction on the railroad resumed again from Cedar Falls. Thus on October 16, 1865, the tracks of the Dubuque & Sioux City Railroad finally reached Ackley. This marked the beginning of an era of expansion which lasted about 20 years and which saw Ackley become a market center attracting local farmers who wanted to sell their grains directly to the great wheat and livestock markets in Chicago. Farmers came to Ackley from as far away as Eldora and Dumont to market their grain in the late 1860s and 1870s to have it shipped eastward. And as the Ackley markets attracted local farmers, the town of Ackley, as well as the surrounding area, grew attracting immigrants from Europe and from the eastern United States. A second railroad appeared in the 1860s, and by 1874, twenty carloads of grain were shipped from Ackley every three days.³ The Ackley Mirror, in an editorial of September 9, 1870, wrote:

"That Ackley is a flourishing town none can deny. Located, as it is, at the junction of two railroads, it offers facilities for transportation second to none in the state. Backed by a scope of country, than which finer land does not lie out of doors, having extensive warehouses and elevators for the storage of produce, a large number of business houses resided over by shrewd, energetic men, ample facilities for manufacturing many articles of daily use, (it has) the prospect of becoming, at no distant day, one of the first manufacturing towns of Iowa."⁴

Underlying the boosterism of the Ackley Mirror editorial were the undeniable facts that with the coming of two intersecting railroads also came the expansion, prosperity and development of the community. "This was the Railroad Age, and the key to expansion and prosperity was the securing of as many railroads as possible."⁵ Ackley remained a business town in the region with its links to the outside world. The Illinois Central Railroad still served Ackley in 1932 when the new IC Railroad Overpass was built at Ackley.

³Ibid.

⁴Ibid. Quoted in the Pioneer Ackley.

By 1910 cars began to appear in ever greater number in Iowa and soon people were demanding better roads instead of the ungraded and undrained mud routes prevailing throughout the counties. But early bridge and road building was slow, due to machinery which was not yet fully developed technically to handle serious road building. By 1917 all states had adopted a system of state aid and state control of their highway systems in unison with federal aid for roads which began in 1916. The Lincoln Highway and the Jefferson Highway were early improved highways with the later running through Hardin County. By the 1930s cars with greater speeds and trucks with greater loads required more than gravel roads with sharp curves and steep grades.⁶

II. HISTORY OF THE IC RAILROAD OVERPASS

According to Helen Rath, an elder in the Ackley community and a worker at the Historical Society in Ackley, in 1903 the railroad, which had its rail lines running flat with the surrounding land, lowered the grade of its road and consequently had to build two wooden bridges over the railroad tracks in Ackley, one on the road which was to become U.S. 20, and the other on Hardin Street which still stands today but is abandoned; U.S. 20 was but a local dirt road until 1932.⁷ (See Fig.1, Appendix B) By 1932 the wooden bridge had become too rickety to safely hold cars and the state decided to build a new steel and concrete bridge while upgrading the dirt road to the status of a U.S. highway. This created a new east-west main road connecting to other major roads in the state; previously the main road was a north-south route.⁸ Contracts were awarded to Welden Brothers for construction of the bridge (Project No. X-950), to Anderson & Empie (for unspecified work on Project P-642) and to J.A. Dunkel Construction for road work (Project P-642).⁹

⁶Ibid., History of Hardin County, 1981, p. 5.

⁷Mrs. Helen Rath explained that locally the remaining wooden bridge over Hardin Street is referred to as the "bridge" while the steel plate deck girder on U.S. 20 is referred to as the "viaduct."

⁸Interview of Mrs. Helen Rath took place August 1, 1996, at the Historical Society in Ackley, Iowa.

III. DESIGN AND TECHNOLOGY OF THE IC RAILROAD OVERPASS

Two major types of bridges are used extensively in Iowa in the late twentieth century for medium and large spans. These are the continuous steel girder and the precast, prestressed concrete girder. The prestressed girder has come into use since World War II, but the continuous bridge has a long history. The IC Railroad Overpass represents an important step in the emergence of this technology from experimental to common use.

The continuous beam, girder, or truss bridge has the advantage over simply supported structures in a saving of material and greater stiffness.¹⁰ This was demonstrated on a grand scale by Robert Stephenson's Britania Bridge, completed in 1850.¹¹ American engineers, however, were slow to adopt the idea of continuity in a bridge, considering it impractical both because of its vulnerability to the effects of any pier settlement and the difficulty of calculating the stresses involved.¹² Some very few examples were built in North America, and the theory found its way into textbooks, but the attitude of the great majority of engineers was summed up, and fortified, by J.A.L. Waddell (the pontifex maximus of the profession) who concluded "few American engineers will countenance the building of continuous girder bridges."¹³ In 1917, the next year, Gustav Lindenthal completed the great Sciotoville, Ohio, continuous truss, and engineers began a slow realization of the practical possibilities in the continuous approach.¹⁴

In Iowa, as in the rest of the country, engineers approached the previously condemned idea with care. In trusses and in girders the nearest thing to a continuous structure is a cantilever. For major bridges, such as crossings of the Mississippi and Missouri

¹⁰The principle of continuity is clearly explained in Harry Parker, Simplified Design of Reinforced Concrete (New York: Wiley, 1943), chapter 3, and later editions of the same work.

¹¹Charles Singer, et al. A History of Technology, 5 The Late Nineteenth Century (Oxford: Clarendon Press, 1958), pp 504-505.

¹²George A. Hool and W.S. Kinne, Movable and Long-Span Steel Bridges, 2nd ed. (New York: McGraw-Hill, 1943), pp. 199-201.

¹³Bridge Engineering I (New York: Wiley, 1916), p. 482.

¹⁴Carl W. Condit. American Building Art: The Twentieth

rivers, cantilever trusses had been used for decades. The first large continuous truss was the Nebraska City bridge over the Missouri, built in 1929.¹⁵ Others were built in the 1930s over the Mississippi, the Missouri, and the Des Moines rivers.

Of wider importance throughout the state was the gradual acceptance of continuous bridges for moderately large crossings. The first, so far as is known, was designed by the highway commission to replace a Luten patented arch that had collapsed in Ames. Built to carry the Lincoln Highway over Squaw Creek, the bridge was a three-span steel through plate girder, and it was continuous. The inflammatory word "continuous" was not used, however, in describing the bridge. The captions to published photographs merely call attention to the beauty of the "continuous curve" of the camber of the bridge, "instead of a series of lines breaking at the pier points."¹⁶ Also noted is the fact that the three girders are "permanently connected to each other end to end," thus saving in the number of supports needed on the top of the piers.¹⁷ If this seems to press the issue of disguising the new a bit far, it is well to note that when the state highway system was established two years earlier, "so great was the opposition to the word 'state' and a state-controlled road system, that legislators, fearing for their political futures, named it the 'Primary Road System'."¹⁸

The cantilever design was also used first with regard to concrete structures. As early as 1905 a concrete cantilevered girder was built for the street railway in Marion.¹⁹ The highway commission experimented with reinforced concrete cantilever girders, beginning with one at Woodbine (also on the Lincoln Highway) in 1917. Others followed, noted in the bridge design section of the

¹⁵Sverdrup & Parcel, Engineering Projects (St. Louis: 1946).

¹⁶Iowa State Highway Commission, Service Bulletin 9 (March-April, 1921):3.

¹⁷Ibid., p. 5.

¹⁸William Thompson, Transportation in Iowa: A Historical Summary (Ames: Iowa Department of Transportation, 1989), p. 73.

¹⁹This may have been the first such bridge in the nation. Carl Condit, American Building (Chicago: University of Chicago

commission's Annual Reports.²⁰ In 1926 the commission reported the design of a "monolithic concrete girder" that "makes use of the cantilever principle."²¹ This was the Winnebago River Bridge (HAER No. IA-78) just north of Mason City.

But things began to change more rapidly. Other states were also introducing the continuous bridge.²² By 1929 an editorial in the Engineering News-Record could proclaim that "structural views have made distinct progress since the days when continuous bridges were considered bad practice."²³ Iowa began to regularly construct continuous bridges, usually of the steel plate girder variety.²⁴ Those that were built in the 1930s are remarkable examples of innovative design in response to the demands of the age of automobiles and highways.

The railroad overpass, which carries U.S. Highway 20 over the Illinois Central railroad at Ackley, was built in 1932. It replaced a "timber trestle," which was a common type of overpass in Iowa, although considered as a temporary solution.²⁵ The present bridge is described as a "multiple span overhead

²⁰Those listed in Fraserdesign, Iowa Historic Bridge Inventory (1993), are Herrold, 1921 (POLK13), Goldfield, 1921-22 (WRIG27), Okoboji, 1929 (DICK01), and Spirit Lake, 1939 (DICK02).

²¹Iowa State Highway Commission, Annual Report for 1926, p. 15.

²²Oregon State Highway Commission, Eighth Biennial Report...1926...1928 (Salem, Oregon: 1929), p. 71.

²³Ibid., January, 17, 1929, p. 89.

²⁴The conclusion that few concrete continuous bridges were built is tentative. The Iowa Historic Bridge Inventory rarely identifies continuous structures, so it is of little value in checking among the surveyed items for this structural type. From an economic point of view, concrete continuous girders, due to cost of formwork, would usually be more expensive, thus less common. The concrete bridge really came into its own with the introduction of prestressed beams after World War II.

²⁵A few blocks south of the present girder bridge in Ackley is an abandoned timber trestle overpass which was still in use as

crossing, two-90' x 24' plate girder spans and four-36' x 24' I-beam approach spans, August 1931."²⁶

Before discussing the details of the bridge, it is well to note the financial circumstances which constrained all road engineering projects at the time. The bite of the Great Depression was felt severely, until later in the 1930s when the value of public works expenditures on roads and bridges was appreciated. But from 1930 through 1932 the situation became desperate. A brief table will illustrate this.

IOWA, PRIMARY ROAD CONSTRUCTION EXPENDITURES	
1930	\$42,616,000
1931	\$28,143,000
1932	\$14,337,094

The number of highway commission employees was likewise cut in half from 1930 to 1932.²⁷ Only the most important projects, like this crossing of a major highway over a busy railroad, could be built.

The bridge itself is a rather unorthodox creation built with a good deal of ingenuity to fit a particular situation. Built at a very acute angle crossing of the railroad, with right-of-way to include a proposed second track, the bridge itself is not skewed although the middle set of piers is. (See Fig.3, Appendix B) The two main girders are bolted together at the joint, and thus might strictly be called "continuous." However, the bolts clearly transmit only a very small portion of the total strain. Structurally, the girders form cantilever and a suspended span plus the cantilever are longer, thus heavier, than the anchor arm. Yet the anchor arm is not tied down at the abutment. The stability of the bridge is achieved by one set of 90' girders being arranged exactly opposite to the other. On the south side of the bridge the anchor arm is at the east end; on the north side of the bridge it is to the west. Tied together by a strong system of floor beams, joists, and concrete slab, the bridge is exactly balanced on the central, skewed piers. In a sense the bridge is using the principles of continuous design in

²⁶Design No. 3731, Hardin County, Iowa State Highway Commission, Iowa Department of Transportation. The erection (completion) date of 1932 is from Fraserdesign, Iowa Historic Bridge Inventory (1993), p. HARD03.

²⁷Report of the State Highway Commission for...1931. p. 3:

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transmitting stresses from one span to the next. It could be envisioned as acting like a single continuous girder running diagonally from one corner (say west end of south girder) to the corner at the other end (say east end of north girder). As far as can be determined from the plans and inspection of the bridge, the floor system is continuous. The cantilever form of the main girders would, of course, have facilitated erection without blocking rail traffic.

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APPENDIX A Bridge Designs for the IC Railroad Overpass

Microfilm files located at the Iowa Department of Transportation, Ames, Iowa. Filed under: File 9280, Design 3731.

1. *Design for Multiple Span Overhead Crossing 2-90' x 24' Plate Girder Spans and 4-36' x 24' I-Beam Approach Spans at Intersection of Illinois Central R.R. and U.S. Highway No. 20. Station 688+74.71. Primary Project No. 642. Hardin Franklin Co. Line. ISHC. August 1931. Crossing Project No. 950. Design No. 3731. [6 sheets]*
2. *Untitled plan of bridge elevation, overhead dimensions of bridge, proposed railroad track, and proposed parallel roadway. No date. [1 sheet]*
3. *Plan and Profile of Proposed Overhead Crossing at Intersection of Ill. Cent. RR and U.S. Highway No. 20. Sec. $\frac{35}{2} | \frac{36}{1}$ Osceola and Etna Twp. Franklin, Hardin Co. IHC. Dec. 26, 1930. State Crossing Project. No. 950.*
4. *Plan and Profile of Bridge Sounding For Proposed Bridge of 1-101.5' and 1-72.5' Turn Plate Girders and 5-36' I-Beam Approach Spans. Bridge has 24' Roadway. Dates sounded - Jan. 28 and 29, 1931. [1 sheet]*
5. *Prelim. Sketch. Proposed Overhead Crossing Ill. Cent. RR and U.S. Highway #20 at Ackley, Iowa. State Crossing #950. No date. [1 sheet]*

APPENDIX B

List of Illustrations

- Fig.1 View of two wooden railroad overpasses built in 1903 in Ackley. Previous crossing (wooden trestle viaduct) on U.S. 20 in background, 1908. From Pioneer Ackley, 1976.
- Fig.2 General Plan. From *Design for Multiple Span Overhead Crossing...*, August 1931.
- Fig.3 Profile Sketch of IC Railroad Overpass. James Hippen, 1996.
- Fig.4 USGS Map. Ackley Quad., 1979. 7.5 min. series (topo.).

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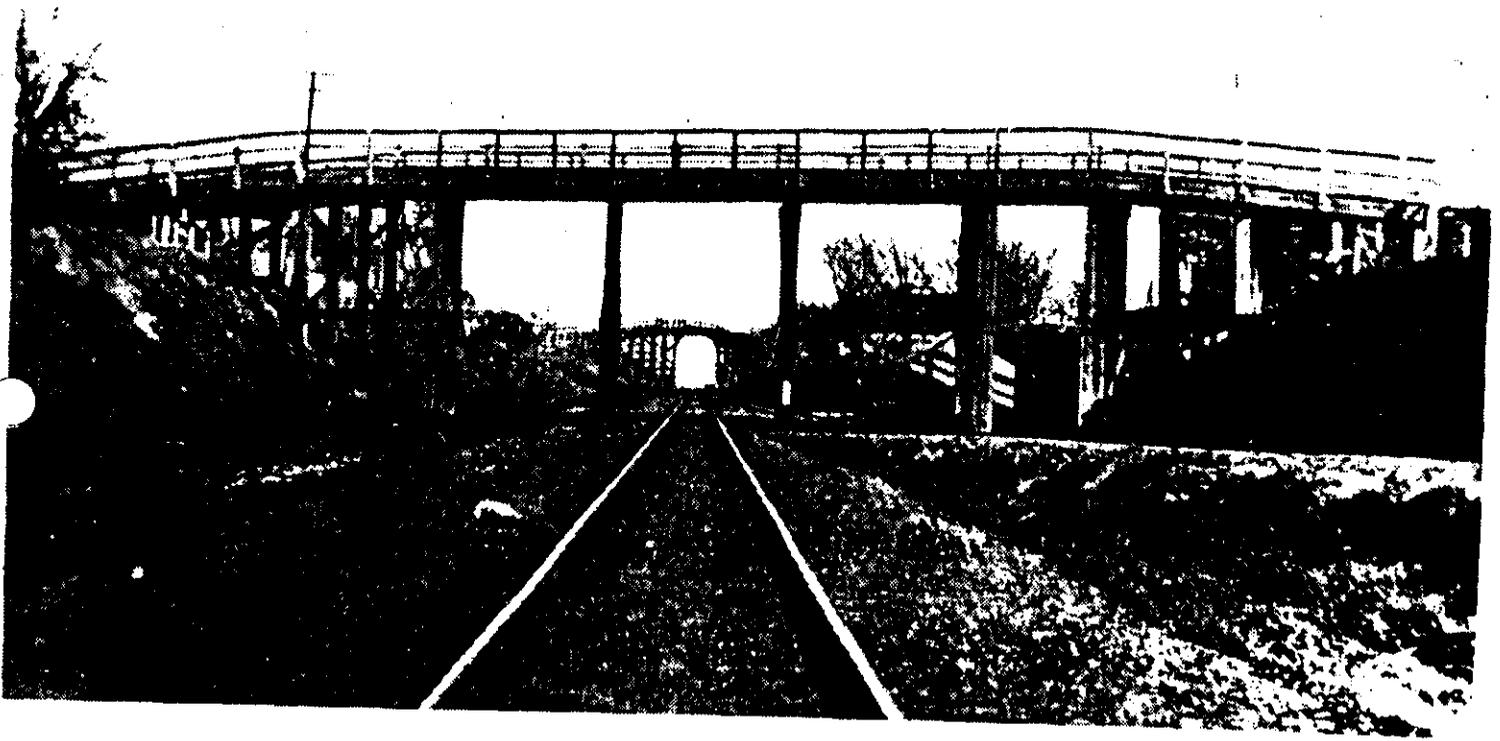


Fig.1 View of two wooden overpasses built in 1903. Previous

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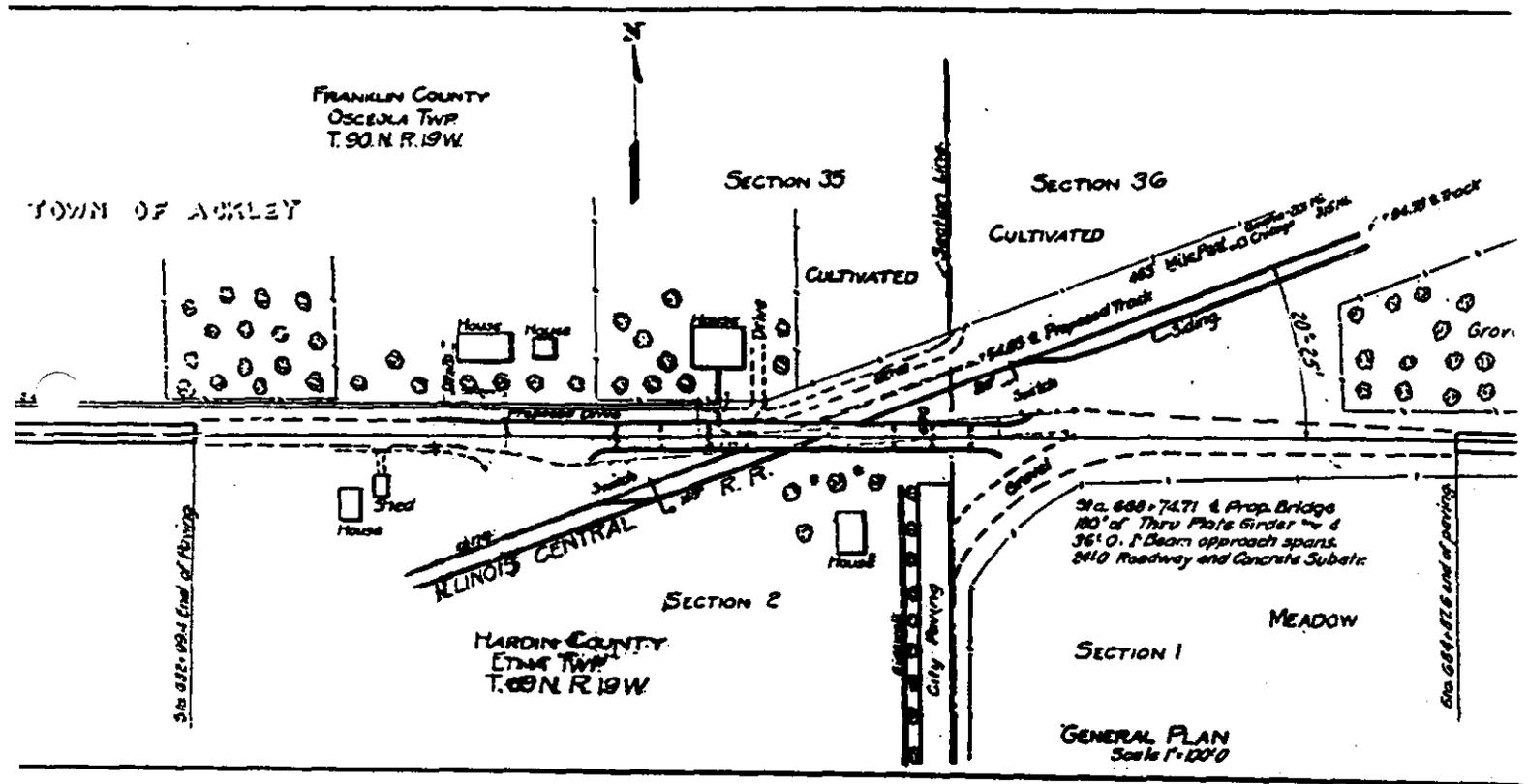
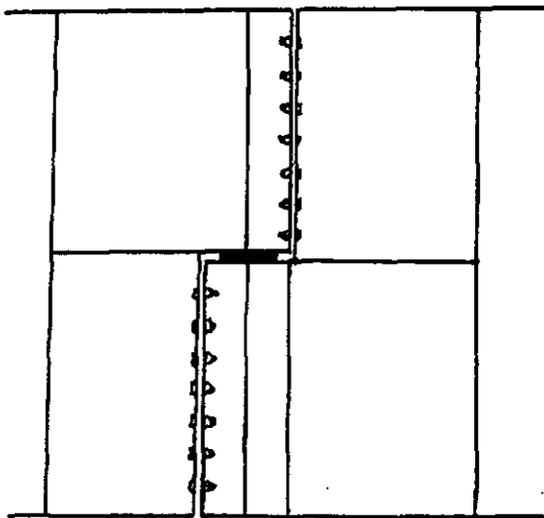
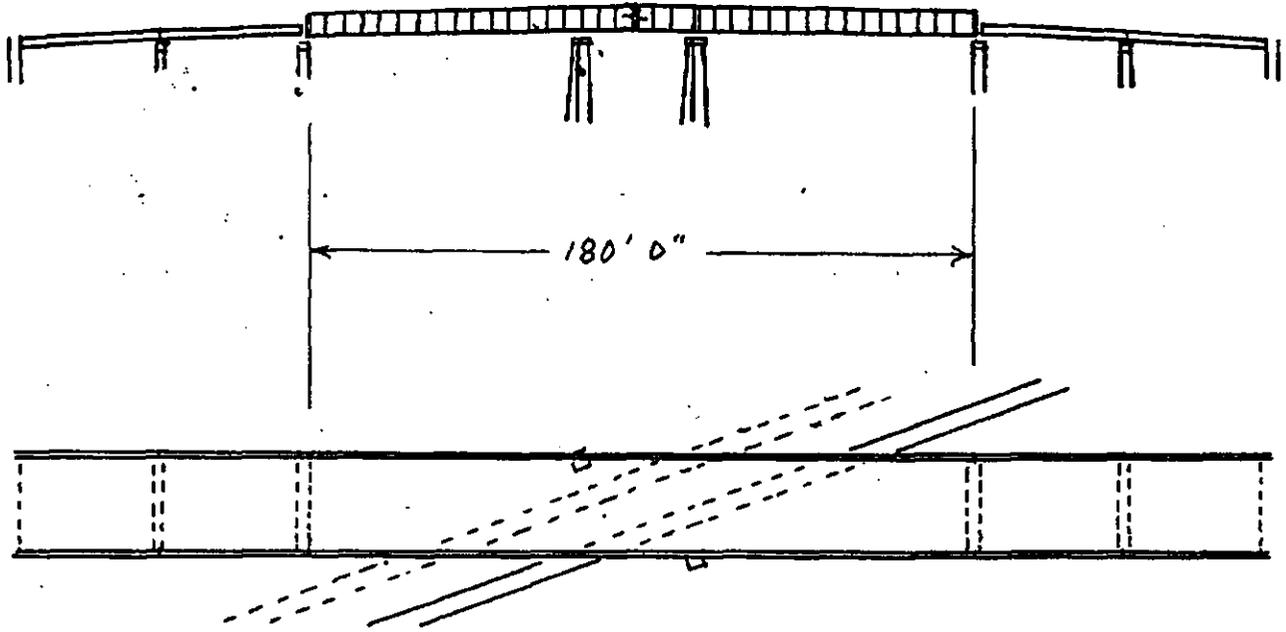


Fig. 2 General Plan. From Design for Multiple Span Overhead

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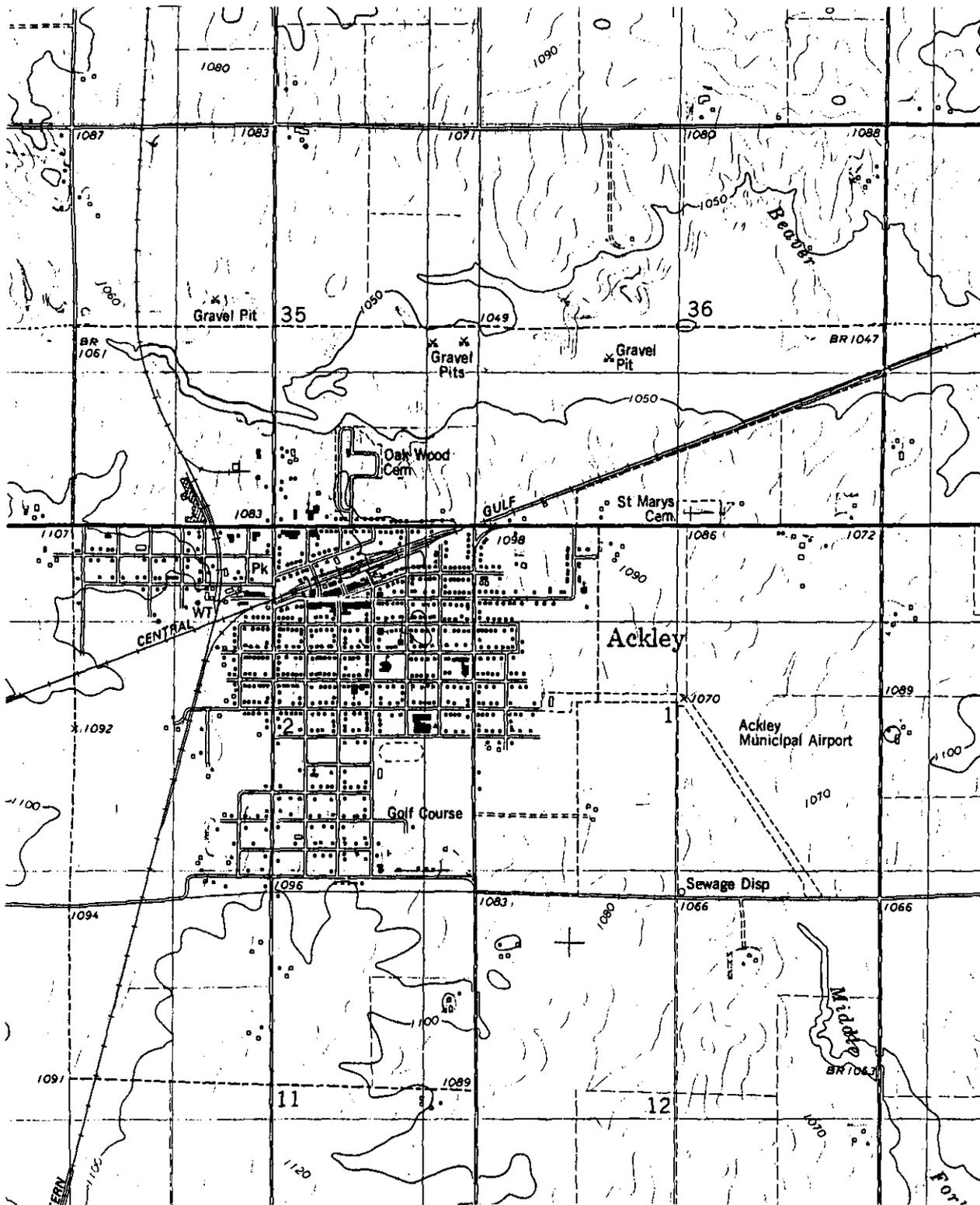


---CANTILEVER JOINT---

RAILROAD
OVERPASS

Fig.3 Profile Sketch of IC Railroad Overpass James Hinnen

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APPENDIX C Research Statement

Research Limitations

No historical photographs were found during the documentation search for the IC Railroad Overpass.

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Spanning Illinois Central Railroad at U.S. Highway 20
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This appendix is an addendum to a 19-page report previously transmitted to the Library of Congress.

APPENDIX: ADDITIONAL REFERENCES

Interested readers may consult the Historical Overview of Iowa Bridges, HAER No. IA-88: "This historical overview of bridges in Iowa was prepared as part of Iowa Historic Bridges Recording Project - I and II, conducted during the summers of 1995 and 1996 by the Historic American Engineering Record (HAER). The purpose of the overview was to provide a unified historical context for the bridges involved in the recording projects."