United States Department of the Interior
National Park Service

NATIONAL REGISTER OF HISTORIC PLACES
Registration Form

1. NAME OF PROPERTY

HISTORIC NAME: Hays Street Bridge
OTHER NAME/SITE NUMBER: National Bridge Inventory Structure #150150B15665001

2. LOCATION

STREET & NUMBER: Hays Street over Southern Pacific Railroad, N. Cherry Street and Chestnut Street
CITY OR TOWN: San Antonio ☐ **VICINITY** **STATE:** Texas **CODE:** TX **COUNTY:** Bexar
CODE: 029 **ZIP CODE:** 78202 ☐ **NOT FOR PUBLICATION**

3. STATE/FEDERAL AGENCY CERTIFICATION

As the designated authority under the National Historic Preservation Act, as amended, I hereby certify that this ☑ nomination ☐ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ☑ meets ☐ does not meet the National Register criteria. I recommend that this property be considered significant ☐ nationally ☑ statewide ☐ locally. (☐ See continuation sheet for additional comments.)

State Historic Preservation Officer
Signature of certifying official / Title **Date**

Texas Historical Commission
State or Federal agency / bureau or Tribal Government

In my opinion, the property ☐ meets ☐ does not meet the National Register criteria. (☐ See continuation sheet for additional comments.)

Signature of commenting or other official **Date**

State or Federal agency / bureau or Tribal Government

4. NATIONAL PARK SERVICE CERTIFICATION

I hereby certify that the property is:	Signature of the Keeper	Date of Action
☐ entered in the National Register ☐ See continuation sheet.		
☐ determined eligible for the National Register ☐ See continuation sheet.		
☐ determined not eligible for the National Register.		
☐ removed from the National Register ☐ See continuation sheet.		
☐ other, explain ☐ See continuation sheet.		

5. CLASSIFICATION

OWNERSHIP OF PROPERTY

	private
X	public - Local
	public - State
	public - Federal

CATEGORY OF PROPERTY

	building(s)
	district
	site
X	structure
	object

NUMBER OF RESOURCES WITHIN PROPERTY

contributing	noncontributing	
0	0	buildings
0	0	sites
1	0	structures
0	0	objects
1	0	total

NUMBER OF CONTRIBUTING RESOURCES PREVIOUSLY LISTED IN THE NATIONAL REGISTER: 0

NAME OF RELATED MULTIPLE PROPERTY LISTING: Historic Bridges of Texas, 1866-1945

6. FUNCTION OR USE

HISTORIC FUNCTIONS: TRANSPORTATION/road-related (railroad, vehicular) = bridge

CURRENT FUNCTIONS: TRANSPORTATION/road-related (pedestrian) = bridge

7. DESCRIPTION

ARCHITECTURAL CLASSIFICATION: OTHER: Pratt and Murphy-Whipple Through Truss

MATERIALS:
FOUNDATION CONCRETE (piers)
WALLS N.A.
ROOF N.A.
OTHER METAL/ Wrought Iron, Steel (spans); WOOD (deck); METAL. Steel (railings)

NARRATIVE DESCRIPTION (see continuation sheets 7-5 through 7-6)

8. STATEMENT OF SIGNIFICANCE

APPLICABLE NATIONAL REGISTER CRITERIA

Property:

X **A** is associated with events that have made a significant contribution to the broad patterns of our history.
B is associated with the lives of persons significant in our past.
X **C** embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.
D has yielded, or is likely to yield information important in prehistory or history.

CRITERIA CONSIDERATIONS: N/A

AREAS OF SIGNIFICANCE: Engineering, Transportation

PERIOD OF SIGNIFICANCE: 1881-1962

SIGNIFICANT DATES: 1881, 1910

SIGNIFICANT PERSON: N/A

CULTURAL AFFILIATION: N/A

ARCHITECT / BUILDER: Phoenix Steel Company

NARRATIVE STATEMENT OF SIGNIFICANCE (see continuation sheets 8-7 through 8-11)

9. MAJOR BIBLIOGRAPHIC REFERENCES

BIBLIOGRAPHY (see continuation sheet 9-12)

PREVIOUS DOCUMENTATION ON FILE (NPS): N/A

_ preliminary determination of individual listing (36 CFR 67) has been requested.
_ previously listed in the National Register
_ previously determined eligible by the National Register
_ designated a National Historic Landmark
_ recorded by Historic American Buildings Survey #
_ recorded by Historic American Engineering Record #

PRIMARY LOCATION OF ADDITIONAL DATA:

x State historic preservation office — Texas Historical Commission, Austin
x Other state agency — Texas Department of Transportation
_ Federal agency
x Local government — City of San Antonio
_ University
_ Other -- Specify Repository:

10. GEOGRAPHICAL DATA

ACREAGE OF PROPERTY: less than one acre

UTM REFERENCES

	Zone	Easting	Northing
1.	14	550445	3255796
2.	14	550864	3255763

VERBAL BOUNDARY DESCRIPTION: The bridge at Hays Street over the Galveston, Harrisburg and San Antonio Railroad , Chestnut and Cherry streets in San Antonio, Texas. The boundary encompasses the entire structure, including the both trusses, the concrete girder approach spans, the railing, and the concrete abutments and piers.

BOUNDARY JUSTIFICATION: The boundary includes all components historically associated with the structure in this location including the substructure and superstructure of the two truss spans. The approach spans, which were constructed in 2010, are within the National Register boundary.

11. FORM PREPARED BY

NAME / TITLE: H. Douglas Steadman; Adrienne Campbell

ORGANIZATION: American Society of Civil Engineers; THC **DATE:** 11/10/11

STREET & NUMBER: 113 Sunflower Lane **TELEPHONE:** 210-342-7839

CITY OR TOWN: San Antonio **STATE:** Texas **ZIP CODE:** 78213-1923

ADDITIONAL DOCUMENTATION

CONTINUATION SHEETS

MAPS (see continuation sheet Map-13 through Map-15)

PHOTOGRAPHS (see continuation sheet Photo-# through Photo-#)

ADDITIONAL ITEMS (see continuation sheets Figure-16 through Figure-21)

PROPERTY OWNER

NAME: City of San Antonio (Mayor Julián Castro)

STREET & NUMBER: PO Box 839966 **TELEPHONE:** 210-207-7060

CITY OR TOWN: San Antonio **STATE:** Texas **ZIP CODE:** 78283

NARRATIVE DESCRIPTION

The Hays Street Bridge is a 353-foot-long, wrought iron, multiple-span, Murphy-Whipple and Pratt truss roadway bridge located at Hays Street over the Galveston, Harrisburg, and San Antonio Railway east of downtown in San Antonio, Texas. Despite replacement of the deck and approaches, the truss spans retain a high degree of integrity of design, materials, workmanship, location, setting feeling and association.

The Hays Street Bridge consists of one 225-foot-long double-intersecting Pratt (or Whipple) through truss and one 128-foot-long Pratt through truss, for a total length of 353 feet (not including the approaches). The deck width is twenty-five feet. The trusses are supported at each end by three battered concrete bents. The shorter Pratt span consists of six panels on each truss and the longer Whipple truss consists of thirteen panels on each truss. On both the Pratt and Whipple trusses, the smaller diagonal members work in tension and the vertical members work in compression. On the Whipple truss, these vertical compression members have a special design, called a Phoenix column. The Phoenix columns are hollow, circular posts, made of six wrought iron, rolled, flanged channels that are riveted together (see figures 5 and 6). Both truss spans feature riveted and pinned connections. The pin-connections, including the diagonals and the bottom chords, consist of multiple sets of eyebars, fastened together by cylindrical pins. Decorative quatrefoils are patterned in the portal bracing on the Whipple truss. Both bridges feature manufacturer stamps from the Phoenix Iron Company.

The Hays Street Bridge was rehabilitated in 2010. Prior to the rehabilitation, few changes had been made to the bridge since its erection at the Hays Street location in 1910. The bridge had concrete approaches; with a west approach of approximately 700 feet long and an east approach of 362 feet long, with a total structure length of approximately 1417 feet. Before rehabilitation, the deck and beams of the approach spans exhibited 80 percent deterioration.[1]. The retaining walls of the approaches had failed and the abutments had settled. As a result, the concrete approach spans were considered to be in such poor condition that their preservation was not prudent and the 2010 rehabilitation included the removal of the concrete approaches, embankments, and retaining walls. The new approaches were designed in a way to maintain the same length, location, and profile as the 1910 approaches (with modifications in slope for accessibility and vertical clearance above the roads that travel underneath the viaduct) and the material, concrete, was in kind. The design of the single pier support system for the approaches and the narrower width of the approaches for pedestrian use differentiated the new approaches from the old in design, but remained compatible with the massing, size and scale of the bridge.

Specifications for the Hays Street Bridge, dated May 28, 1910, required a seven-foot-wide pedestrian walkway that would cantilever out from the bridge trusses on the outside, connected to the trusses with brackets. The specifications also required structural steel stairways from the sidewalk at Cherry Street and Chestnut Street to the "foot walk" on the bridge. The hand rail for the walkway was specified as "gas pipe hand railing." In the

[1] S. Patrick Sparks, "Ironclad." Civil Engineering (August 2010): p. 70-75.

2010 rehabilitation, the railings, timber stringers, stairway, and deck were removed and replaced. The original deck was wooden, but had been overlaid with asphalt and other paving materials. The 2010 rehabilitation replaced the decking with wood. The original gas pipe hand railing did not meet modern safety requirements for pedestrians and was replaced by a compliant rail. None of these materials were considered character-defining features of the bridge. The 1910 cantilevered pedestrian walkway ("foot walk"), which was attached to the trusses by steel brackets, was also repaired.

Rehabilitation also included repair of the trusses, including heat-strengthening and replacing rivets using field hot riveting. The trusses, which showed no evidence of having ever been painted, were coated with linseed oil. The project also included the addition of lighting, landscaping, artwork in the handrails of the approaches, and interpretive signage. The rehabilitation of the Hays Street Bridge met the *Secretary of the Interior's Standards for Rehabilitation*. The bridge reflects a high degree of integrity of materials, design, and workmanship. Because it functions as a pedestrian bridge in its historic location, and the railroad it crosses is still active, it also retains a high degree of integrity of location, setting, feeling and association.

General Specifications:
Truss Type: Double-intersection, "Old Phoenix" Pratt truss (Murphy-Whipple), Pratt truss
No. Truss Spans: 2
Truss Span length: Whipple truss span- 225', Pratt truss span-128'
Deck Width: 25'
Overall length: 353 ft.
Deck type: wood
Piers/interior bents: concrete
Abutments/end bents: concrete

STATEMENT OF SIGNIFICANCE

The Hays Street Bridge, in San Antonio, Bexar County, was erected over the Galveston, Harrisburg, and San Antonio (GH&SA) Railroad and adjacent streets in east San Antonio in 1910 as the GH&SA was expanding its lines through San Antonio. One of the spans, a Murphy-Whipple wrought iron truss, was originally constructed in 1881 along the GH&SA Railroad over the Nueces River west of Uvalde, and moved to San Antonio in 1910 for the construction of the Hays Street Bridge. This span is one of only four known extant Whipple trusses in Texas and is the only known Texas bridge with a Phoenix column, a design commonly used by the Phoenix Bridge Company of Pennsylvania, the manufacturer of this structure. The Hay Street Bridge is significant under Criterion C, in the area of Engineering, at the state level of significance for its unique design. It is also significant under Criterion A, in the area of Transportation, for its association with the expansion of the railroads in San Antonio. The period of significance for the bridge dates from the construction of the Murphy-Whipple truss in 1881 over the Nueces River to the end of the historic period, fifty years before the date of this nomination.

Wrought Iron Bridges

Hays Street Bridge is constructed of wrought iron, a rare extant example of this material used in bridge construction in Texas.[2] Wrought iron was first used in metal truss bridges in the 1840s and gained popularity in the mind-nineteenth century as a material that worked well both in tension and compression, unlike the more brittle cast iron. By 1870 it was the standard material for truss bridges. By the 1890s, however, steel became the preferred material for truss bridges. Because few nineteenth century bridges remain in Texas and because Texas highway development saw little development until after the turn of the century; wrought iron bridges are rare in the state.[3]

Murphy-Whipple Truss

The Whipple truss was patented in 1847 by American engineer Squire Whipple. Also known as a “Double-intersection Pratt,” the Whipple was a stronger iteration of the Pratt truss because the diagonal tension members cross two panels, while those on the Pratt cross one (see figure 1).[4] This design shortened the length of the panels without altering what was considered an optimal 45 degree angle of the diagonal members. The shorter panel lengths and intersection of the diagonal members provided greater rigidity and strength, which allowed

[2] Stocklin:F-18.
[3] TxDOT Historic Bridge Inventory.
[4] http://pghbridges.com/basics.htm (accessed May 21, 2008)

for an increased span length (generally, 150 to 300 feet long).[5] John W. Murphy, of the Lehigh Valley Railroad, modified the Whipple for wrought iron construction. Therefore, when constructed of wrought iron, Whipple trusses are also known as Murphy-Whipple trusses.[6] Between 1860 and 1890 the Murphy-Whipple and other variations of the Pratt truss became the preferred truss type for long-span bridges.[7] In Texas, however, it was a fairly uncommon type, with the exception of long spans, such as the six-span Colorado River Bridge in Austin (replaced in 1910 by the Congress Avenue Bridge; three of the spans of the Colorado River Bridge were later moved to Moore's Crossing, where they still stand today).[8] Only four known Whipple truss bridges are still extant in the state; all are wrought iron Murphy-Whipple bridges. All are listed or eligible for listing in the National Register of Historic Places under Criterion C, in the area of Engineering, at the state level of significance, as rare examples of Murphy-Whipple trusses and as rare examples of extant nineteenth century bridges. The following is a brief description of the other three Whipple trusses in Texas and their comparative significance (see also table 1 at the end of this section):

Clifton Bridge, Bosque County

The Clifton Bridge (CMB-AA0333001) in Clifton, Bosque County was constructed in 1884 by the Wrought Iron Bridge Company of Canton, Ohio. Its total length is 371 feet and is composed of four spans. The main span is a Murphy-Whipple and is 148 feet long; the three approach spans are Warren Pony trusses that were added by Austin Brothers Bridge Company (two in 1912 when the bridge was also widened and one in 1918). This bridge is eligible for listing in the National Register of Historic Places under Criterion C, in the area of Engineering, at the state level of significance.[9] The bridge may also be eligible for listing under Criterion A, in the area of Transportation, at the local level of significance. It was designated a Recorded Texas Historic Landmark in 1996. This bridge is the only Whipple truss in Texas that still serves vehicular traffic.

Moore's Crossing Bridge, Travis County

The Moore's Crossing Bridge (CMB-A1711001) in Travis County consists of three Whipple truss spans of the old Colorado River (Congress Avenue) Bridge in Austin,[10] which were moved to this location in 1922. The total bridge length is 534 feet; the main span is 150 feet. The bridge is listed in the National Register of Historic Places as a contributing structure to the Moore's Crossing Historic District.[11] It was designated a Recorded

[5] Parsons Brinckerhoff and Engineering and Industrial Heritage, *A Context for Common Historic Bridge Types: NCHRP Project 25-25, Task 15*. October 2005:3-28; Stocklin, Barbara, "Historic Bridges of Texas, 1866-1945." National Register Multiple Property Documentation Form, 1995, Texas Historical Commission National Register files.
[6] Parsons Brinckerhoff and Engineering and Industrial Heritage:3-28.
[7] Ibid:3-29.
[8] Stocklin, Barbara, "Historic Bridges of Texas, 1866-1945." National Register Multiple Property Documentation Form, 1995:E-12.
[9] TxDOT Historic Bridge Inventory.
[10] The 1884 Colorado River Bridge was a six-span structure fabricated by the King Iron Bridge Company of Cleveland, Ohio.
[11] Myers, Terry. "Moore's Crossing Historic District." National Register nomination, 1996, Texas Historical Commission National Register files.

Texas Historic Landmark in 1980. Burleson Road has been rerouted and the bridge is closed to vehicles, but is accessible to pedestrians. [12]

Faust Street Bridge, Comal County

The Faust Street Bridge (CMB-B005-30-001) in New Braunfels, Comal County, was constructed in 1887 by the King Iron Bridge Company of Cleveland, Ohio and is the most technically complex, complete, and well-preserved example of a bridge constructed by the King Iron Bridge Company in Texas. The overall length of the bridge is 640 feet and it is composed of two Pratt trusses at 100 feet each in length and two Murphy-Whipple trusses 220 feet each in length. The bridge received a Recorded Texas Historic Landmark designation in 1999. The bridge is listed in the National Register of Historic Places under Criterion C, in the area of Engineering, and criterion A, in the area of Transportation, at the state level of significance.

By 1900, the Parker truss, another variant of the Pratt design, had replaced the Whipple as the standard truss type for long spans.[13] *A Context for Common Historic Bridge Types*, which is a national context developed for historic bridges, indicates that Whipple trusses should be "considered highly significant when they retain their character-defining features, including the parallel top and bottom chords, intersecting diagonals, vertical members, method of connection, inclined end posts, floor beams and stringers, and portal features."[14] Like the other three Texas Whipple bridges, the Hays Street Bridge retains all of these features from its original construction.

The Phoenix Iron Company, the Phoenix Bridge Company and the Phoenix Column

The Hays Street Bridge is unique in that it is the only known extant metal truss bridge in Texas and one of the few remaining trusses in the country to exhibit a Phoenix column. The Phoenix column, patented in 1862 by Samuel Reeves of the Phoenix Iron Company of Phoenixville, Pennsylvania, consists of a hollow, circular post, composed of four, six, or eight wrought iron, rolled, flanged channels riveted together (see figure 5). The column was designed so that it would be easy to manufacture, but strong enough to carry heavy loads and withstand buckling from lateral forces. As a stronger and lighter member than previously manufactured cast iron columns common at the time, the Phoenix column allowed for the construction of taller buildings and longer bridges. The Phoenix Bridge Company (originally Kellogg, Clarke and Company), a subsidiary of the Phoenix Iron Company organized in 1869, manufactured and erected rail and road bridges across the country and used the column in its longer spans. Both of the truss spans were constructed by the Phoenix Bridge Company.

[12] TxDOT Historic Bridge Inventory.
[13] Stocklin, Barbara, "Historic Bridges of Texas, 1866-1945." National Register Multiple Property Documentation Form, 1995:E-12.
[14] Parsons Brinckerhoff and Engineering and Industrial Heritage:3-29.

Galveston, Harrisburg and San Antonio Railway

The Buffalo Bayou, Brazos and Colorado Railway Company, which was chartered in 1850, changed its name to the Galveston, Harrisburg and San Antonio Railway in 1870. It was a subsidiary of Southern Pacific and was the first railroad to operate in the state of Texas. Construction of the railroad began in Harris County, but did not reach San Antonio until 1877. Construction between San Antonio and El Paso was completed in 1883. This route eventually became part of Southern Pacific's "Sunset Route" for the Los Angeles to New Orleans line.[15]

When the G.H. &S.A. Railway Company requested permission from the City of San Antonio to lay tracks across city streets in San Antonio in 1909, the city agreed, conditionally. One of the conditions the city required was the construction of above-grade crossings at specific locations, including one at Hays Street. Upon provision of information, including the plans for the Hays Street Bridge, the city passed and approved an ordinance on February 14, 1910 granting permission to lay tracks across Sherman, Burleson, Lamar, Hays, Burnett, Dawson, North Hackberry, Walnut, Montana, Wyoming, Dakota and Nevada streets.

Plans for the Hays Street Bridge were completed in January, 1910 and approved by City Council in February. A change order required the production of additional drawings, however, in April 1910. A note on the April 1910 drawings identified that one 225-foot-long "Thro' Phoenix Span" from Nueces River would be re-erected at this location (see figure 3). This indicates that the original location of the Whipple truss on the Hays Street Bridge was on the Galveston Harrisburg and San Antonio (G.H. &S.A.) Railway over the Nueces River in Uvalde County, just west of Uvalde (see maps 1 and 2). The line between San Antonio and El Paso was constructed between 1877 and 1883, the records of the Phoenix Bridge Company indicated that the Nueces River Bridge was constructed in 1881 and was composed of four 225 foot-long spans.[16] As the records do not indicate a 128 foot-long span at the Nueces River Bridge, the Pratt span, which is wrought iron and therefore predates the 1910 erection at Hays Street, was likely moved from another location along the G.H. & S.A. railroad, or another subsidiary of Southern Pacific. Both trusses were originally on a narrow gauge railroad and were 16 feet wide in their original location. The spans were widened to allow for a 25 foot wide deck when they were erected at the Hays Street location in 1910. Moving metal truss spans from one location to another was a very common practice during the nineteenth and twentieth centuries, particularly by the railroads.

After its erection at Hays Street, this railroad overpass remained in service until 1982, as a main artery connecting the east side of San Antonio to downtown. At that time it was closed, but was not removed.

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[15] George C. Werner, "GALVESTON, HARRISBURG AND SAN ANTONIO RAILWAY," *Handbook of Texas Online* (http://www.tshaonline.org/handbook/online/articles/egg06), accessed November 10, 2011.

[16] Phoenix Bridge Company, Album of Designs of the Phoenix Bridge Company: Successors to Clarke, Reeves & Co., Phoenixville Bridge Works, J.B. Lippincott: 1885. (http://digital.lib.lehigh.edu/cdm4/bridges_viewer.php?CISOROOT=%2Fbridges&CISOPTR=2848&ptr=2890&DMSCALE=25&DMWIDTH=500&DMHEIGHT=407.51332380086&DMMODE=viewer&DMFULL=0&DMX=710&DMY=578.24333809957&DMTEXT=&DMTHUMB=1&REC=1&DMROTATE=0&x=229&y=94&view=de) accessed November 10, 2011.

After closing the Hays Street Bridge to vehicular service, the City of San Antonio considered demolition of the bridge, but local efforts to preserve the bridge raised awareness of its historical significance and the bridge was left alone for several years. This local movement was led by Douglas Steadmen, P.E., and F.ASCE and resulted in designation of the bridge as a Texas Historic Civil Engineering Landmark by the American Society of Civil Engineers (ASCE) in March 2001. The bridge is also a City of San Antonio Historic Landmark. After continued interest in the rehabilitation of the bridge for pedestrian use, the Texas Department of Transportation selected the bridge as a candidate for funding through the Statewide Transportation Enhancement Program and the bridge was rehabilitated using federal funds in 2010. Patrick Sparks was the principal engineer on the rehabilitation project, which included the demolition and reconstruction of the concrete approach spans, repair of the trusses, and the addition of lighting, landscaping, and interpretive signage. The bridge is now open to pedestrian traffic.

The unique design of the Phoenix column and the rarity of the Whipple truss qualify the Hays Street Bridge for listing in the National Register of Historic Places under Criterion C, in the area of Engineering, at the state level of significance. Because of its role in the development of the railroads in San Antonio, the bridge is also eligible under Criterion A, in the area of Transportation, at the local level of significance. Although the 1881 Whipple truss was moved to this location in 1910, this resource does not need to meet Criteria Consideration B, as it was moved during its period of significance.

Table 1: comparative data for extant Whipple trusses in Texas.

Name	Location	Total length (ft)	Main span length (ft)	Date of construction	Fabricator
Clifton Bridge	Clifton, Bosque County	371	148	1884, 1912, 1918	King Iron Bridge Company
Hays Street Bridge	San Antonio, Bexar County		228	1881, ca. 1910	Phoenix Steel Company
Moore's Crossing Bridge	Austin vicinity, Travis County	534	150	1884, 1922	King Iron Bridge Company
Faust Street Bridge	New Braunfels, Comal County	640	220	1887	King Iron Bridge Company

BIBLIOGRAPHY

Myers, Terry. "Moore's Crossing Historic District." National Register nomination, 1996, Texas Historical Commission National Register files.

Parsons Brinckerhoff and Engineering and Industrial Heritage, *A Context for Common Historic Bridge Types: NCHRP Project 25-25, Task 15*. October 2005:3-28;

Phoenix Bridge Company, Album of Designs of the Phoenix Bridge Company: Successors to Clarke, Reeves & Co., Phoenixville Bridge Works, J.B. Lippincott: 1885. (http://digital.lib.lehigh.edu/cdm4/bridges_viewer.php?CISOROOT=%2Fbridges&CISOPTR=2848&ptr=2890&DMSCALE=25&DMWIDTH=500&DMHEIGHT=407.51332380086&DMMODE=viewer&DMFULL=0&DMX=710&DMY=578.24333809957&DMTEXT=&DMTHUMB=1&REC=1&DMROTATE=0&x=229&y=94&view=de) accessed November 10, 2011.

Railroad Commission of Texas, "Railroad and County Map of Texas,1908," Texas State Library and Archives Commission digital map collection (https://www.tsl.state.tx.us/cgi-bin/aris/maps/) accessed November 10, 2011.

S. Patrick Sparks, "Ironclad." Civil Engineering (August 2010): p. 70-75.

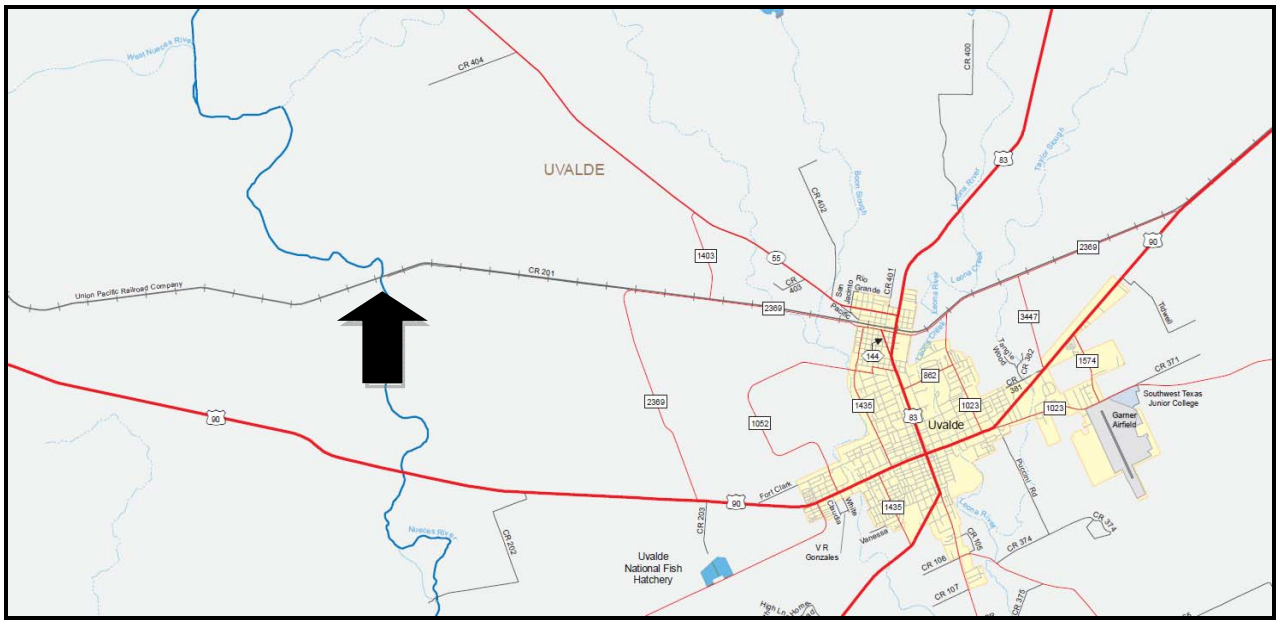
Stocklin, Barbara, "Historic Bridges of Texas, 1866-1945." National Register Multiple Property Documentation Form, 1995, Texas Historical Commission National Register files.

Texas Department of Transportation Historic Bridge Inventory.

Texas Department of Transportation. "Uvalde County Highway Map, 2010," (http://www.dot.state.tx.us/travel/county_grid_search.htm?UserInput=Uvalde) accessed November 10, 2011.

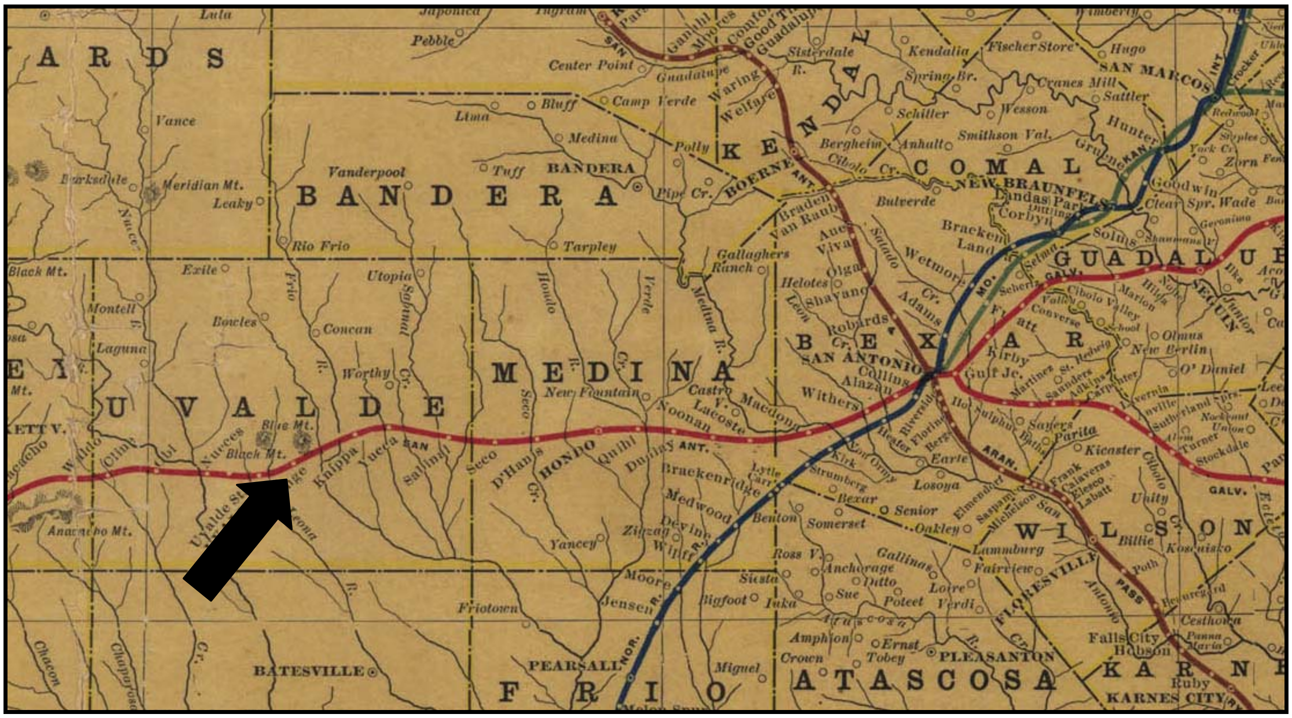
Texas Department of Transportation. Uvalde County Highway Map (http://www.dot.state.tx.us/travel/county_grid_search.htm?UserInput=Uvalde) accessed November 10, 2011.

George C. Werner, "GALVESTON, HARRISBURG AND SAN ANTONIO RAILWAY," *Handbook of Texas Online* (http://www.tshaonline.org/handbook/online/articles/eqg06), accessed November 10, 2011.



Map 1: Original location of Hays Street Bridge, 2010 TxDOT County Map.[17]

[17] Texas Department of Transportation. Uvalde County Highway Map (http://www.dot.state.tx.us/travel/county_grid_search.htm?UserInput=Uvalde) accessed November 10, 2011.



Map 2: Original location of Hays Street Bridge, 1908 railroad and county map.[18]

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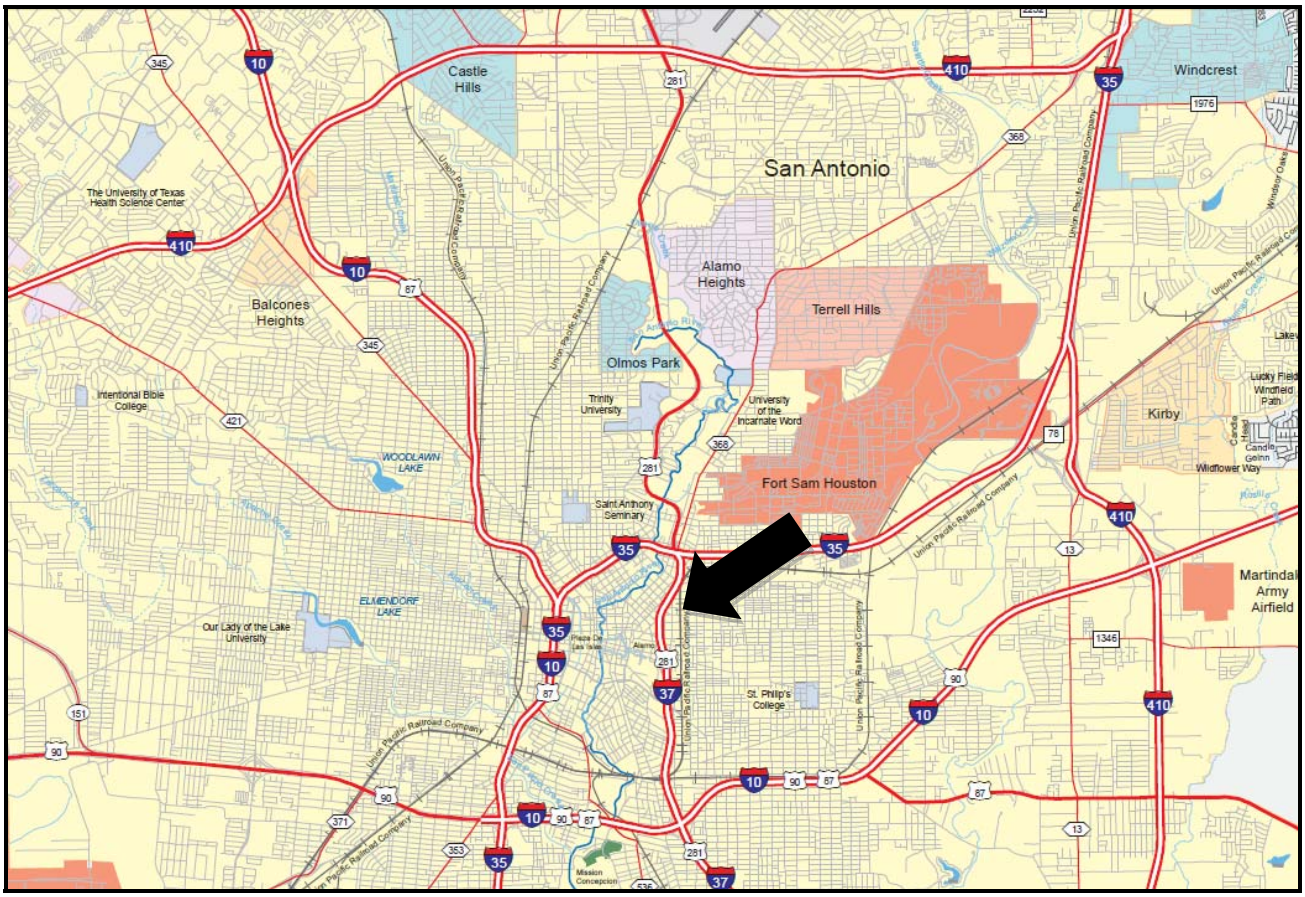
18 Railroad Commission of Texas, "Railroad and County Map of Texas,1908" Texas State Library and Archives Commission digital map collection (https://www.tsl.state.tx.us/cgi-bin/aris/maps/) accessed November 10, 2011.



Map 3: Location of Hays Street Bridge in San Antonio, Texas.

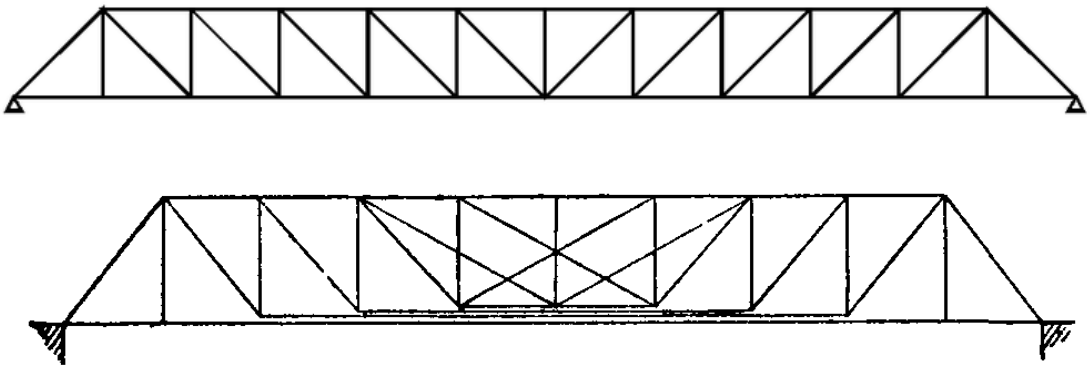


Figure 1. **top- Illustration of Pratt truss, showing each diagonal crossing a single panel. bottom- Illustration of Whipple truss, showing diagonals crossing two panels.**

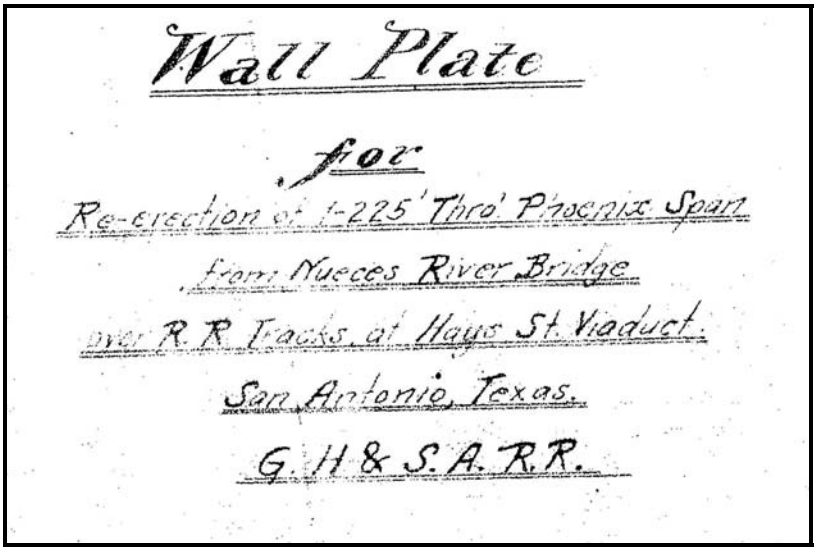


Figure 2: Note from plans identifying original location of Whipple truss.

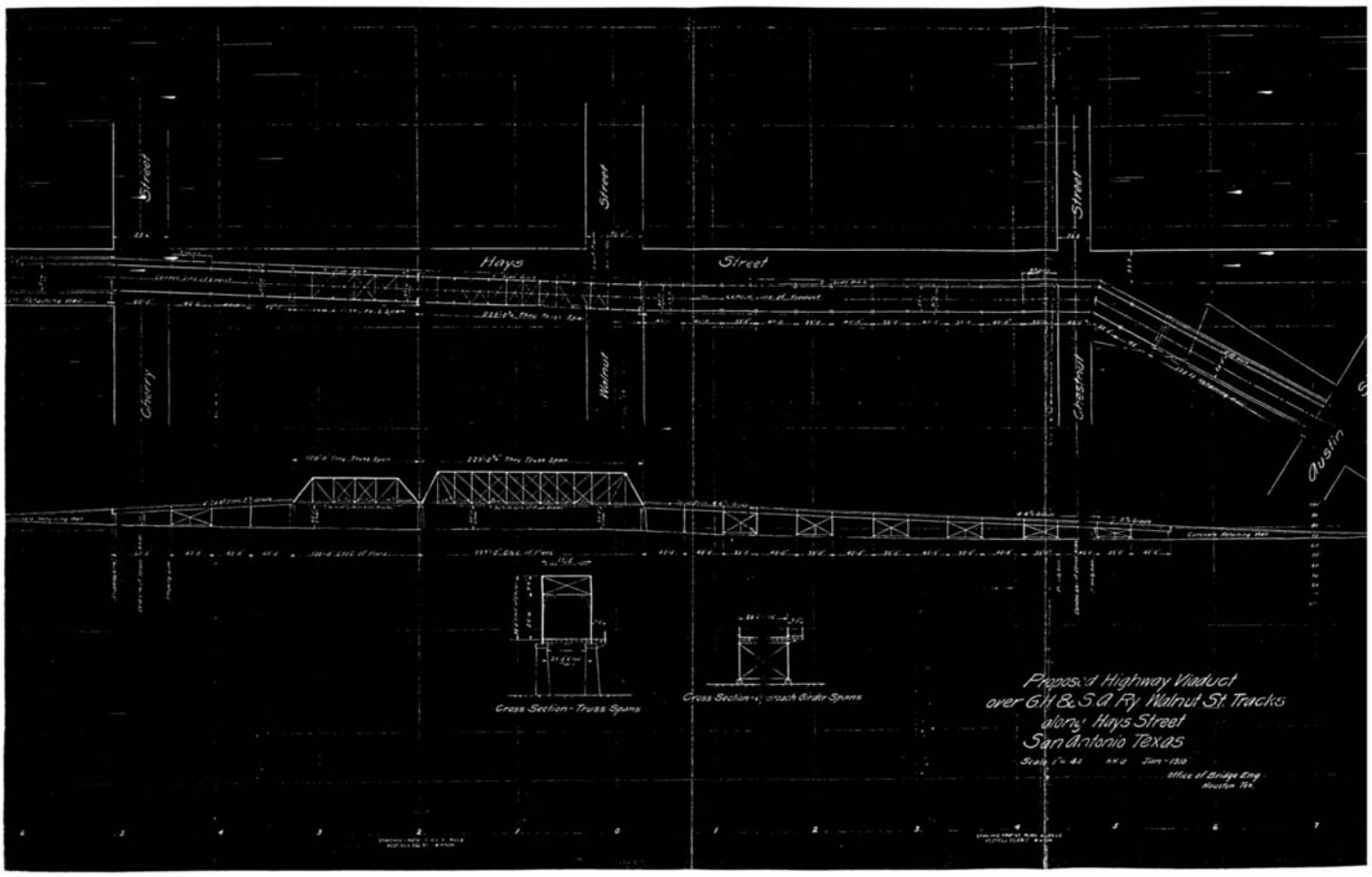


Figure 3: January 1910 plans for Hays Street Bridge.

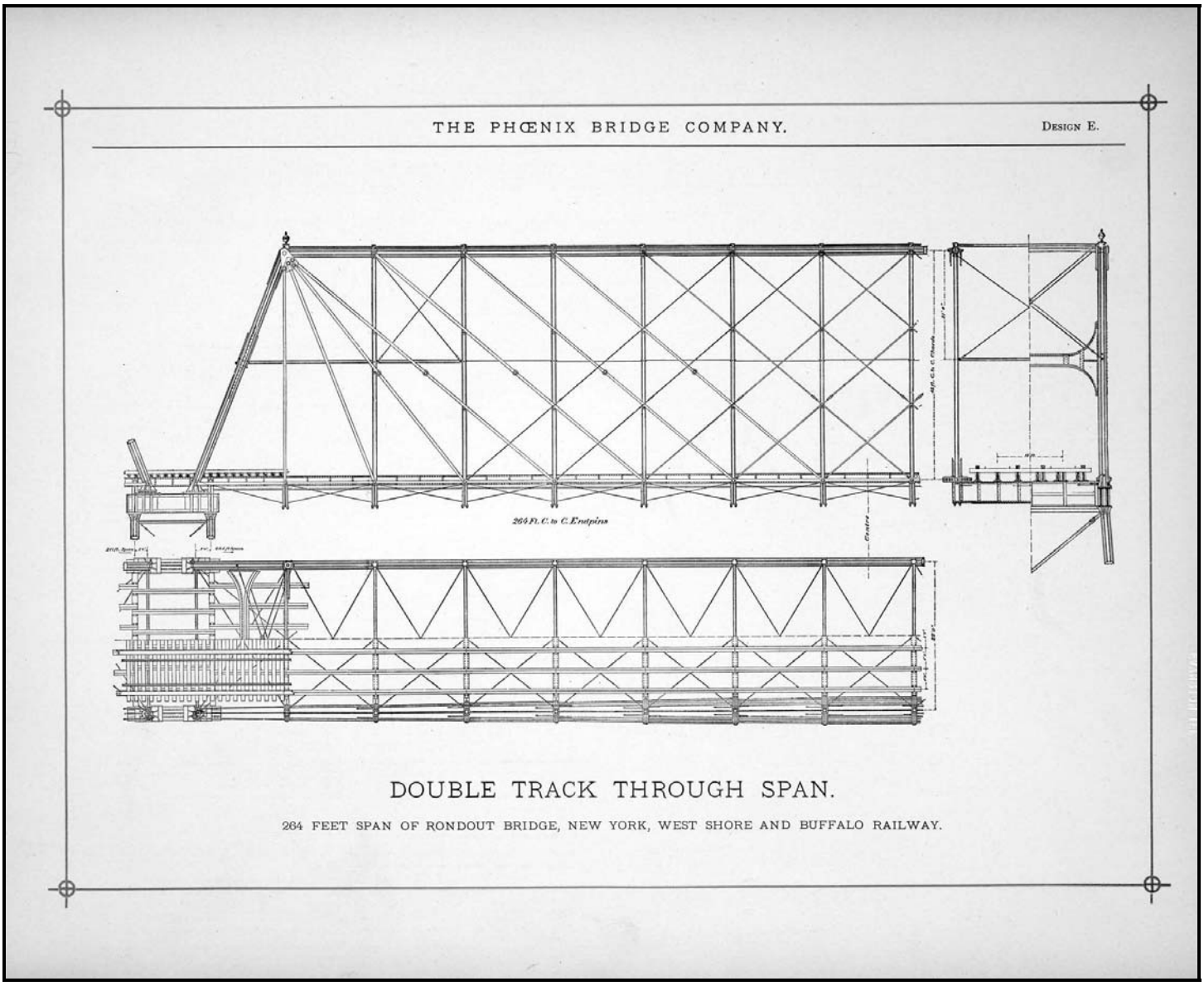


Figure 4: Standard Phoenix Bridge Company Whipple truss design with Phoenix column.[19]

[19] Phoenix Bridge Company, Album of Designs of the Phoenix Bridge Company: Successors to Clarke, Reeves & Co., Phoenixville Bridge Works, J.B. Lippincott: 1885. (http://digital.lib.lehigh.edu/cdm4/bridges_viewer.php?CISOROOT=%2Fbridges&CISOPTR=2848&ptr=2890&DMSCALE=25&DMWIDTH=500&DMHEIGHT=407.51332380086&DMMODE=viewer&DMFULL=0&DMX=710&DMY=578.24333809957&DMTEXT=&DMTHUMB=1&REC=1&DMROTATE=0&x=229&y=94&view=de) accessed November 10, 2011.

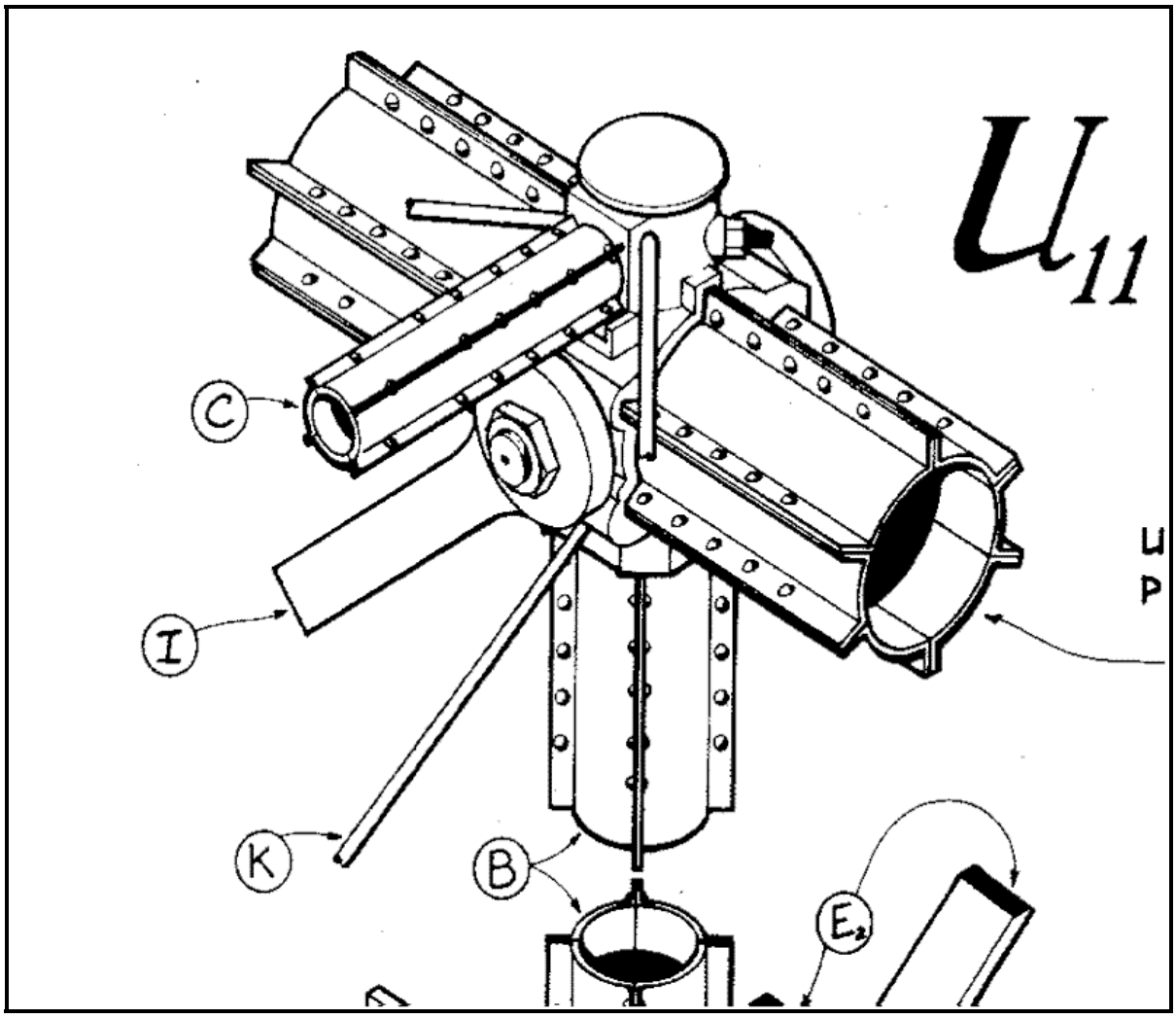


Figure 5: Illustration of a Phoenix column.

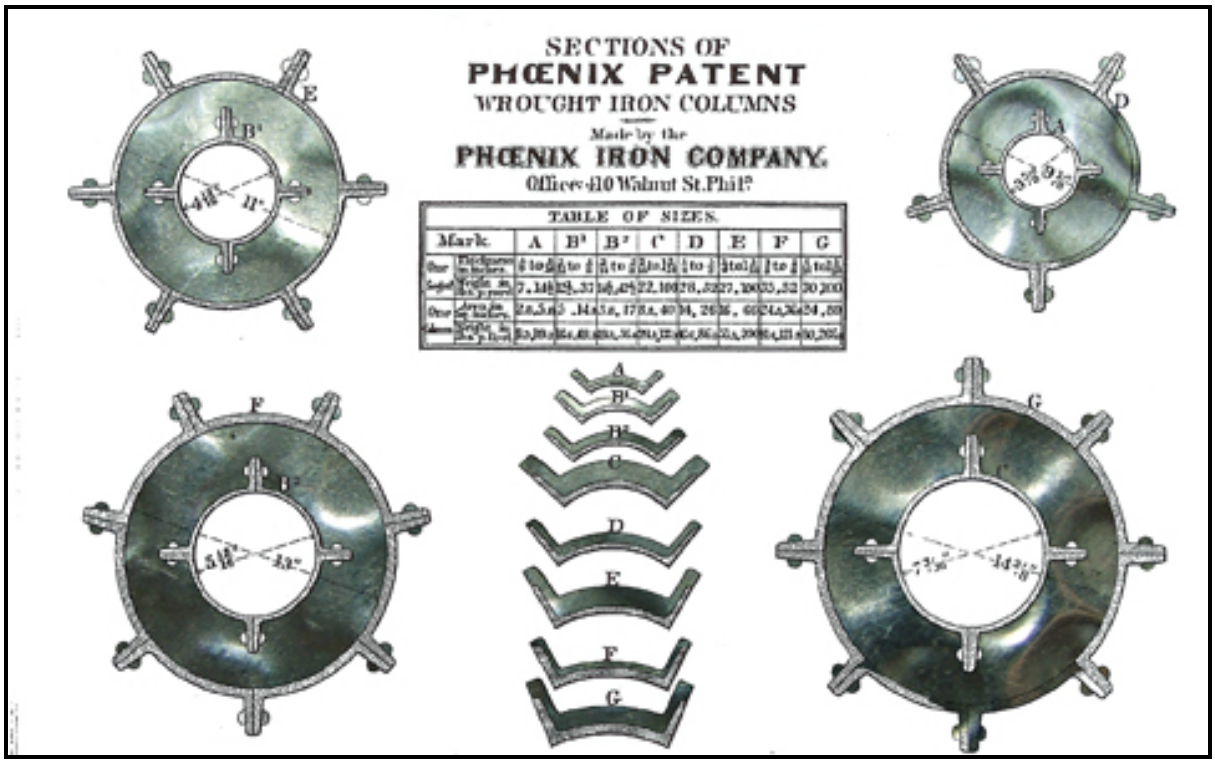
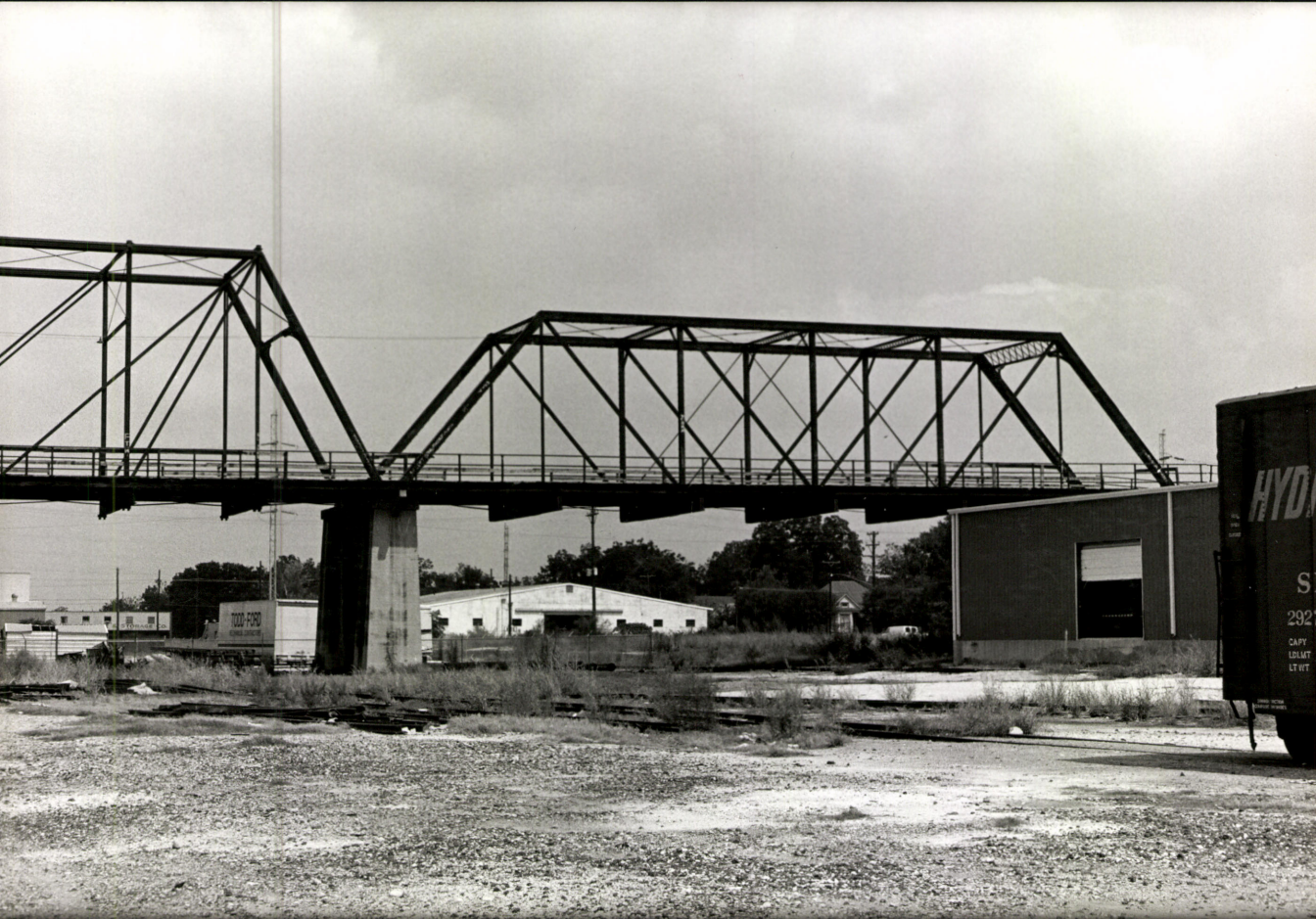


Figure 6: Sections of Phoenix columns from U.S. Patent (Library of Congress)

Figure 6: Portal bracing with quatrefoils and Phoenix column. (Photo by Pat Sparks)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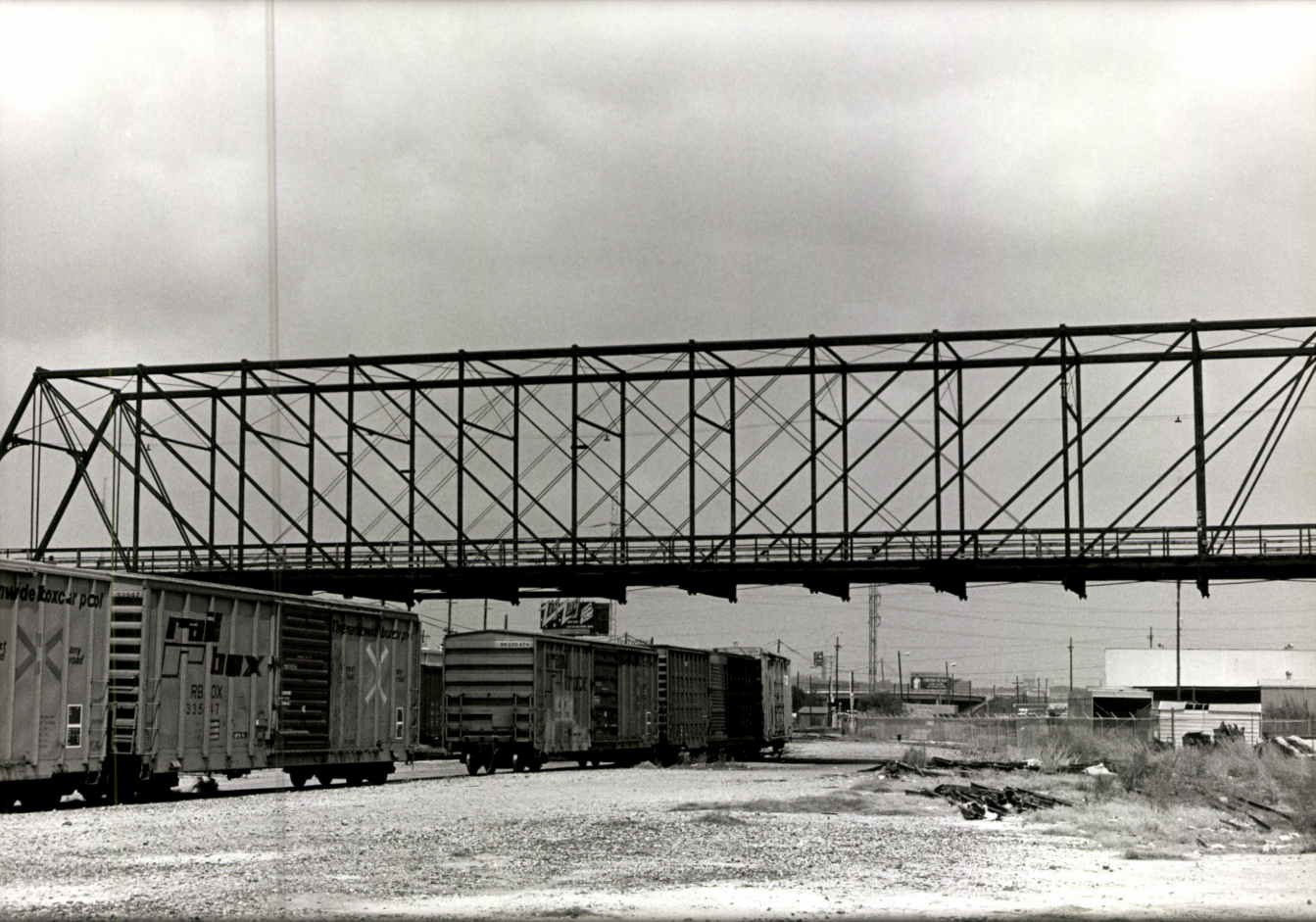
HYD
CAPY
LD/LMT
LT WT


VALLEY
COTTON
BELT


TODD-FORD
MECHANICAL CONTRACTORS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