ITEM # ___32___
DATE 12-11-12

COUNCIL ACTION FORM

SUBJECT: **6TH STREET BRIDGE DESIGN ALTERNATIVES**

BACKGROUND:

The bridge inspections in 2010 and 2012 both recommended the replacement of the 6th Street Bridge over Squaw Creek due to the current condition; a feasibility study in 2009 also recommended replacement. The replacement of the bridge was placed in the Capital Improvements Plan as a multi-year project to allow time for study, design, procurement of grants, and construction.

The first step was identified in FY 2012/13 for a design alternatives study. This study refines the type, layout, and style of the bridge. City staff retained the firm WHKS for this study (see attached final report). A meeting was held with representatives from Public Works and Parks & Recreation Departments to discuss options and the layout in the area. A public meeting was then held to gain feedback from the public on the options presented.

This information and input is included in the report from WHKS. The report identifies **Alternate D as the preferred alternative** based on cost and the feedback received on the alternatives and aesthetics. This alternative calls for a concrete bridge having two vehicular travel lanes and on-street bike lanes, a shared use path on the south side, and a sidewalk on the north. This alternate also includes the aesthetic elements identified through the public input process. As stated in the report, the total costs shown ($2,286,000) include the aesthetics; however, costs could be reduced by choosing only certain aesthetic treatments.

The following table shows the corresponding estimated costs of each aesthetic treatment identified in that input process.

Aesthetic Premiums (handrail on separation rail)	
	Total
Structural Steel Pedestrian Hand Railing	$ 78,000
Steel Pipe Pedestrian Hand Railing	$ 28,600
Structural Concrete (oversize west abutment)	$ 18,000
Concrete Texturing (abutment & piers)	$ 140,000
Concrete Texturing (rails)	$ 26,000
Colored Concrete Sealer (including exterior beams)	$ 36,300
Roadway Lighting	$ 4,000
Sidewalk Lighting	$ 16,800
Underdeck Lighting	$ 1,800
Total	**$ 349,500**

The direction given by the City Council as to the preferred design alternative (either Alternative A,B, C, or D) along with the selected aesthetic features will be used by WHKS as they move forward to complete the design of the bridge.

ALTERNATIVES:

1. Accept the 6th Street Bridge Design Alternative Study with Alternate D (which includes two traffic lanes, two on-street bike lanes, a separated shared-use path, and a separated sidewalk along with all nine of the $349,500 of aesthetic features identified above.

2. Accept the 6th Street Bridge Design Alternative Study with Alternate D (which includes two traffic lanes, two on-street bike lanes, a separated shared-use path, and a separated sidewalk along with a lesser number of aesthetic features identified above.

3. Direct staff to move ahead with a different design alternative and combination of aesthetic features as reflected on page 9 of the attached Design Alternative Study.

4. Do not move forward with the project which will result in the eventual closure of the bridge due to its further deterioration.

MANAGER'S RECOMMENDED ACTION:

While most costly, Alternative D best accommodates all of the users within the corridor. It continues to extend the on-street bike lanes from the east to accommodate the more experienced bikers. It also provides connectivity of the shared-use path system as well as a sidewalk access to Brookside Park. Because it meets federal design guidelines, this design will enable us to receive federal construction grants.

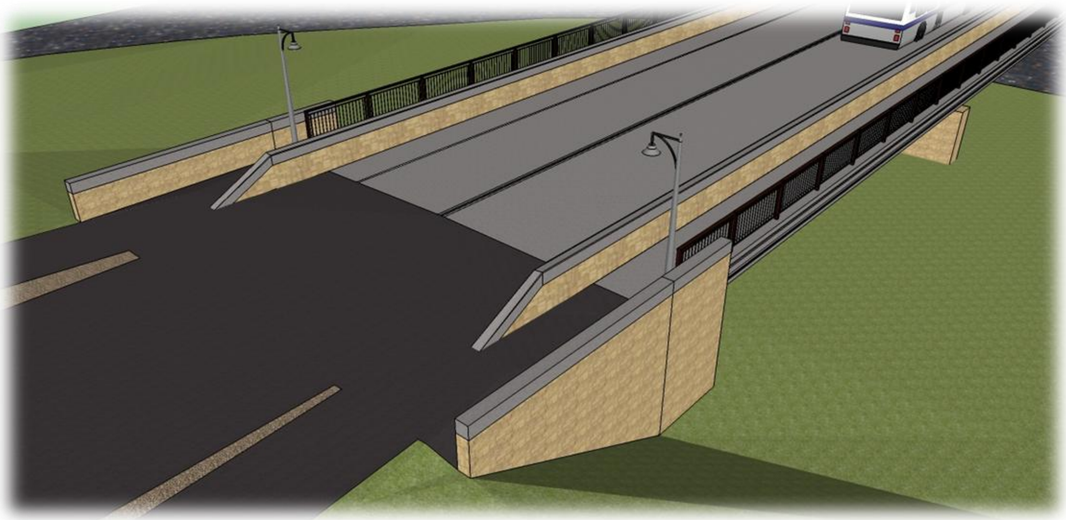
Incorporating all of the nine suggested aesthetic features will better assure the bridge will blend with the look and feel of Brookside Park. The three aesthetic lighting features also enhance safety.

Therefore, it is the recommendation of the City Manager that the City Council adopt Alternative No. 1, thereby accepting the 6th Street Bridge Design Alternative Study with Alternate D as the preferred design layout along with the nine aesthetic elements noted in the report.

DESIGN ALTERNATIVE STUDY

SIXTH STREET OVER SQUAW CREEK
BRIDGE REPLACEMENT

December 2012



LICENSED PROFESSIONAL ENGINEER Joshua J. Opheim 20567 IOWA	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. Joshua J. Opheim (signature) — 12/4/2012 Joshua J. Opheim, P.E. — Date License number 20567 My license renewal date is December 31, 2012. Pages or sheets covered by this seal: All

whks

engineers + planners + land surveyors

Contents

Introduction

This study will examine various design alternatives associated with the replacement of the bridge on 6th Street over Squaw Creek in the City of Ames, IA. In addition to presenting the options, detailed discussion, cost comparisons, and recommendations will be made. Some of the main areas of study include the bridge type, aesthetics, and accessibility from the standpoint of pedestrians and bicyclists.

Scope and Limitations

The main focus of the report is on the bridge type, size and proposed cross section. For each item, the following items are presented:

- Description
- Design features
- Estimated costs
- Advantages and disadvantages

In addition, the report will examine in detail many other aspects of the future bridge, including: preliminary right-of-way (ROW) impacts, bridge design criteria, aesthetic options and impacts, estimated aesthetic costs, railing options, requirements for Americans with Disability Act (ADA) compliance, accessibility for pedestrian/bicycle users, and approach roadway tie-in.

The study is preliminary in nature and involves limitations and unknowns. Survey, ROW easements/acquisition, utility coordination, permitting and other historical, archeological and/or environmental studies have not been conducted. The study should not be considered preliminary design; the actual sizing/location of the bridge will depend on future hydrology and hydraulic studies.

Cost estimates are based on information available at this time, and could vary depending on market factors and various design options that may alter the cost of the project. Costs are presented in present dollars and do not include any provision for inflation.

Background

The Sixth Street Bridge over Squaw Creek is located in the central portion of Ames near the west end of Sixth Street where it terminates at University Boulevard. The nearest intersection on the east side of the bridge is Brookridge Avenue and North Hazel Avenue. The roadway and shared use path is heavily used as a connection between Iowa State University, downtown Ames, and residential areas between. Users of Brookside Park and the nearby skate park, which are north and west of the bridge, also frequently use the bridge. Brookside Park on the north side of the bridge is owned by the City of Ames, and property to the south of the bridge is owned by Iowa State University, according to City Assessor's records. The main Union Pacific Railroad east-west line is approximately 160-ft south (downstream) of the bridge. There is also a shared-use path that runs under the bridge on the west side of Squaw Creek.

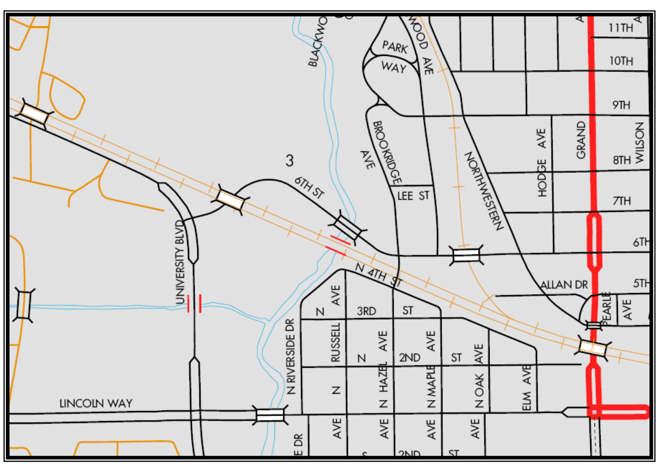


Figure 1. Location Map

In 2009, WHKS was commissioned by the City to conduct a feasibility study regarding the state of the existing bridge. The objective was to examine the existing condition of the bridge and determine what future action regarding repair or replacement, if any, should be taken. The need for the study was based on the condition of the bridge, the type of construction, and the projected need for bridge maintenance.

The study determined that the bridge has exceeded its intended service life, is in the beginning stages of accelerated deterioration and will require substantial future maintenance to extend its service. Furthermore, the bridge superstructure is constructed in a non-redundant fracture critical configuration which is particularly susceptible to fatigue and fracture. To address these varied concerns, the report recommended further study of a prestressed, pretensioned concrete beam bridge replacement based on long-term viability and lowest cost.

Existing Bridge

The bridge on Sixth Street over Squaw Creek is a three span steel two-girder bridge with a cast-in-place concrete deck that was built in 1948. It was designed for H15 highway loading. A bridge deck overlay with sidewalk repair, railing modifications and steel painting was completed in 1987. In 1997, abutment backwall, bridge seat and approach pavement repairs were constructed. The bridge length is approximately 250'-0 and the roadway width is 25'-8 with 6-ft sidewalks on each side. The sidewalks are raised 1'-0 above the roadway with no separation rail. 43-in high steel picket rails protect users at the outside edge of each sidewalk. They were originally 34-in but were modified and raised in 1987. Decorative art deco-style post caps were removed as part of the rail height increase.

The approach roadway section is typically 25-ft (11-ft lanes with 1.5-ft shoulders) to the west, but widens to accommodate a left turn lane and curb and gutter east of the bridge. Beginning at Brookridge Avenue, the cross section consists of bike lanes, a two-way left turn lane and curb and gutter. The posted speed limit is 30 miles per hour. The shared-use paths leading to the bridge are generally 8- to 9-ft wide and narrow to 6-ft on the bridge. The path on the south side is more heavily used as a continuous link between residential areas, Downtown and Iowa State University. Traffic counts from 2011 show that approximately 4160 vehicles per day use the bridge.

There have been some safety concerns about the raised sidewalks for bicyclists when two or more bicycles or pedestrians are crossing the bridge. In response to concerns of the bicycle community and following discussion with the City Council, the City installed sharrows on the roadway in 2012 to direct bicyclists to use the roadway instead of the bridge sidewalks. They also alert motorists to share the roadway with bicyclists.

Due to the two-girder superstructure arrangement, the bridge is non-redundant and is classified as fracture critical. According to AASHTO, "fracture critical members or member components (FCMs) are steel tension members or steel tension components of members whose failure would be expected to result in collapse of the bridge".[1] Redundancy refers to the ability of other structural members that could temporarily take the load previously carried by a failed member, thereby potentially avoiding the collapse of the bridge. For this bridge, there are no other structural members that could temporarily take the load in the event of failure of one girder. This would likely lead to collapse of the span, which results in the classification of the bridge as fracture critical. The report from the recent 2012 bridge inspection reads as follows:

> *Hairline transverse cracks in top of deck and hairline cracks with leaching on bottom of deck. Edge of south curb is spalled and crumbling. Pack rust between cover plates and gusset plates, occasionally causing bulging and distortion of the flange plates. Other locations of bottom flange distortion include center span north girder and south girder near Pier 1 in center span. Ends of girders and bearings are very rusty with some section loss. Heavy leaf rust on bottom flange of north girder in the center span 10-15' from Pier 1, approximately 1/8" section loss in places. Leaf rust at horizontal bracing gusset plates*

[1] American Association of State Highway and Transportation Officials (AASHTO), Manual for Condition Evaluation of Bridges, 1994 (Washington, DC: AASHTO, 2000)

and some transverse/bearing stiffener locations. Rockers at both abutments are tipped to expansion (2" on 10") at 85 deg. Minor erosion in west berm. Rip rap added to east bank in 2010.

Water and deicing chemicals are starting to leach through the deck as well as cause deterioration of the concrete fascia as well as steel beams and bearings below the joints. Pack rust is also causing a loss of section at the girder bottom flange cover plates and other locations.

Bridge Concepts

Superstructure Type

Pretensioned Prestressed Concrete Beam (PPCB) Bridge

This bridge type is a mainstay of Iowa bridges, combining a traditional form with economy and constructability. Long-term maintenance is generally very low, especially when integral abutments without joints are utilized.

Different Iowa DOT-designed standard beam lengths can be combined to create a custom bridge length and reduce costs. The bridge length should be maintained around the existing waterway opening of 250 ft. One possible span arrangement is 75'-100'-75'. Another possible arrangement is 100'-100'-50' which locates the piers near the existing stream banks. This later arrangement is favorable hydraulically but not as desirable aesthetically.

In either scenario, shifting the bridge approximately 10 feet to the east of the existing bridge to avoid the existing abutment piles and better center the bridge on Squaw Creek is recommended. This in turn allows a shallower berm slope at the east abutment with less potential for erosion. Some channel shaping may be required.

Applicable Iowa DOT Standard PPCB Types for Possible Use			
Beam Type	Beam Depth	Approx. Total Depth	Maximum Spacing
D	4'-6	5'-5	7'-6
BTC	3'-9	4'-8	9'-3

Based on a preliminary review of the profile grade and hydraulic data, it appears that D beams will provide adequate freeboard to meet DNR requirements. The deeper D beam is approximately 6.18 feet above the Q_{50} flood elevation, greater than the 3 feet required. BTC beams will also work for the proposed span lengths, and due to the higher strength and greater allowed spacing may provide substantial savings over D beams.

Advantages

- Standard Iowa DOT beam sections are familiar to contractors and fabricators, and easy to construct
- Faster construction with less impact to traffic
- Lower construction cost than steel girders
- Generally lower design cost
- Easy to apply colored concrete sealer for aesthetics
- BTC beams are cost effective depending on the cross section chosen. BTC beams save **two beam lines** when compared to D beams for Alternates A and D.

Disadvantages

- Site accessibility may be a concern due to the low railroad bridge clearance from the west
- Not as aesthetically pleasing as steel girders
- Requires two piers instead of one

Continuous Welded Plate Girder (CWPG) Bridge

This bridge type is commonly used in Iowa where span arrangements, horizontal alignment or vertical alignment do not allow the use of PPCB or other bridge types. It is generally more time consuming to design and fabricate, which can lead to higher design and construction costs. However, there are standards and guidelines for economical construction, and CWPG bridges are sometimes considered desirable for aesthetic or other preference reasons. CWPG bridges are generally constructed of weathering steel girders, which reduce long-term maintenance costs due to the lack of need for painting.

One possible span arrangement is 125'-125'. The overall bridge length will approximately match the existing, but the bridge will be shifted to the east to avoid existing abutments and center the bridge on Squaw Creek. Notably, only one pier is necessary. For this span arrangement, the probable beam depth is 3'-6, and the total depth is 4'-3, making it at least 5 inches shallower than the PPCB options. It is also more hydraulically efficient due to the fewer piers, making it possible that the overall bridge length could be shorter.

Advantages

- Possible cost savings and shorter construction time due to only one required pier
- Weathering steel reduces long-term painting costs and matches Brookside Park pedestrian truss bridge
- Increased aesthetic appeal

Disadvantages

- Higher material and fabrication costs
- Higher design cost
- Generally not economically feasible for this bridge size, layout and location
- Steel erection more complicated and time consuming than setting PPC beams

Rolled Steel Beam (RSB) Bridge

The Iowa DOT has a set of standards for RSB bridges for use in typical stream crossings. Use of the standards speeds up and makes the design process more economical. However, this is not a typical stream crossing and at a minimum some modifications to the width and beam spacing would need to be made. Further investigation during preliminary design would determine whether the standards could be modified or if a custom design would be required. Even in the case of the latter, some savings in design could still be realized by using a standard length/span and re-using standard details.

Applicable Iowa DOT RSB Standards for Possible Use				
Length (feet)	End Span (feet)	Interior Span (feet)	Beam Depth (ft-in)	Total Depth (ft'-in)
240	72	96	3'-0	3'-11
260	78	104	3'-4	4'-3
280	84	112	3'-4	4'-3

Using a modified 260' RSB standard (78'-104'-78') would ensure the waterway opening is at least greater than existing. The bridge should be shifted approximately 10 feet to the east of the existing bridge to avoid the existing abutment piles and better center the bridge on Squaw Creek. This also allows a shallower berm slope at the east abutment with less potential for erosion. Some channel shaping may still be required.

Advantages

- Weathering steel reduces long-term painting costs and matches Brookside Park pedestrian truss bridge
- Smaller girder sections for easier delivery
- Shallower beams could allow reduction in bridge length during preliminary design

- Design cost savings if Iowa DOT standards are partially utilized
- Beam spacing can be varied and custom designed, allowing efficient use for any typical section

Disadvantages

- Incomplete historical cost data, but generally more expensive than equivalent PPCB bridge
- Steel erection time longer than PPC beams
- Two piers required
- Span arrangement not adjustable if using RSB standards

Typical Section

Four possible alternatives for the bridge typical cross section were developed, as shown and discussed below. In all cases, the current raised sidewalk configuration is eliminated and replaced with separation rails which provide increased safety and protection to pedestrians and bicyclists. Minimum Iowa Department of Transportation (Iowa DOT) and AASHTO design criteria were followed in developing the cross section geometry. Improvements and concerns are addressed with each alternative, with an attempt to emphasize one primary objective for each alternate while seeking to achieve a balance of benefits and costs. If desired, other alternatives may be possible by combining various elements from each alternative.

Alternate A – 32' roadway, 12' shared-use path & 5' sidewalk

This alternate is based on meeting the lane and gutter width criteria of the Iowa DOT Urban Design Aids, and providing the most protection for bicycle and pedestrian users. The bridge roadway width is 32'-0 (2-12' lanes and 2-4' gutters) with separation rails on both sides. Due to the concentration of bicycle traffic on the south side of the existing bridge, a 12'-0 shared-use path is provided on the south side only. It is also recommended to provide a path width greater than the 10'-0 minimum due to heavy use. The sidewalk on the north side for less frequent pedestrian use and park access is a minimum of 5'-0 wide to meet Americans with Disabilities Act (ADA) requirements, which will be discussed in more detail later. A 3'-6 pedestrian handrail is provided adjacent to the sidewalk and a 4'-6 bicycle railing is provided adjacent to the shared-use path.

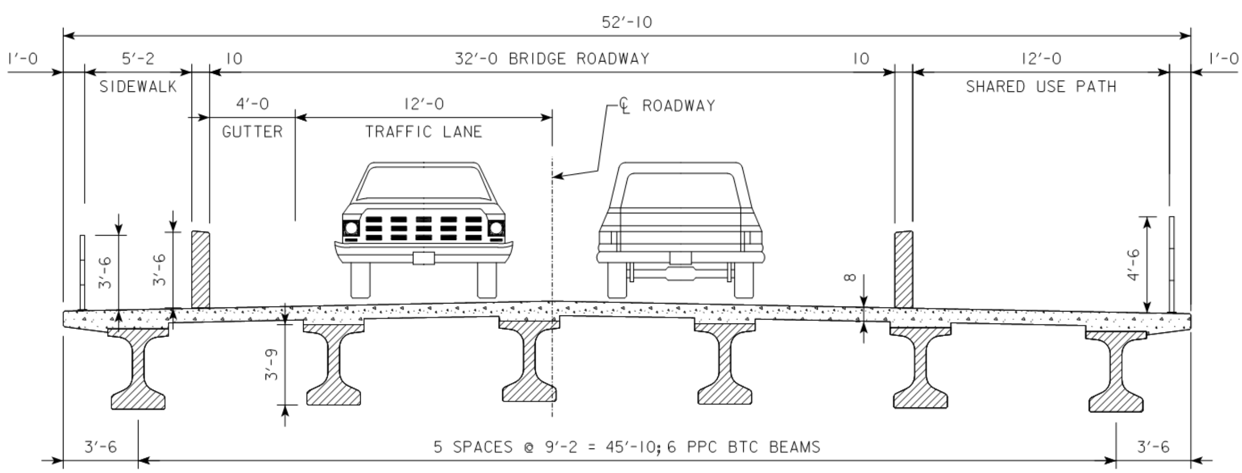


Figure 3. Alternate A Cross Section; Looking East.

Advantages

- Largest bridge roadway width (6-ft increase in width compared to existing roadway)
- Provides flexibility to allow for possible conversion to on-street bike lanes in the future
- Shared-use path exceeds required width (10-ft) due to heavy path use, and provides continuity with existing shared use path at bridge approaches
- Best option for snow removal (4-ft gutter storage for snow)

Disadvantages

- Encourages higher speed traffic with larger roadway width
- Requires a mix of pedestrian/bicycle traffic on shared-use path
- Requires westbound bicycles to cross Sixth Street prior to bridge to use shared-use path
- Highest cost alternate
- May require 10- to 15-ft additional easement/ROW at south side

Alternate B – 32’ roadway with bike lanes, 5’ sidewalks

This option utilizes alternative design practices and reduces cost by including 5’-0 bicycle lanes on the roadway. By providing the on-street bike lanes, the need for a shared-use path is eliminated and the overall bridge width is reduced. This alternative mimics and ties into the roadway typical section on Sixth Street just east of the bridge. The 32’-0 bridge roadway width is maintained, but the lanes are reduced to 11’-0 to accommodate the 5’-0 bike lanes. The lane and gutter widths do not meet the Urban Design Aids, but do meet the Iowa DOT Alternative Urban Design Criteria. There are also 5’-0 minimum width sidewalks on each side for pedestrian use, protected by separation rails.

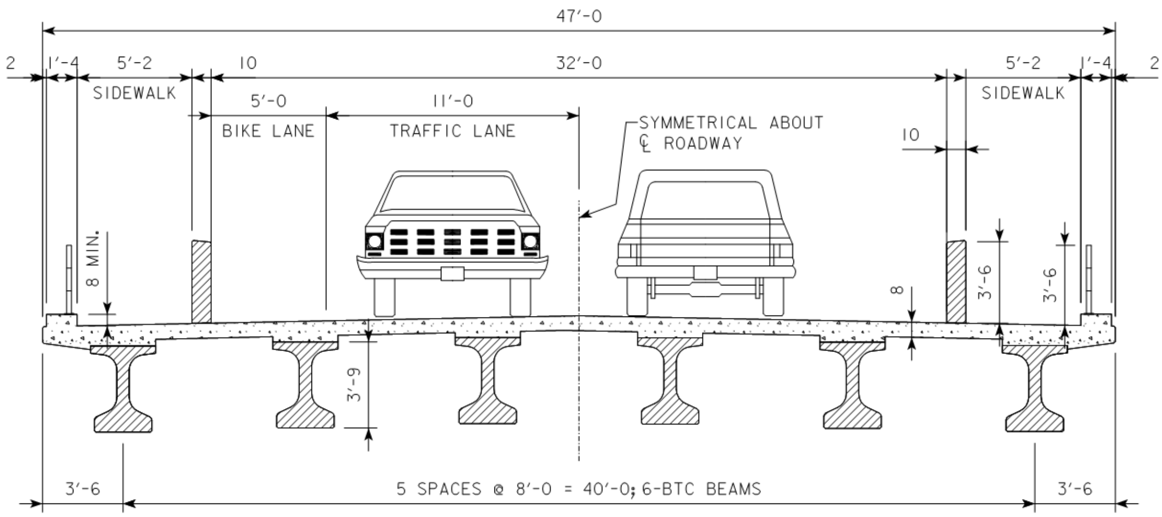


Figure 4. Alternate B Cross Section; Looking East.

Advantages

- Provides separate, continuous facilities for bicycle users and pedestrian users
- Consistent with the current lane/pavement markings and the use of bicycle lanes on Sixth Street from Brookridge Ave. to Grand Ave
- Additional width from bicycle lanes provides a 32'-0 "effective roadway width" at reduced cost
- Encourages roadway sharing and traffic calming

Disadvantages

- Does not provide physical separation of bicycles from vehicles (may not be comfortable for younger or inexperienced riders)
- Sidewalks are too narrow for mixed bicycle and pedestrian traffic
- Requires westbound bicycles to cross Sixth Street west of the bridge to cross the road to use the shared-use path or merge with traffic to pass under the narrow UPRR underpass bridge
- No gutter storage for snow if bike lanes will be maintained throughout the winter
- May require easement at south side

Alternate C – 24’ roadway, 12’ shared-use path & 5’ sidewalk

This option seeks to minimize the bridge width and cost, while maintaining separate protected pedestrian and bicycle paths. The roadway and bridge width is reduced by 8-ft, making it similar in overall width to Alternate B. The bridge roadway width is 24’-0 (2-11’ lanes and 2-1’ gutters), which meets the Alternative Urban Design Criteria. However, the roadway width may disqualify the bridge from Federal funding; to ensure Federal funding the minimum roadway width should be 28’-0. There is a 12’-0 shared-use path on the south and a 5’-0 sidewalk on the north, both protected by separation rails. Again, the shared-use path was only deemed necessary on the south side due to the heavy use by bicyclists.

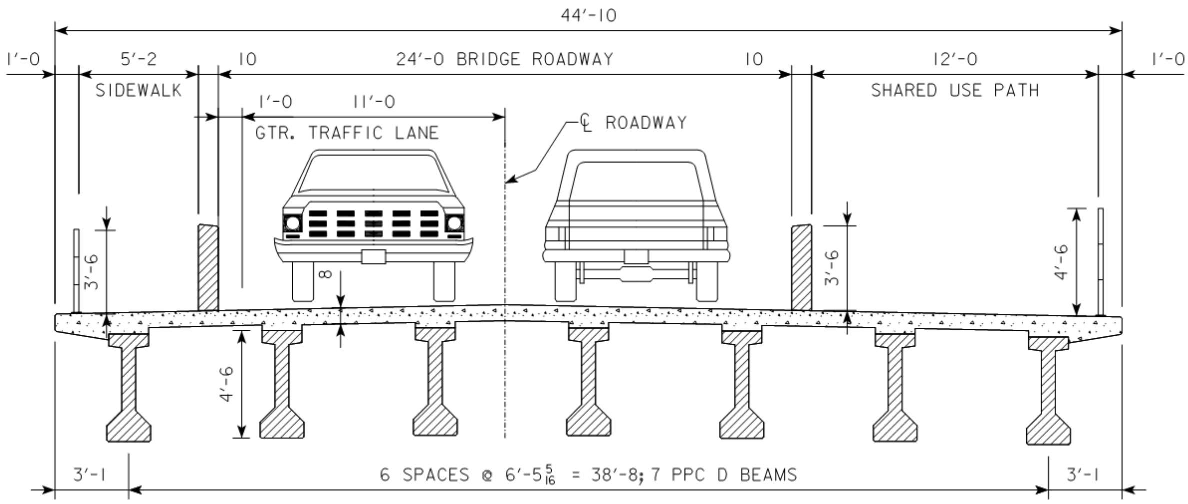


Figure 5. Alternate C Cross Section; Looking East

Advantages

- Minimizes overall cost
- Shared-use path exceeds required width (10') due to heavy path use, and provides continuity with existing shared use path at bridge approaches
- Provides a sidewalk for less frequent pedestrian and park access on the north side

Disadvantages

- Narrow roadway width may not be eligible for federal City Bridge Program since the bridge would still be classified as functionally obsolete
- Does not provide any flexibility for future
- No gutter storage for snow
- May require easement at south side

Alternate D – 32’ roadway with 5’ bike lanes, 12’ shared-use path & 5’ sidewalk

This alternate is a combination of Alternates A and B, and was developed in response to comments received during the public information meeting. The 32’-0 bridge roadway width is maintained, but the lanes are reduced to 11’-0 to accommodate the 5’-0 bike lanes. However, the 12’-0 shared-use path at the south side is retained to provide the most accommodation for all levels of bicycle and trail users. This alternative also mimics and ties into the roadway typical section on Sixth Street just east of the bridge. The lane and gutter widths do not meet the Urban Design Aids, but do meet the Iowa DOT Alternative Urban Design Criteria. A 3’-6 pedestrian handrail is provided at the north edge and a 4’-6 bicycle railing is provided at the south edge.

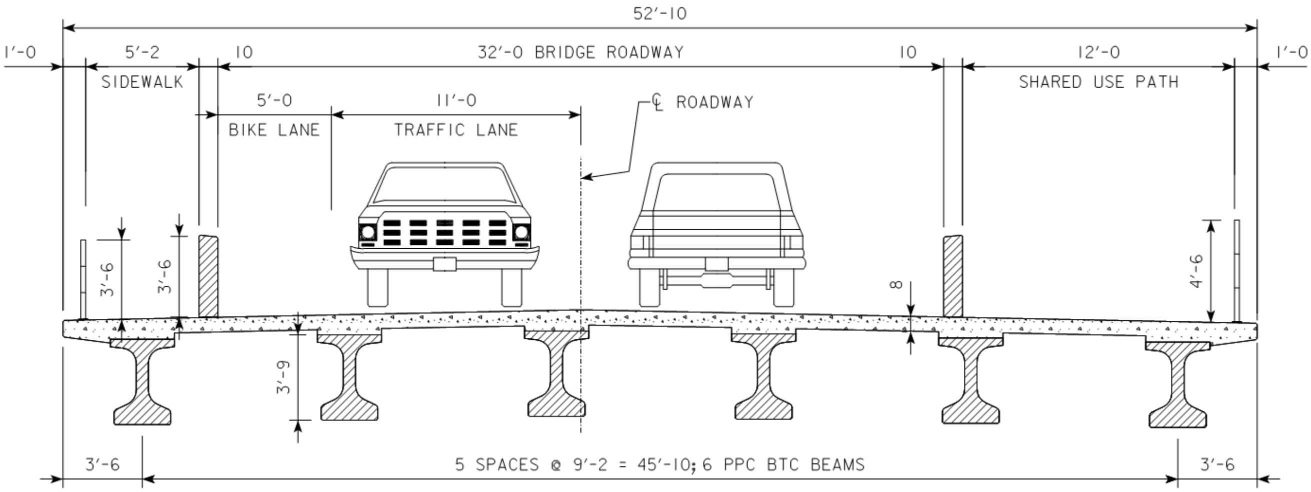


Figure 6. Alternate D Cross Section; Looking East

Advantages

- Provides most flexibility and accommodation for all types of users
- Provides on-street bike lanes for experienced bicyclists who prefer to use the road
- Shared-use path provided for continuity with existing shared-use path and to provide a facility for less experienced bicyclists, runners and skaters
- Consistent with the current lane/pavement markings and the bicycle lanes on Sixth Street from Brookridge Ave. to Grand Ave
- Encourages roadway sharing and traffic calming
- Additional width from bicycle lanes provides a 32'-0 "effective roadway width" at reduced cost

Disadvantages

- Highest cost alternative (similar to Alternate A)
- No gutter storage for snow if bike lanes will be maintained throughout the winter
- May require 10- to 15-ft additional easement/ROW at south side

Cost Comparisons

Five alternatives were considered for cost planning purposes. They included the four cross section alternates as described above, as well as subsets of each alternative to illustrate the differences in cost for different bridge types.

The Alternate A cross section was examined for a 254-ft long by 32-ft wide PPCB bridge utilizing BTC beams. The prices will be favorable for this option because of the efficient spacing of beams in the cross section, as noted earlier. Alternate A was also examined for a 250-ft long by 32-ft wide CWPG option as a comparison and illustration to show the relative price of using steel girders. Overall, this alternate was the most costly of all the alternates due to the width, and the CWPG option was 13% more than the PPCB option. Costs for Alternate D will be nearly identical to Alternate A since the overall width is the same.

Alternate B was analyzed for a similar PPCB BTC beam bridge 259-ft long by 32-ft wide. The cost savings of this option is only around $130,000 as compared to Alternate A. Alternate B was also estimated for a 260-ft long by 32-ft wide RSB bridge, which turned out to be approximately 5% more expensive than the PPCB option.

Finally, Alternate C was analyzed for a PPCB D beam bridge, 253-ft long by 24-ft wide. Because of the numerous disadvantages of this option, it was not analyzed for any other superstructure type. It was the least costly of the alternates by over $330,000.

Construction Cost Alternatives Cost Summary (excludes design and observation)									
Alternate	Description	Structure Type	Base Construction Cost	Estimated Aesthetics (25%)	Total (rounded)	[1]Cost Difference	%	[2]Cost Difference	%
A/D	254' x 32' w/ 12' Path & 5' Sidewalk	PPCB	$1,957,000	$329,000	$2,286,000	--	--		
A/D	250' x 32' w/ 12' Path & 5' Sidewalk	CWPG	$2,208,000	$376,000	$2,584,000	$298,000	13%		
B	259' x 32' w/ Bike Lanes & 5' Sidewalks	PPCB	$1,847,000	$308,000	$2,155,000	($131,000)	(6%)	--	--
B	260' x 32' w/ Bike Lanes & 5' Sidewalks	RSB	$1,933,000	$324,000	$2,257,000	($29,000)	(1%)	$102,000	5%
C	253' x 24' w/ 12' Path & 5' Sidewalk	PPCB	$1,677,000	$276,000	$1,953,000	($333,000)	(15%)		

1. Cost difference of each alternative compared to Alternate A/D – PPCB
2. Cost difference of RSB vs. PPCB for Alternate B

The costs are based on per-square-foot bridge costs compiled by the Iowa DOT, and a preliminary estimate of the necessary roadway work items. Roadway work is assumed to include pavement removal, channel excavation and placement of revetment, bridge approach pavement, sidewalk/shared-use path pavement, concrete approach barriers, storm sewer intake and manhole, storm sewer, and traffic control. Detailed cost estimates for each alternative are presented in Appendix A.

Mobilization (10%) and contingency (20%) are included, but costs associated with right-of-way acquisition and utility relocation (beyond the storm sewer noted above) are not included. Design and construction observation costs are also not included in the table. For estimating purposes, that could be taken to be around $250,000. An average aesthetics cost of 25% of the total bridge cost has been included. The actual cost of aesthetics could vary widely depending on the level of aesthetic treatments selected, as discussed later in this report.

Bridge Design Criteria

The primary purpose of the following design criteria is to summarize the information used in developing the cross sections above, and document and provide the basis for future preliminary design of the bridge. Other more general criteria applicable to final design are also included.

Hydrology and Hydraulics

The following information was taken from the existing plans and City of Ames Flood Insurance Study. It should be considered only as a guide to be verified during preliminary design.

Preliminary Hydraulic Information	
Existing Low Chord at Midspan	Elev. 900.9’ ±
Drainage Area	204 square miles
50-year Flood	Elev. 898.9’ ±
100-year Flood	Elev. 900.3’ ±
High Water	Elev. 902.2’ ± (1993)
Low Water	Elev. 884.6’ ±
Floodway Width	230 ft. ±
50-yr Stream Velocity	5.0 ft/sec
Backwater	Max. 0.75 ft. (Q_{50}), 1.5 ft. (Q_{100})
Freeboard	Min. 3 ft. above Elev. 898.9’ ±
100-yr Flood Profile	No-rise required

Under Clearances (BDM 3.2.5)

Bridge Under Clearances (BDM 3.2.5)	
Minimum vertical clearance of the bridge superstructure over the shared-use path	10 ft. preferred 8 ft. minimum
Horizontal shy distance to edge of pier column to edge of path	3 ft.
Horizontal shy distance to edge of berm to edge of path	2 ft.

Lane Configuration

The vehicular lane widths on the bridge are dependent on the typical cross section selected. However, the typical lane width for design is 12 feet. Based on the existing traffic and existing roadway configuration, a two lane roadway is recommended. Minimum widths for sidewalks, bicycle lanes and shared-use paths are shown below.

Sidewalk and Shared-use Path Width Guidelines	
Sidewalk (BDM 3.2.6.2.2)	5 ft. min. width
Bicycle Lanes (BDM 3.2.6.2.2)	5 ft. min. width
Shared-Use Path (BDM 3.2.6.2.2)	10 ft. min width; consider 12-14 ft. if heavy use (greater than 300 users within peak hour) 15 ft. min width if segregation of pedestrian and bicycle traffic is desired 12 ft. width for snooper access

The shared-use path should be designed as a Type 1 facility, meaning that it is adjacent to the roadway and functions similar to a sidewalk. Additionally, it should have bicycle-safe expansion joints and non-slip deck material.

Bridge Design

The governing design specifications for bridge design will be the AASHTO LRFD Bridge Design Specifications, 6th Edition – 2012 (AASHTO LRFD) and the current edition of the Iowa DOT Bridge Design Manual (Iowa BDM). Bridge construction will conform to the Iowa DOT Standard Specifications for Highway and Bridge Construction, 2012 (Iowa DOT SS).

The bridge deck shall be 8-in with ½-in integral wearing surface. Include provision for 20 psf future wearing surface.

The bridge live load shall be HL-93, as specified in AASHTO LRFD 3.6. The sidewalks and shared-use paths shall be designed for 75 psf uniform loading, as specified in AASHTO LRFD 3.6.1.6. A minimum H10 maintenance vehicle load shall be applied to shared-use paths over 10-ft wide, without impact. Live load deflection of the bridge superstructure shall be limited to 1/1000 of the span length due to the sidewalk and shared-use path on the bridge.

All other loads including dead, wind, thermal, braking, buoyancy, earth pressure, stream flow and ice shall be applied according to AASHTO LRFD and Iowa BDM. Pier foundations in the stream channel shall be a minimum of 6-ft below the streambed elevation, and scour shall be considered.

Steel and concrete design shall be according to the Iowa BDM. All reinforcing steel in the bridge deck, rails and abutments shall be epoxy coated.

Substructure Design

Integral abutments are preferable due to lower construction and maintenance costs. Utilizing integral abutments eliminates expansion joints, which prevents deck runoff from contacting and deteriorating below deck bridge components. For PPCB bridges, the maximum bridge length is 575-ft at 0-degree skew. For CWPG/RSB bridges, the maximum length is 400-ft at 0-degree skew (Iowa BDM Table 3.2.7.2). Therefore, integral abutments are feasible and recommended for this bridge.

Since the drainage area is greater than 50-sq mi, the Iowa DOT strongly recommends use of diaphragm (wall) or hammerhead (tee) piers. This helps reduce the chances of damage from ice and/or driftwood flow. Pier foundations in stream channels should be set so the bottom of footing is 6-ft below the streambed elevation.

Detailed recommendations for substructure and geotechnical design will be developed after the geotechnical report is completed. As a minimum, one soil boring should be performed at each proposed substructure location. It is anticipated that the abutments and piers will be supported on friction steel piling.

Aesthetics

Due to the proximity of the bridge to Brookside Park, developing a context sensitive and appealing bridge is a high priority for the City. The overall goal is to upgrade the look of a standard replacement bridge by incorporating aesthetics when economically feasible.

Principles of Context Sensitive Aesthetic Design (Bridge Aesthetics Sourcebook, AASHTO, 2010)
• Simplicity
• Good proportions with an emphasis on thinness
• Clear demonstration of how the structure works
• Fits context and surroundings

There are many considerations which go into the decisions surrounding bridge aesthetics. The first step in the process is to understand the goals of the proposed bridge, and just as importantly, understanding the site and context of the bridge. Following that, a design intent and vision is developed, which led to multiple alternatives which were shared with the City and public. After one design vision is agreed upon, the process proceeds to conceptual engineering which will include further refinement of the aesthetic concepts, drawings, renderings and cost estimates. Finally, when the final aesthetic treatments are selected final design of the bridge can be initiated.

The process began by visiting the bridge and the surrounding area, including Brookside Park, to gain insight into the site and context of the bridge. The bridge is located in a highly wooded area of Squaw Creek and bordered on the north and west by the rustic and expansive Brookside Park. On the south it is bordered by an old limestone and steel Union Pacific Railroad bridge. The east side is bordered by the historic Brookridge and Ridgewood neighborhoods. This naturalistic setting led to the development of the preferred rustic and natural theme for aesthetic treatments on the proposed bridge. Several other themes and design visions were considered, including the formal/urban theme shown to the right with brick façade, but were considered inconsistent with the bridge location and context. The preferred aesthetic theme is highly influenced by the prevalence of limestone and weathered steel found in the park. The color scheme is subdued and uses dull, earth tones to blend with the natural environment. The details should be kept simple and avoid excessive ornamentation, allowing the bridge to fit in naturally to the site. Details of how the proposed theme affects the treatments of specific bridge elements are discussed in more detail below.

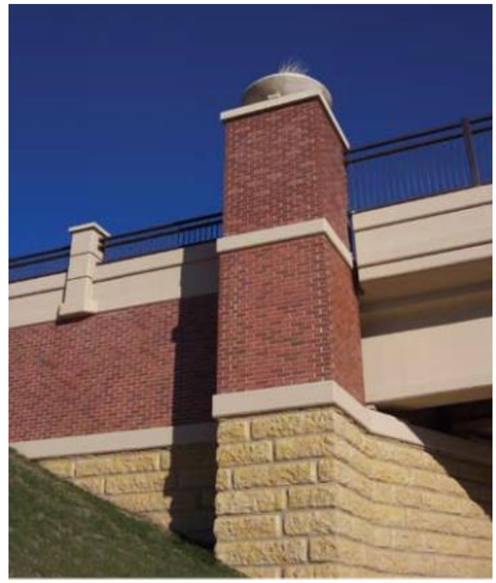


Figure 7. Example of formal/urban aesthetic theme.

Figure 8. The Brookside Park restroom building inspired the aesthetic treatment for bridge concrete.

Bridge Elements

Railings

The pedestrian railings will be one of the most visible portions of the bridge, and will receive a high level of attention to detail. The proposed rail draws influence from the existing picket railing, along with the picket railing used on the Lincoln Way bridge less than a mile to the south. The rail will be painted a rustic reddish brown to replicate the look of weathering steel, which is a naturally occurring patina on the surface of steel which is used on the steel truss pedestrian footbridge upstream in Brookside Park. To add detail and interest to the rail as well as give a historical connection to the existing bridge, the rail posts could be capped with a replica of the art deco caps removed from the existing bridge in 1987 as shown below.

Figure 10. Proposed rendering of bridge railings.

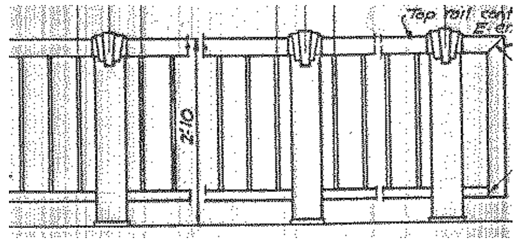


Figure 9. Art Deco Cap Detail

The concrete rails separating the roadway from the sidewalks can also be treated to improve their appearance. They could receive the same concrete texturing and staining proposed for the piers and abutments, discussed below. Optionally, a steel handrail with art deco themed caps could be installed on top of the separation rail to tie it together with the exterior rails and to prevent skateboarders from routinely using the rail.

Figure 11. Possible concrete texturing of separation rail.

Beams

Structural steel girders could be used to directly tie-in with the natural, rustic theme as well as the railings and steel truss footbridge. However, due to cost reasons prestressed concrete beams will likely be used for the superstructure. To give the appearance of weathering steel, they could be stained a reddish brown to match the color of the railings.

The beam depth and span lengths will be selected to achieve the appearance of a long, sleek structure. Further, using a dark coating on the exterior beams in combination with a large overhang will create shadows to give the bridge a thin, light appearance.

Abutments

Figure 12. Example of a massive abutment and wing.

Abutments are an important symbolic function where travelers begin and end their passage on the bridge. Thus, they are well-suited to a unique or visible aesthetic treatment. The proposed abutment at the west end of the bridge will utilize a long, massive wing at the northwest corner where it faces Brookside Park. This could be combined with terracing, plantings, or other landscaping to soften the bridge end and blend it with the natural surroundings. The height of the west abutment is also increased to allow more vertical clearance, openness, and light under the bridge for the shared-use path. Large, stone-like pilasters could be used at each bridge corner to define the bridge ends and provide a space for planters or lights.

The proposed texturing of concrete includes a rustic random ashlar stone textured formliner to continue the limestone theme found throughout the site and replicate the Brookside Park restroom structure. Following concrete placement, it will be stained with a colored concrete sealer to give it an aged look more like the appearance of natural stone. This treatment can be applied to most of the exposed surfaces of the abutments, including the wings and end posts.

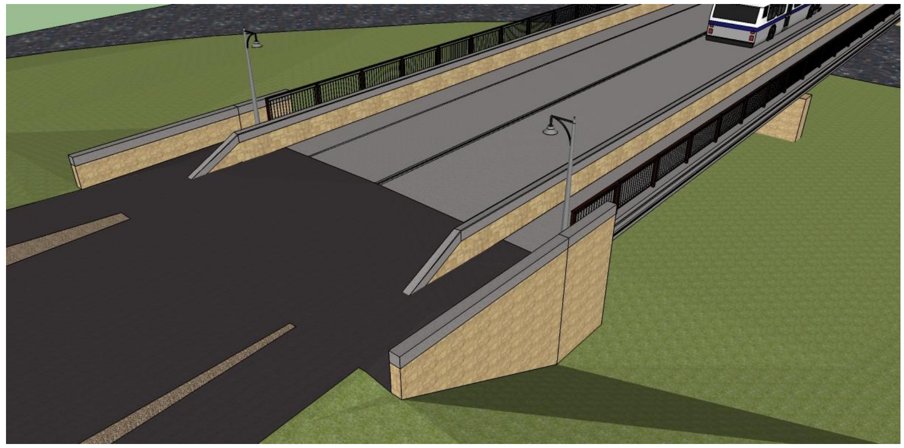


Figure 13. Proposed end view of the bridge abutment.

Piers

Use of three spans (two piers) is generally preferred for aesthetic reasons. Typically hammerhead (tee) pier would be used in this situation. However, to give the piers a simple appearance and remain consistent with the rustic theme, diaphragm (wall) piers are proposed. The piers are another recommended location to apply an aesthetic treatment since they will be visible to users on the shared-use path under the bridge. The pier walls can be textured and colored to give a random ashlar stone appearance, similar to the abutments.

Lighting

The main purpose of bridge lighting is to aid users, especially pedestrians, in safely crossing the bridge. LED lighting is gaining in popularity as the costs decrease and the awareness of the lifetime maintenance and energy savings is realized. LED lighting currently carries a 10-20% cost premium, but it will be used for the bridge lighting were possible. The proposed lighting scheme includes four street lights at each corner of the bridge. These light poles could be placed on small pilasters and could be similar in style to the lights used Downtown. For pedestrians and/or bicyclists crossing the bridge, small brick lights embedded in the concrete rails every 15- to 20-ft illuminate the walkways. Since the bridge is located over a shared-use path which is accessible at night, underbridge lighting over the shared-use path should also be provided. Underbridge lights help with security concerns and encourage path use at night. If desired, consideration could also be given to adding accent lighting to the abutments and piers to highlight the bridge for purely aesthetic purposes.

Cost Estimates

The cost premium for a bridge with a level of aesthetic treatments as described above is generally 15-25% of the base bridge cost. However, we have completed an individualized cost estimate for the proposed treatments described above, and determined a preliminary additional cost of around $350,000. A detailed cost estimate is shown below.

Proposed Aesthetics Premium Cost Estimate				
Item	Quantity	Unit	Rate	Total
Structural Steel Pedestrian Hand Railing	520	LF	$ 150.00	$ 78,000
Steel Pipe Pedestrian Hand Railing	520	LF	$ 55.00	$ 28,600
Structural Concrete (oversize west abutment)	30	CY	$ 600.00	$ 18,100

Concrete Texturing (abut. & piers)	5600	SF	$ 25.00	$ 140,000
Concrete Texturing (rails)	2600	SF	$ 10.00	$ 26,000
Colored Concrete Sealer	12100	SF	$ 3.00	$ 36,300
Roadway Lighting	4	EA	$ 1,000.00	$ 4,000
Sidewalk Lighting	56	EA	$ 300.00	$ 16,800
Underdeck Lighting	2	EA	$ 900.00	$ 1,800
Total				**$ 349,500**

Accessibility

One of the goals of this project is to maintain and improve pedestrian access through the area—both during and after construction—for pedestrians, bicyclists, public transit, park users and others. It is equal in importance to providing adequate traffic lanes and detours for vehicular traffic. Some of the issues related to providing adequate non-vehicle access to the bridge are discussed below.

ADA Requirements

References and Design Specifications for ADA Compliance
ADA Sidewalk Design Guidelines (BDM 2.5 and Office of Design Design Manual Chapter 12)
Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG) of 2011
Americans with Disabilities Act Accessibility Guidelines (ADAAG) of 2010

The above references and specifications govern the design of pedestrian facilities for compliance with the Americans with Disabilities Act (ADA). The minimum ADA requirements applicable to sidewalks and bridges are as given below. The Iowa DOT requires bridges with "pedestrian access" to have ADA compliant facilities.

Minimum ADA Requirements for Pedestrian Facilities on Bridges	
Minimum sidewalk width	5 feet
Slip-resistant walking surface (Iowa DOT Standard Specifications for burlap drag or broom texture are adequate)	
Maximum cross slope	• 2% (1-1.5% target to balance between adequate drainage and not exceeding 2%) • Slope in one direction, usually toward street, instead of crowning
Running slope	• Matching but not exceeding the adjacent street grade (5% maximum preferred)
Cover all joints wider than 1/2" with galvanized floor plate with raised figures (checker plate)	
Maximum vertical surface discontinuity	• 1/2" • If greater than 1/4", bevel with a slope not exceeding 1 vertical to 2 horizontal
Handrail	• Required if safety rail taller than 42" is constructed next to a pedestrian path

Closure and/or detour of pedestrian facility during construction will also need to be addressed. This includes transit facilities and stops, including the CyRide Green route. PROWAG requires an alternate pedestrian access route when a pedestrian facility is closed. However, this is subject to the feasibility of providing such a route, and should be the subject of further study during preliminary design. At a minimum, the sidewalks and shared-use paths leading up to and underneath the bridge will need to be closed, signed and barricaded. One alternative for maintaining pedestrian access is to detour CyRide and bicycle traffic to cross Squaw Creek at the Lincoln Way bridge approximately 0.3 mile south. Pedestrian and park users could continue to use the Brookside Park steel truss trail bridge to cross Squaw Creek. Any detour paths should also meet ADA guidelines.

Railing/Fencing

Depending on the typical section alternate selected, different options for railings and pedestrian handrails are available. However, there are several design guidelines for sidewalk and shared-use path protection determined by AASHTO, interpreted and modified by the Iowa DOT in BDM 5.8.1 and summarized below. These guidelines were used to develop, and are incorporated in, the typical sections alternatives given above.

Minimum Pedestrian Railing Guidelines	
Sidewalk (AASHTO LRFD 13.8.1)	• 42" minimum height at outer edge of sidewalks • Maximum 6" opening below 27" and maximum 8" opening in horizontal band 27" to 42" above sidewalk • Safety toe or curb should be provided
Bicycle (AASHTO LRFD 13.9)	• 42" minimum height (AASHTO LRFD 13.9.2) • Iowa DOT recommends 54" • Maximum openings same as sidewalk rails, as per AASHTO LRFD 13.8.1

As can be noted above, there are conflicting requirements for the height of bicycle railings. In an attempt to resolve the differences and determine a clear recommendation, a study was performed on the differing bicycle railing heights (Lewendon, Papile, & Leslie, 2004)[2]. The study revealed the following issues related to a 42" vs. 54" bicycle railing:

- Perceived safety of falling: 54" provides a greater feeling of safety & protection from falls, feeling of insecurity with 42" rail
- Actual record of accidents or safety problems from 42" railing is very sparse
- Aesthetics & visibility is greatly improved by using a 42" railing
- 54" railing has greater impact on sign lines and reduction of views
- Price difference between 42" and 54" railing on both sides of a bridge is negligible to minor: approximately $40/ft or less than one percent of the total cost of the bridge

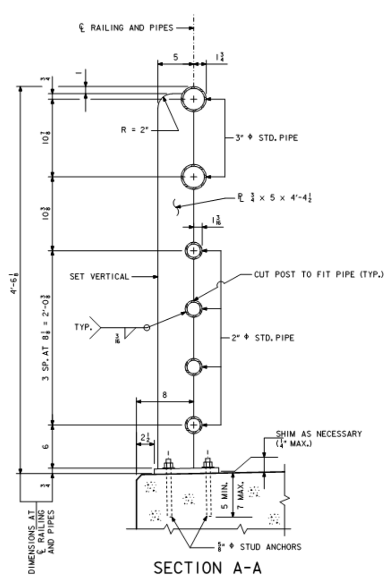


Figure 14. Example Pedestrian Handrail.

In the end, a 48” rail was recommended to balance the concerns of safety, visibility, and cost. This compromise height has not yet been adopted by any agency but could be considered if visibility is a significant concern.

[2] Lewendon, J. S., Papile, A., Leslie, R. (2004). Determination of Appropriate Railing Heights for Bicyclists. NCHRP Project 20-7 (168).

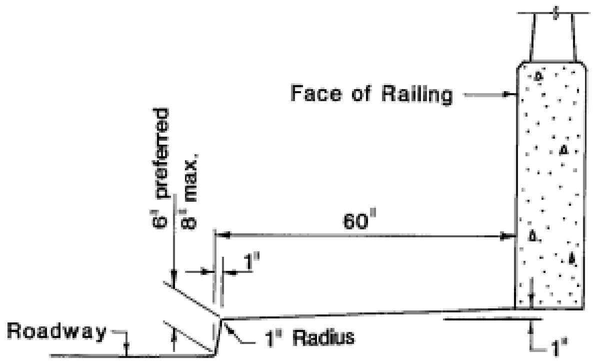


Figure 15. Barrier Curb with Combination Railing.

- The railing shall have a vertical face on both sides.
- The concrete railing shall be a minimum of 24 inches high on the pedestrian side.
- The concrete railing shall be a minimum of 27 inches and a maximum of 34 inches (865 mm) high on the traffic side.
- The concrete railing shall be a minimum of 10 inches thick
- Reinforcing shall be a minimum of No. 5 at 12 inch spacing
- The steel railing's total suggested minimum height (by AASHTO) is 42 inches

If sidewalk or shared-use path is at the bridge deck elevation, it should be protected with separation barrier. If sidewalk is elevated from bridge deck with a raised (barrier) curb, no sidewalk separation rail is required (Figure 15). This option was considered but rejected as an alternate due to prevailing concerns about the safety of the raised curb.

If a separation rail is used, it should meet the following minimum guidelines for design & detailing (Figure 16).

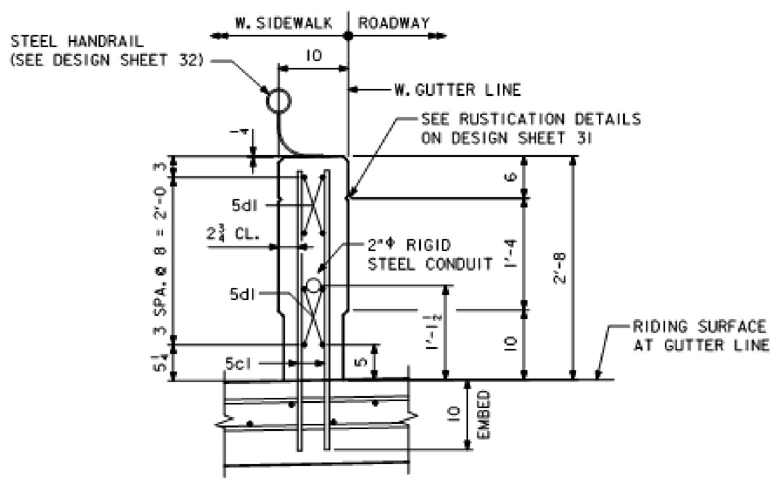


Figure 16. Example Separation Rail.

Approaches & Traffic Control

The approach pavement is PCC concrete covered with HMA. Approximately 20 feet of the east approach was replaced with 10 inch PCC in 1997. The condition of both approaches is generally fair to poor. Both approaches should be replaced with 70 feet long, 10 or 12 inch PCC approaches. As noted previously, there is a short segment—approximately 700 feet in length—west of the bridge that has fair to poor pavement and does not have curb and gutter. If desired, rehabilitation/replacement of this pavement may be cost effective in conjunction and/or staged with the bridge replacement project, while the traffic control is already established.

Figure 17. Bridge Approach Pavement at West End

Replacement of the approach pavement would also facilitate the necessary work to tie the possible bicycle lanes for Alternate B or D. West of the bridge, the UPRR overhead bridge does not permit the roadway to be widened to allow bicycle lanes all the way to University Avenue. Therefore, the bicycle lanes will end somewhere just west of the bridge. Eastbound bicycles could easily transition to the bicycle lanes from the existing shared-use path with a 250 feet pavement widening transition. However, westbound bicycles would need to share the road on Sixth Street, or cross the street to enter the existing shared-use path. A logical place for this crossing would be at the existing cross walk near the entrance to Brookside Park. This option would require approximately 440 feet of pavement widening to extend the bicycle lane to the cross walk. On the east end of the bridge, the length of approach replacement would likely be sufficient to provide for the necessary extension of the bicycle lanes to tie in with the existing bicycle lanes, since the existing pavement immediately begins to widen at the bridge end to provide a left turn lane at Brookridge Avenue.

If Alternates A or C are preferred, there will be little to no additional work required to tie-in to the existing sidewalk and shared-use path at each end. Minor realignment of the paths could be contained within the area of approach replacement. Since major grade raise of the bridge is not anticipated, any adjustment in vertical alignment to ensure tie-in of the paths will likewise be minor.

The existing sidewalk going down the embankment into Brookside Park at the northwest corner of the bridge will likely need to be realigned due to the bridge construction. The north sidewalk may need to be extended west approximately 440 feet to the entrance of Brookside Park.

Since the roadway is low speed (less than 35 mph), separation rail (if used) can be terminated with a 30 foot concrete tapered/sloped end section, similar to Iowa DOT Standard BA-108. Guardrail is not anticipated, due to the low speed roadway and because it would also interfere with the sidewalk and shared-use path.

Due to the narrow bridge width and fracture critical construction of the bridge, staged construction is not possible. The bridge will need to be closed during construction and traffic detoured. Depending on the type of bridge construction, extent of aesthetics and other design choices made, construction time may take four to six months. The most logical detour route is the four-lane Lincoln Way bridge over Squaw Creek approximately 0.3-mi south. Brookside Park access will be maintained throughout construction via University Boulevard and Sixth Street from the west.

Figure 18. Bridge Approach at East End.

Summary and Conclusions

Executive Summary

In 2009, a feasibility study was completed to examine the condition of the existing Sixth Street bridge and recommend options for improvements. The study concluded that based on the age, condition, projected future maintenance, and fracture critical and functionally obsolete designations, replacement with a prestressed concrete beam bridge would be recommended. This study follows up on that report, and is intended to examine in detail the options and alternatives for the proposed bridge replacement, focusing on the bridge type, size and cross section. Among the items considered are:

- Right-of-way impacts
- Bridge design criteria
- Aesthetics
- Railings and pedestrian accessibility
- ADA compliance
- Accomodation for bicycles

- Roadway work and detours
- Estimated costs

Cost, constructability, and aesthetics of a bridge are largely dominated by the bridge superstructure type. The proposed bridge length is around 250-ft which is similar to the existing bridge. Three possible superstructure options considered for the Sixth Street bridge including a pretensioned, prestressed concrete beam (PPCB) bridge, continuous welded plate girder (CWPG) bridge, and a rolled steel beam (RSB) bridge. Different superstructure types are generally used for different situations, and there are various advantages and disadvantages for each option. The choice will be affected by the bridge length, pier location, beam depth and hydraulic capacity.

Four possible cross section alternates were developed for consideration, each attempting to address current concerns and balance benefits and costs. In order to eliminate the current raised sidewalk, each alternate includes separation of pedestrian/bicycle traffic with concrete separation rails. Cost estimates vary for each alternate and superstructure type, but generally range from $1.7 million to $2.2 million without any addition of aesthetics.

Typical Section Alternatives	
Alternate A	32’ roadway, 12’ shared-use path & 5’ sidewalk
Alternate B	32’ roadway with 5’ bike lanes, 5’ sidewalks
Alternate C	24’ roadway, 12’ shared-use path & 5’ sidewalk
Alternate D	32’ roadway with 5’ bike lanes, 12’ shared-use path & 5’ sidewalk

Aesthetics are a prime consideration due to the location and setting of the bridge. Site and contextual studies were completed to assess how the proposed bridge should fit and complement the surroundings. Following meetings with City staff and the public, a preferred aesthetic theme was identified which gives the bridge a natural, rustic look. The preferred theme features a prevalence of textured concrete that gives the appearance of rustic limestone, steel picket railings which match the existing railings and other railings throughout Ames, and dull, earth tones to blend with the natural environment. Lighting and landscaping may also be incorporated into the bridge. Aesthetics may add up to $350,000 to the bridge cost.

The proposed bridge must comply with the requirements of the Americans with Disabilities Act (ADA). Major elements which require compliance include the sidewalk width, cross slope, running slope, handrails and joint openings. Detour of pedestrian and bicycle traffic, in addition to vehicular traffic, will be maintained through the project.

Bridge approaches will also be reconstructed for approximately 70-ft on each side as part of the bridge replacement project. This will improve the riding surface and allow for proper alignment and tie-in of the sidewalks and shared-use path. The bridge will need to be closed and traffic detoured during construction, which may last up to six months.

Recommendations

Of the superstructure types considered, the **pretensioned, prestressed concrete beam** (PPCB) is the most cost effective and easy to construct. The PPCB option provides adequate clearance for hydraulic freeboard, and allows for staining of the exterior beam faces for improved aesthetics. The **rolled steel beam option** is a valid alternate if the look of steel is desired, but on average it has 5% higher construction costs than the PPCB option. The **welded plate girder** option is on average 13% more costly to construct; it also carries higher design costs and is more difficult to construct. Use of the PPCB superstructure type was recommended in the 2009 feasibility study, and it is again recommended here for use in the proposed bridge.

Choice of the bridge typical section requires a careful consideration of the extent of improvements desired, flexibility for the future, and consideration of stakeholder concerns. **Alternate A** provides a widened roadway adequate for the level of traffic on the bridge, along with a protected sidewalk and 12'-0 wide shared-use path for bicycle and pedestrian use. **Alternate B** seeks to separate bicycle and pedestrian traffic through the use of 5'-0 bicycle lanes on the road, while providing 5'-0 sidewalks for pedestrian use only. However, neither of these alternates completely address the concerns of all users, since Alternate A forces experienced bicyclists to use the shared-use path with mixed and slower paced users and Alternate B forces all bicyclists to use the roadway even if they do not feel comfortable doing so. Furthermore, the UPRR underpass just west of the bridge is not wide enough to allow bicycle lanes, so westbound bicyclists would be forced to choose to merge with traffic or cross Sixth Street to use the existing shared-use path. Less confident bicyclists such as children are more likely to cross the street to use the shared-use path, creating a possible dangerous conflict with traffic. **Alternate C** is considered unacceptable since it may not be eligible for federal funding because the roadway width is too narrow for the level of traffic on the bridge.

Alternate D combines the most desirable benefits of both Alternates A and B. It provides flexibility, safety, and accommodates the widest range of users. It provides bicycle lanes for bicyclists who prefer to share the road with traffic and are comfortable merging with traffic, and provides a separated shared-use path for skaters, joggers, children, and less experienced bicyclists. It also maintains continuity with the Sixth Street roadway section east of the bridge, shared-use path east and west of the bridge, and encourages some traffic calming. The cost increase over Alternate B is around $130,000 (6%), which is a relatively minor increase for the flexibility and long-term benefits gained.

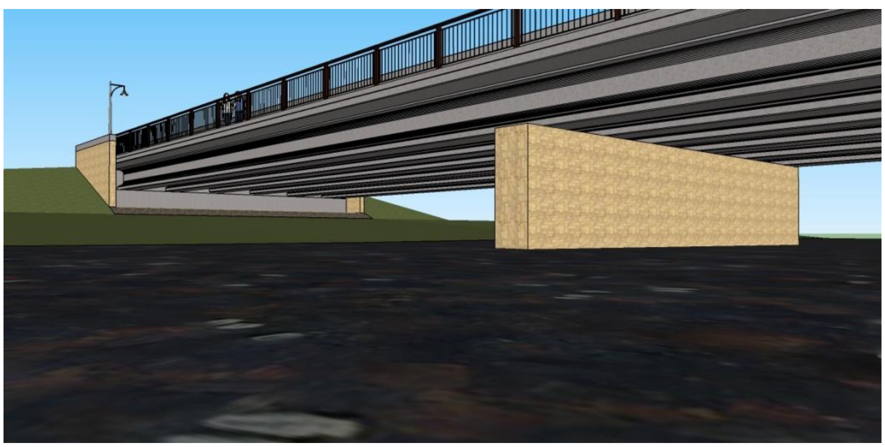


Figure 19. Proposed View of Bridge Looking Southeast

The **aesthetic rustic ashlar stone theme** as described earlier was the overwhelming favorite based on the comments received from City staff and the public. Based on its suitability for the site and attractive yet subtle details which will complement Brookside Park, it is recommended for selection and inclusion on the proposed bridge. The specific details, colors, and locations within the theme can still be varied during preliminary design and even into final design; however, the preliminary recommended aesthetic details/locations are listed below:

- Structural steel picket rail at bridge edges painted reddish-brown
- Ornamental art deco cap on rail posts to give historical connection
- Ashlar stone concrete texturing/staining on the separation rails with optional steel handrail and art deco caps
- Reddish brown staining of exterior beam faces to match exterior rails
- Tall west abutment adjacent to underbridge shared-use path with "massive" wings
- Ashlar stone concrete texturing/staining on the face of piers and abutments
- LED lighting (bridge corners light poles, sidewalk lighting, underbridge trail lighting)

Element specific recommendations for other bridge components and bridge design criteria are noted previously in the report.

Next Phases

Should the City Council decide to pursue the recommended bridge alternatives the next phase in the design process would be preliminary design. The preliminary design phase would include the following: survey, final hydraulic design, obtaining all required permits from the Iowa Department of Natural Resources (DNR) and the US Army Corps of Engineers (USACE), determination of ROW impacts, bridge type, size and location (TS&L) drawings, preliminary roadway drawings, and more detailed construction cost estimates.

After completion of the preliminary design phase, final design consisting of bridge and roadway design and creation of final construction plans and specifications will take place. Funding for the project needs to be secured, and the necessary permits from the Iowa DNR and the USACE need to be approved before the project can be let. The current City of Ames Capital Improvement Plan lists preliminary design for fiscal year 2013/2014, final design for fiscal year 2014/2015 and construction occurring in fiscal year 2015/2016.

Alternate A/D
254' x 32' Bridge w/ 5' Sidewalk and 12' Shared Use Path
PPCB Bridge - 100'-100'-50' BTC Beams
Base Cost - No Aesthetics

Item	Quantity	Unit	Unit Price	Price
Removal of Existing Bridge	10200	SF	$ 8.00	$ 81,600.00
PPC BT Bridge - 257' x 52'-8	13535	SF	$ 87.50	$ 1,184,349.16
Cofferdams for Piers	2	EA	$ 25,000.00	$ 50,000.00
Removal of Pavement	676	SY	$ 15.00	$ 10,140.00
Revetment, Class E	488	TON	$ 40.00	$ 19,520.00
Excavation, Class 13, Channel	200	CY	$ 12.00	$ 2,400.00
Bridge Approach Pavement, RK-20	500	SY	$ 180.00	$ 90,000.00
Recreational Trail, PCC, 5-in	190	SY	$ 40.00	$ 7,600.00
Concrete Barrier, Tapered End	4	EA	$ 2,300.00	$ 9,200.00
Intake	2	EA	$ 2,500.00	$ 5,000.00
Manhole, Storm Sewer	1	EA	$ 3,000.00	$ 3,000.00
Storm Sewer, 15 in. RCP	100	LF	$ 50.00	$ 5,000.00
Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
Other Roadway Items	1	LS	$ 10,000.00	$ 10,000.00
Mobilization (10%)	1	LS	$ 148,300.00	$ 148,300.00
Contingency (20%)				$ 326,200.00
			Construction Cost Total =	**$ 1,957,000.00**
Optional Aesthetics (25% of bridge)				$ 329,000.00
Estimated Design & Observation				$ 250,000.00
			Project Budget Total =	**$ 2,536,000.00**

Note:
Cost of additional ROW and utility relocations not included

Alternate A/D
250' x 32' Bridge w/ 5' Sidewalk and 12' Shared Use Path
CWPG - 125' x 125' Spans
Base Cost - No Aesthetics

Item	Quantity	Unit	Unit Price	Price
Removal of Existing Bridge	10200	SF	$ 8.00	$ 81,600.00
CWPG Bridge - 253' x 52'-8	13325	SF	$ 105.00	$ 1,399,098.86
Cofferdams for Piers	1	EA	$ 25,000.00	$ 25,000.00
Removal of Pavement	676	SY	$ 15.00	$ 10,140.00
Revetment, Class E	488	TON	$ 40.00	$ 19,520.00
Excavation, Class 13, Channel	200	CY	$ 12.00	$ 2,400.00
Bridge Approach Pavement, RK-20	500	SY	$ 180.00	$ 90,000.00
Recreational Trail, PCC, 5-in	190	SY	$ 40.00	$ 7,600.00
Concrete Barrier, Tapered End	4	EA	$ 2,300.00	$ 9,200.00
Intake	2	EA	$ 2,500.00	$ 5,000.00
Manhole, Storm Sewer	1	EA	$ 3,000.00	$ 3,000.00
Storm Sewer, 15 in. RCP	100	LF	$ 50.00	$ 5,000.00
Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
Other Roadway Items	1	LS	$ 10,000.00	$ 10,000.00
Mobilization (10%)	1	LS	$ 167,300.00	$ 167,300.00
Contingency (20%)				$ 368,000.00
			Construction Cost Total =	**$ 2,208,000.00**
Optional Aesthetics (25% of bridge)				$ 376,000.00
Estimated Design & Observation				$ 250,000.00
			Project Budget Total =	**$ 2,834,000.00**

Note:
Cost of additional ROW and utility relocations not included

Alternate B
259' x 32' Bridge w/ 5' Sidewalks and 5' Bike Lanes
PPCB Bridge - 75'-105'-75' BTC Beams
Base Cost - No Aesthetics

Item	Quantity	Unit	Unit Price	Price
Removal of Existing Bridge	10200	SF	$ 8.00	$ 81,600.00
PPCB Bridge - 262' x 46'-8	12227	SF	$ 90.00	$ 1,100,407.86
Cofferdams for Piers	2	EA	$ 25,000.00	$ 50,000.00
Removal of Pavement	676	SY	$ 15.00	$ 10,140.00
Revetment, Class E	488	TON	$ 40.00	$ 19,520.00
Excavation, Class 13, Channel	200	CY	$ 12.00	$ 2,400.00
Bridge Approach Pavement, RK-20	500	SY	$ 180.00	$ 90,000.00
Recreational Trail, PCC, 5-in	190	SY	$ 40.00	$ 7,600.00
Concrete Barrier, Tapered End	4	EA	$ 2,300.00	$ 9,200.00
Intake	2	EA	$ 2,500.00	$ 5,000.00
Manhole, Storm Sewer	1	EA	$ 3,000.00	$ 3,000.00
Storm Sewer, 15 in. RCP	100	LF	$ 50.00	$ 5,000.00
Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
Other Roadway Items	1	LS	$ 10,000.00	$ 10,000.00
Mobilization (10%)	1	LS	$ 139,900.00	$ 139,900.00
Contingency (20%)				$ 307,800.00
			Construction Cost Total =	**$ 1,847,000.00**
Optional Aesthetics (25% of bridge)				$ 308,000.00
Estimated Design & Observation				$ 250,000.00
			Project Budget Total =	**$ 2,405,000.00**

Note:
Cost of additional ROW and utility relocations not included

Alternate B
260' x 32' Bridge w/ 5' Sidewalks and 5' Bike Lanes
RSB Beams - 78'-104'-78' Spans
Base Cost - No Aesthetics

Item	Quantity	Unit	Unit Price	Price
Removal of Existing Bridge	10200	SF	$ 8.00	$ 81,600.00
RSB Bridge - 263' x 46'-8	12273	SF	$ 95.00	$ 1,165,975.00
Cofferdams for Piers	2	EA	$ 25,000.00	$ 50,000.00
Removal of Pavement	676	SY	$ 15.00	$ 10,140.00
Revetment, Class E	488	TON	$ 40.00	$ 19,520.00
Excavation, Class 13, Channel	200	CY	$ 12.00	$ 2,400.00
Bridge Approach Pavement, RK-20	500	SY	$ 180.00	$ 90,000.00
Recreational Trail, PCC, 5-in	190	SY	$ 40.00	$ 7,600.00
Concrete Barrier, Tapered End	4	EA	$ 2,300.00	$ 9,200.00
Intake	2	EA	$ 2,500.00	$ 5,000.00
Manhole, Storm Sewer	1	EA	$ 3,000.00	$ 3,000.00
Storm Sewer, 15 in. RCP	100	LF	$ 50.00	$ 5,000.00
Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
Other Roadway Items	1	LS	$ 10,000.00	$ 10,000.00
Mobilization (10%)	1	LS	$ 146,400.00	$ 146,400.00
Contingency (20%)				$ 322,200.00
			Construction Cost Total =	**$ 1,933,000.00**
Optional Aesthetics (25% of bridge)				$ 324,000.00
Estimated Design & Observation				$ 250,000.00
			Project Budget Total =	**$ 2,507,000.00**

Note:
Cost of additional ROW and utility relocations not included

Alternate C
253' x 24' Bridge w/ 5' Sidewalk and 12' Shared Use Path
PPCB - 100'-100'-50' D Beams
Base Cost - No Aesthetics

Item	Quantity	Unit	Unit Price	Price
Removal of Existing Bridge	10200	SF	$ 8.00	$ 81,600.00
PPCB Bridge - 256' x 44'-8	11435	SF	$ 85.00	$ 971,953.92
Cofferdams for Piers	2	EA	$ 25,000.00	$ 50,000.00
Removal of Pavement	676	SY	$ 15.00	$ 10,140.00
Revetment, Class E	488	TON	$ 40.00	$ 19,520.00
Excavation, Class 13, Channel	200	CY	$ 12.00	$ 2,400.00
Bridge Approach Pavement, RK-20	500	SY	$ 180.00	$ 90,000.00
Recreational Trail, PCC, 5-in	190	SY	$ 40.00	$ 7,600.00
Concrete Barrier, Tapered End	4	EA	$ 2,300.00	$ 9,200.00
Intake	2	EA	$ 2,500.00	$ 5,000.00
Manhole, Storm Sewer	1	EA	$ 3,000.00	$ 3,000.00
Storm Sewer, 15 in. RCP	100	LF	$ 50.00	$ 5,000.00
Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
Other Roadway Items	1	LS	$ 10,000.00	$ 10,000.00
Mobilization (10%)	1	LS	$ 127,000.00	$ 127,000.00
Contingency (20%)				$ 279,500.00
			Construction Cost Total =	**$ 1,677,000.00**
Optional Aesthetics (25% of bridge)				$ 276,000.00
Estimated Design & Observation				$ 250,000.00
			Project Budget Total =	**$ 2,203,000.00**

Note:
Cost of additional ROW and utility relocations not included

Appendix B – Public Comments

6th Street Bridge Public Meeting, November 5, 2012

- Have an off-street shared use path to avoid being on the street at UPRR bridge
- Have bike lanes on new bridge to avoid multiple crossovers
- Extend sidewalk on the north to Brookside driveway
- Have bike lanes and two sidewalks to separate kids, strollers, skaters
- Don't like width of Alt. A due to traffic calming need
- Favor the Brookside ashlar look; conveys sense of space and connection
- Brown beam & limestone to tie with neighborhood
- Be aware of creating attractive nuisance for skaters
- Creative use of lighting (LEDs)
- Be aware of snow removal concerns in sidewalk width selection
- Be able to see through outside railing
- Concerned park building will be torn down and bridge won't match
- Have the east end of the bridge define beginning of park; replicate feel on west side of UPRR bridge
- Brick doesn't fit in; gives a jarring look
- Enhance bike signing and sharrows

Public Meeting Participant List

Name	Organization	Phone/Email
Sandy Fleck	N/A	N/A
James Heggen	Ames Tribune	jheggen@amestrib.com
George Covert	N/A	George@covert.net
Jeri Neal	Iowa Bicycle Coalition/ Friends of Central Iowa Biking	leopold.ecology@gmail.com
Jim Wilcox	Friends of Central Iowa Biking	jwsknk@iastate.edu

Appendix B – Public Comments

Comments from Cathy Brown, Iowa State University Facilities Planning & Management

1. Cross Sections –

   We tended to favor alternative A primarily because of the volume of bike trails in the area and the connectivity of this segment of 6th Street with trails to the east, west and south. It seems inconsistent to move bikes into the roadway for the limited length of this segment. We are also concerned that cyclists may shift randomly between the bike trail and road trails through the vehicular lanes. This bike trail seems to have heavy use by recreational as well as commuters. The connections to the park system and skate park are also noteworthy.

   An additional consideration in support of alternative A is the limited width of the RR underpass to the west, where there is an insufficient opening to accommodate on street bike lanes in addition to pedestrian walks, so the connectivity of the bike facility would be compromised. Sixth Street has bike lanes on both the north and south sides of the roadway so there is the potential for head to head bike traffic on either trail. Limiting the trail width to 5 feet on the walks does not accommodate head to head bike traffic over the bridge.

2. Bridge Aesthetics
   a. Beams—the weathering steel girders are very acceptable, likely lower maintenance and resistant to graffiti
   b. Pedestrian rail—the SE 16th Street alternative offers two advantages, the protection offered by the concrete base from traffic and a setback that creates distance between the 'pickets' and bike handle bars. The rail style is visually appealing, accommodates visibility, yet safe for crossing the stream.
   c. Separation rail—materials should be easily maintained, resistant to snow removal or vehicular damage. Cast in place concrete to match other bridge finishes or similar to the S 16th street alternative would make sense.
   d. Abutments and Piers—the ashlar look for these elements and the separation rail would create a nice consistency for the bridge structure, that is also consistent with the appearance of the Park and UPRR structures in the area. One could also consider that if the bridge at Lincoln Way over Squaw Creek were to be reconstructed this material could be compatible as well. Extending the wing walls at the ends of the bridge is of interest, but likely a design detail that should be given some care in final design for scale.
   e. Color—the use of color in the Decorah 5th Ave structure seems to fit this area well.
   f. Lighting—we would encourage a holistic look at lighting for this area, downtown, campustown, Lincoln Way and south Duff that ties the community together—branding of Ames or trails on a larger scale—even if it takes many years to implement. The Decorah Trout Run Trail lighting of the underside of the bridge is interesting and seems to have some relevance to this area due to the proximity of the park and trail that extends under the Sixth Street bridge.
   g. Landscaping—it makes sense to consider landscaping as an extension of the streetscape and park landscape.