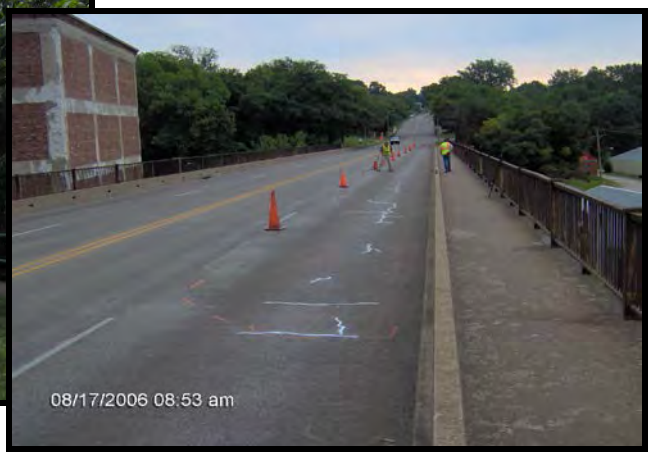
2006 BRIDGE INSPECTION

CASCADE BRIDGE



MT. PLEASANT STREET BRIDGE

THE

ARCH

SIXTH STREET BRIDGE

WEST BURLINGTON AVENUE BRIDGE

CITY OF BURLINGTON, IOWA

OCTOBER 2006

2006 Bridge Inspection
Table of Contents

11. 2006 Bridge Inspection Summary

12. IDOT SI & A Forms

13. Traffic Counts

14. WOS Pin Testing Cascade Bridge

15. Photo Log of Defects

    a. Cascade Bridge
    b. West Burlington Avenue Bridge
    c. Mt. Pleasant Street Bridge
    d. Sixth Street Bridge
    e. Arch Street (Stone Arch)

2006 Bridge Inspection Abbreviations

Btw Between

Flg Flange

(W) (E) (N) (S) West, East, North, South

U_o Upper Joint #0

L_o Lower Joint #0

M_1 Middle Joint #1

FB Floor Beam

Str Stringer

W12 x 27 Wide Flange Beam d = 12″ weight = 27 lbs/lf

I 6 x I-Beam d = 6″ weight =

C 6 x 12.5 Channel Iron d = 6″ weight = 12.5 lbs/lf

L 3 ½ x 3 ½ x 5/16 Angle Iron

Abt Abutment

Brg Bearing

SI & A Structural Inventory and Appraisal Sheet

ADT Average Daily Traffic

NR Not Rated

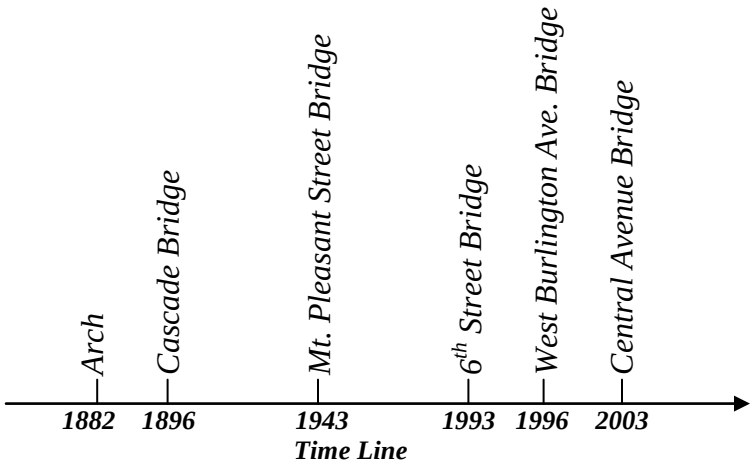
2006 Bridge Inspection Summary

1. General Description

In August of 2006 five of the City's six maintained bridges were inspected. The new Central Avenue Overpass was not inspected. However, it was added to the FHWA inventory list; and the West Avenue Bridge, which was replaced with a culvert was removed from this list. The inspection included the following:

1. Close-up visual inspection
2. Sounding of the deck
3. Ultrasonic testing of the Cascade pins' connections
4. Measurement of expansions joints

The average age of Burlington's bridges is 53.8 years, 9.8 years older than the national average. The time line below shows the date which our bridges were constructed.



2. Inspection Procedure

The collapse of the Silver Street Bridge at Point Pleasant, West Virginia in 1967 prompted the US Congress to add a section to the Federal Highway Act of 1968 which required all bridges over 20' in length located on public roads to be inspected every two years. As of January 13, 2005, Code of Federal Regulations, Part 650 placed further requirements on bridge inspections, most notable, the qualifications of bridge inspection personnel (see following paragraph from Bridge Inspection Refresher Training Course.

Inspection Program Manager

Individual in charge of the organization unit. Responsible for bridge inspection, reporting, and inventory and shall possess the following minimum qualifications:

(1) Be a registered professional engineer, or have ten years bridge inspection experience; and
(2) Successfully complete a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course.

Currently the City has two qualified inspectors. To keep up their qualifications will require further bridge inspection refresher training courses. These courses are expensive.

#130055A	Safety Inspection of In-Services Bridges	$1,875.00	13 day
#130053A	Bridge Inspection Refresher Training	$ 525.00	3 day

An alternative to keeping qualified employees, is to hire a consultant to do the inspection. The following proposals were obtained for the 2006 Cascade inspection.

1) Harrington & Cortelyou

In-Depth Inspection (Cascade Only)	$36,060
Analysis	$16,323
	$52,383

2) Shoemaker & Haaland

Field Inspection (Cascade Only)	$14,200
Scaffolding	$ 6,200
Testing of Pins	$ 5,200
	$25,600

3) Extream Access (HNTB)

Lump Sum (All 5 Bridges)	$70,000

Since outside bridge inspection service was not budgeted, we elected to inspect them in-house. Due to safety requirements, we accessed Cascade Bridge via a snooper truck which was rented from Tharp Brothers of Oquawka, Illinois.

Our out-of-pocket cost was as follows:

1) City in-house inspection

a. Tharps Truck	$7,650.00
b. WOS Pin Testing	$1,845.70
c. University of Iowa Finite Element Analysis	$ 300.00
	$9,795.70

Safe access to the Cascade truss is part of the cause for the high inspection cost. Prior to the 2006 inspection, Cascade Bridge was posted 15 ton for a Type 3 double bottom straight truck. Tharp Brother's truck weighs 46,420 lbs. GVWR which overloads the bridge 155% above previous inventory rating and 113% above its operating rating. The 2006 inspection prompted further reduction of the load rating restriction on this bridge. It is possible that the only snooper truck capable of being used on Cascade Bridge now is from:

Aspen Aerials, Inc.
4303 W. 1st Street
Duluth, Minnesota 55807

3. Bridge Conditions

The condition rating of two bridges, namely Cascade and Mt. Pleasant was lowered this inspection. The overall condition rating of bridge components is directly related to the physical deficiencies of bridge elements. Condition ratings are used to describe the existing in-place bridge as compared to the as-built condition. Accurate assignment of condition rating is dependent upon the bridge inspector's ability to identify the bridge components and their elements. In my opinion, both Cascade and Mt. Pleasant have slipped to a poor/critical condition. This means that structural capacity of the bridge components is affected or jeopardized by significant deterioration, section loss, spalding, cracking or other deficiencies.

Mt. Pleasant Street Bridge

The Mt. Pleasant Street Bridge deck Item #58 on the SI & A was lowered to 4. This represents a poor condition with advance section loss, deterioration or spalding. I believe the 1976 bridge deck overlay that IDOT had done is failing and is delaminating from the substrate base below.

Mt. Pleasant Street Overpass
Profilograph Results
Tested 6-4-07

Eastbound, Inside – 33.46 in/mi
Eastbound, Outside – 58.73 in/mi
Westbound, Inside – 51.42 in/mi
Westbound, Outside – 31.28 in/mi

Eastbound Lanes Have:
1 Bump @ 0.39 in.
1 Dip @ 0.63 in.

Westbound Lanes Have:
2 Bumps @ 0.14 in. each

IDOT Smoothness Chart

B = 22 in/mi. C = 30 in/mi

The bridge deck overlay is now 31 years old. Based on Photo #12, 13, 14, 18, 20, 21 & 24 it would make more sense to replace the entire deck rather than trying another overlay. It is hard to determine the amount of re-bar deterioration in the deck base material.

The east abutment is no worse than last inspection. Please note the back wall of this abutment has broken off of the abutment cap and is now leaning up against the steel frames.

Three cantilevered sidewalk brackets have rusted off from the steel frame girder.

The condition rate reduction only amounted to a 3 point decline of the Budge Sufficiency rating on the SI & A sheet. A copy of these calculations are included with the SI & A form in the bridge inspection section. With the ADT, detour length and load limit unchanged. The Iowa bridge point system for consideration of State funding remains too low for consideration of state funding.

Cascade Bridge

Cascade Bridge superstructure, Item No. 59, was reduced from 7 to 3. This appears to be a big drop. However, the rating which should be questioned is the previous reported 7 rather than the new rating of 3.

Photo #1 – Span #4

Diagonal U_2 L_3 60' truss. 1 – 7/8" diameter rod type instead of 2 – 7/8".

Photo #2 – Span #4

FB #2 6^L9 (W) of (E) truss 1½' x 7" hole rusted through bottom outstanding angle leg to (N) Span #4.

Photo #3 – Span #4

Joint L_1 (E) truss Span #4 1/8 ± plate is left that connects L_1 U_1 to the pin.

Photo #4 – Span #4

Stringer E Span 4 at U_o has section loss in bottom flange of W 12 x 27 at point of bearing.

Photo #5 – Span #3

Photo #6 – Span #3

Member M_5 (W) truss to member M_5 (E) truss is rusted with approximately 10% section loss.

The rating of 7 in Item #59 has been carried forward from previous inspection. Several deficiencies are shown in the photo log. The most notable, and which should be repaired soon, are the lateral struts or sway bracings.

The following defects were also noted:

1. Member U_2 L_3 and L_1 U_2 of Span “4”, 60' truss is missing one 7/8" diameter rod each member of both trusses.

2. Span #4 - Floor Beam U_2 and Span #1 - Floor Beam U_4 has up to 8.4% of the metal rusted off which reduces section modules 21.9%.

3. Vertical Member L_1 L_1 west truss Span #4 is completely rusted away from the lower chord pin connection.

4. 1/8" rusted away around pin in Member L_2 L_3 @ J+ L_2, Span #4.

5. Pier cap of Pier #1 is deteriorated.

6. Span #3 all sway bracing deteriorated in the Cascade Bridge.

4. Bridge Ratings

Along with the noted defects on Cascade Bridge, it was also discovered that the vertical height of the 60' and 204' truss was previously measured wrong. This has necessitated a recalculation of the local rating for this bridge. The analysis was done in accordance with AASHTO Standard Specifications for Highway Bridges using average working stress design methods. The trusses were analyzed by its general analysis of a bridge truss consisting of computing bar forces in each member, due to each type of loading and combination for each truss member of these forces into the maximum and total bar force that will control design.

Due to the statically indeterminate nature of the 204' truss, I could not analyze this truss by my methods. Professor Asghar Bhatti, of the University of Iowa analyzed this truss for me using a finite element software program. A summary of the load rating calculation is shown in the following table.

Load Rating Summary
Inventory Rating

Bridge Member		Type of Vehicle				
		HS-20	H-15	Type 3	Type 3-3	Type 353
1	Deck	20.0	15.0	23	37	36
2	Sidewalk	NR	NR	NR	NR	NR
3	Railing	NR	NR	NR	NR	NR
4	Stringer	13.7	13.7	19	37	32
5	Floor Beam	7.6	9.1	11	18	17
6	60' Truss	8.0	7.8	7	7	8
7	90' Truss	12.7	12.6	12	12	13
8	204' Truss	7.0	NR	6	6	7
9	Abutments	NR	NR	NR	NR	NR
10	Piers	NR	NR	NR	NR	NR
11	Pin Connection	NR	NR	NR	NR	NR

Note:

(1) Deck in very good condition. Some cross bars have broken welds.
(2) Stringer limited due to 18'-0 span in 90' trusses.
(5) Floor beam rating limited to 60' truss Span #4, FB# U_2 and 90' truss Span #1, FB #4. Section loss reduced section modules.
(6) 60' truss diagonal member U_2L_3 & L_1U_2. There is only one 7/8" diameter bar with 5% section loss.
(7) 90' truss Span #1 & Span #2 diagonal member U_2L_3 & L_2U_3. These members consist of 2-1" diameter bars with 5% section loss.
(8) 204' truss is indeterminate to 4^{th} degree. Members L_4M_5, M_5U_6, U_6M_7 & M_7L_8 are the weakest member in this truss. Member U_2M_3 M_9U_{10}, M_3L_4 L_8M_8, M_3U_4 U_8M_8, U_4M_5 M_7U_8, & M_5L_6 L_6 M_7 are also load restricted accounting for section loss.

Cascade Bridge will be posted for 7 tons maximum load, and SI & A will be coded 907. Please note the operating rating for a Type 3 vehicle of 6 tons; this rating will necessitate renting a lighter weight snooper truck for inspection as previously noted.

By lowering the load limit on this bridge, the bridge priority point system is now 23.

5. Repairs

a. General

The **Cost Summary** on the following page summarizes the needed repair along with a preliminary estimate of the work.

b. Bump at the end of the Bridge

The bump at the end of the bridge is a common but complex problem that involves a dizzying range of design factors, including soil settlement in embankments, approach fill material, abutment foundation type, abutment type, structure types, joints, approach slab, paving and construction methods. A special case, the integral bridge abutment appear to create a constant bump problem resulting from cycles and the associated compression and decompression of the fill approach fill by the abutment wall.

COST SUMMARY

A. General

Sixth Street Bridge ($23,247.00)

a.) Asphalt Level Course @ Abutments Approach	$11,614.00
b.) Seal Joints	1,700.00
c.) Weld Cracks & Paint Railing	7,161.00
d.) Fill void South Abutments & Remove Trees	2,292.00
e.) Cover Exposed Re-bar on Diagrams	480.00
	$23,247.00

West Burlington Avenue Bridge ($9,781.00)

a.) Asphalt Level Course @ Abutments Approach	$ 6,861.00
b.) Seal Joints	2,180.00
c.) Fill Erosion & Remove Tree	740.00
	$ 9,781.00

Mt. Pleasant Street Bridge ($727,585.00)

a.) Repair Sidewalk Brackets	$ 16,000.00
b.) Clean & Paint Bearings	1,960.00
c.) Replace Concrete Deck	704,248.00
d.) Fill Erosion & Repair Walk	4,340.00
e.) Replace Back Wall East Abutment	54,102.00
	$780,000.00

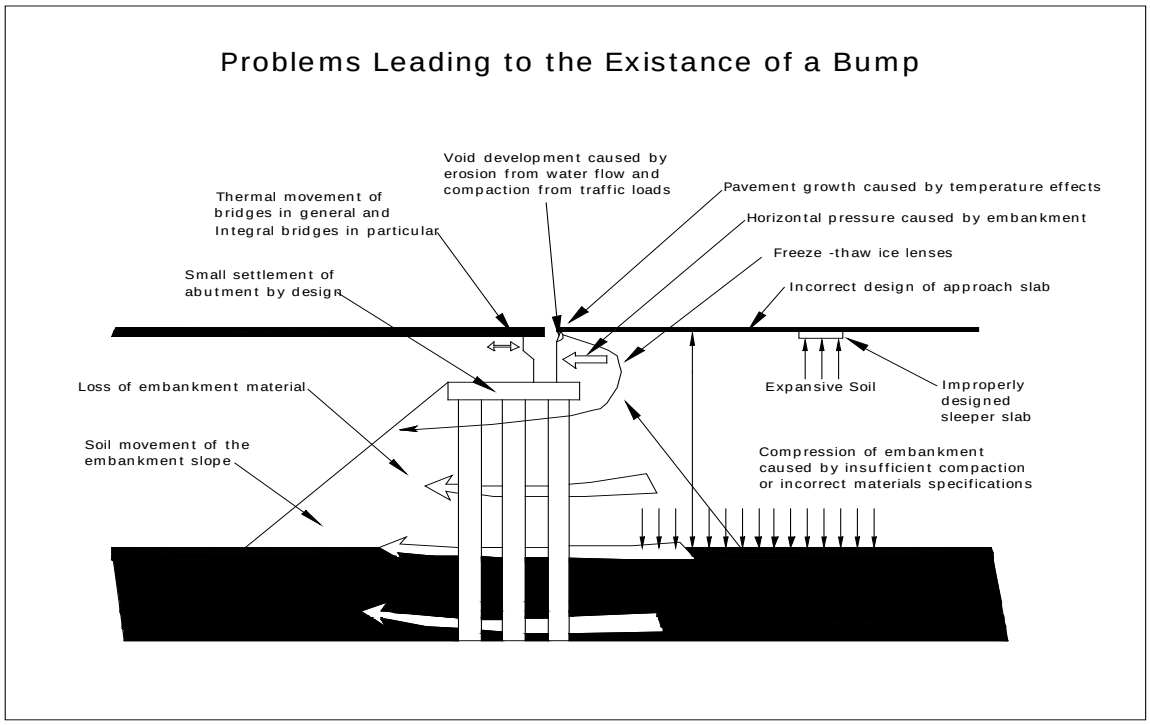
Arch Street

a.) Guardrail, Fence & Attenuator	$28,565.00

Cascade

1. ShotcretePier #1
   a). North Abutment
   b). South Abutment
2. Repair Lower Chord Connection, Span #4
3. Grease Roller Bearings
4. Strengthen Member
   a.) L_1U_2 & U_2L_3 Span #4
   b.) U_2L_3 & L_2U_3 Span #1 & #2
   c.) U_2M_3, M_0U_{10}, M_3L_4, L_8M_9, M_3U_4, U_8M_9, U_4M_5, M_7U_8, M_5L_6, L_6M_7, L_4M_5, M_7L_8, M_5U_6, U_6M_7 All in Span #3
5. Replace FB, Stringer, Deck $548,211.00
6. Replace Sway Bracing Span #3
   a. M_7 (W) to M_7 (E)
   b. M_9 (W) to M_9 (E)
   c. M_5 (W) to M_5 (E)
   d. M_3 (W) to M_3 (E)

2. Repair Joint M-1 & M-11, Span #3



Three of Burlington's bridges have this type of abutment; they are

1. 6th Street Bridge
2. West Burlington Avenue Bridge
3. Central Avenue Bridge

I have included a section in the Appendix. Recommending possible solution to the bump problem. However, the cost of these solutions may be prohibitive or may exceed the life-cycle maintenance cost associated with a tolerable bump, thus a simple HMA surface patch is proposed.

c. New Deck for Mt. Pleasant Street

The 1976 deck overlay on the Mt. Pleasant Street Bridge has outlived it's 31 year life. Four profilograph plots were made to show the present profile of it's surface. It should be noted that the original deck only lasted 33 years also without major maintenances.

Lowering of the deck condition rating from 7 to 4 only resulted in a decline of the sufficiency rating of 5 points. The sufficiency rating is now 31. These calculations are included with the inspection notes. By lowering this rating, Mt. Pleasant Street Bridge has now obtained a status of 15 on the City Bridge point system.

The City can request Federal and State funds for Federal Fiscal Year 2009 by submitting a request prior to October 1, 2007 to Donna Backwall @ dot.iowa.gov. The request should include Federal Structure Number, Street Name, Feature crossed and the most recent cost estimate. Last years qualifying bridge project had a 23 or more priority point (ours has 15).

A complete replacement of the deck was estimated by one bridge contractor to be over $1,000,000.00. This may, however, be the best solution depending on how the back wall of the east abutment is repaired. If the bridge has to be jacked up for abutment repairs, $260,000 + lbs. of dead load could be removed in the deck.

d. Cascade Bridge

Post Card Photo Name Photo

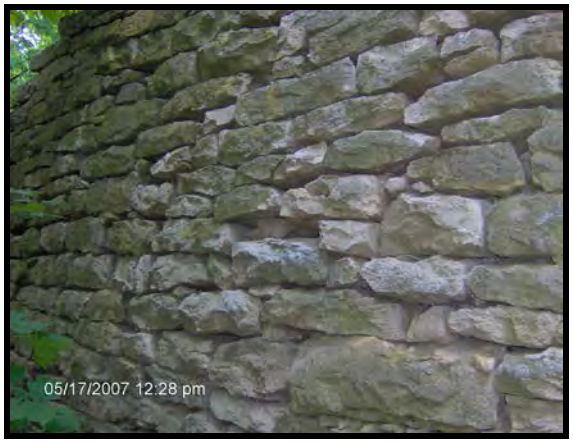
The historic Cascade Bridge as stated in the condition and rating section, is really showing its age. With the long detour length and low posted load limits, it has now attained a rank of 23 on the City Bridge priority point system (calculations in the inspection section). In 2006 bridges with a priority of 23 or more were eligible for Federal/State Funding. There may be a better chance of obtaining Federal/State funding for Cascade Bridge than on the Mt. Pleasant Street Bridge.

Cascade Bridge is now 111 years old and carries 1364 vpd with 4.8% trucks. The bridge, even at 12 heavy trucks per day, would have received over 500,000 cycles of loading. Members of a bridge subject to repeated variation of stress may suffer from a phenomenon known as fatigue. Fatigue is a failure in the metal or connection at a stress smaller than the yield point of the metal due to repetitive loading. Its severity is most significantly affected by the number of load applications, the magnitude of the stress range and the severity of the stress concentration associated with the particular details. A complete fatigue analysis is beyond the scope of this report. However, it should be addressed when determining the future repairs to this bridge.

As an alternate to major repairs, such as Item Nos. 4 & 5 in the repair list, the following is offered for discussion. A road could be constructed around Cascade Bridge, as shown on Sketch #1. The main advantage of this proposal is that the Historic Bridge could be saved.

D. Photo Log of Defects

Photo #106 – Span #1



South Abutment stones falling out.

Photo #107 – Span #1

West corner wall leaning.

Photo #108 – Span #1

First Pier spalled pier caps.

Photo #109 – Span #1

First Pier spalled pier caps.

Photo #110 – Span #3

Third Pier void under west side of Pier Cap.

Photo #111 – Span #3

Third Pier void under west side of Pier Cap.

Photo #112 – Span #1

North Abutment spalding.