



STV Incorporated
Consulting Engineers
900 West Trade Street, Suite 715
Charlotte, NC 28202
Phone (704) 372-1885

I-26 Bridge Assessments

Newberry County, South Carolina

Bridge Assessment Report for Holy Trinity Church Road (S-36-39) over I-26

Prepared for:
The South Carolina Department of Transportation



November 11, 2016

Table of Contents

I. INTRODUCTION.....	3
OVERVIEW.....	3
SCOPE OF SERVICES SUMMARY	3
EXISTING BRIDGE INFORMATION	4
BRIDGE TYPICAL SECTION	5
DECK.....	5
CONCRETE BEAMS	5
EXPANSION JOINTS	5
DIAPHRAGMS.....	5
LIGHTING.....	5
DRAINAGE	6
BEARINGS.....	6
END BENTS.....	6
INTERIOR BENTS.....	6
SIGNS.....	6
TRAFFIC COUNTS.....	6
II. BRIDGE ASSESSMENT PHYSICAL CONDITION.....	6
GENERAL	6
SUPERSTRUCTURE CONDITION.....	6
DECK.....	6
CONCRETE BEAMS	7
DIAPHRAGMS.....	8
BEARINGS.....	8
EXPANSION JOINTS	9
BRIDGE RAILING	9
SUBSTRUCTURE CONDITION	10
INTERIOR BENTS.....	10
END BENTS.....	11
UTILITIES	12
MISCELLANEOUS.....	12
CLEARANCES.....	12
HORIZONTAL CLEARANCE	12
VERTICAL CLEARANCE	13
OTHER FACTORS.....	13
STRUCTURE INVENTORY AND APPRAISAL (SI&A) REPORT	13
INSPECTION REPORT	13
AGE.....	13
OPTIONS.....	13
III. RECOMMENDATIONS.....	14

I. INTRODUCTION

OVERVIEW

This report has been prepared by STV Incorporated for the South Carolina Department of Transportation to provide a general assessment of Holy Trinity Church Road over I-26 in Newberry County, SC in preparation for the widening of I-26. This document provides an overview of existing available information, discussion of conditions observed during a visit to the bridge site, and an overall assessment and recommendations for this structure as it relates to this project's planning efforts. Based on these factors described in this report, the recommendation is **replacement**.

SCOPE OF SERVICES SUMMARY

A non-intrusive visual assessment of the Holy Trinity Church Road Bridge over I-26 was conducted in order to identify items that will need to be addressed during the construction phase of the I-26 widening project. This report is based on the visual assessment, the most recent Bridge Inspection Report, the most recent Structure Inventory and Appraisal Report, and plans for the existing bridge. STV did not conduct an inspection similar to the Biennial Bridge Inspection, did not generate any calculations in regard to the condition of the existing bridge, and did not generate any load rating calculations.



Figure 1 - Existing Bridge (looking south)



Figure 2 - Existing Bridge (looking west)

EXISTING BRIDGE INFORMATION

The existing bridge is a four (4) span, simply supported prestressed concrete girder structure with an overall length of 226'-0" (measured along the centerline of the roadway). The existing bridge width is 31'-6". The substructure consists of concrete caps and columns on spread footings for the interior bents and concrete cap on timber piling for the end bents.

Bridge: Holy Trinity Church Road (S-36-39)
 Over: Over I-26
 Bridge ID: 000367003900100
 Type: Prestressed Concrete Beams with Concrete Deck and Substructure
 Year Built: 1959 (stamped on bridge parapet)
 Spans: 53'-0", 60'-0", 60'-0", 53'-0" (taken from construction documents)
 Width: 31'-6" (taken from construction documents)
 Skew: 22°-00' (taken from construction documents)

Design Methodology:

Code: AASHTO 1953 with revisions through 1955 and "Criteria for Prestressed Concrete Bridges, Bureau of Public Roads" 1954 (taken from construction documents)
 Live Load: AASHTO H15-S12-44 (taken from construction documents)
 Seismic: No mention of seismic design in construction documents

It appears spread footings were used at End Bent 5.

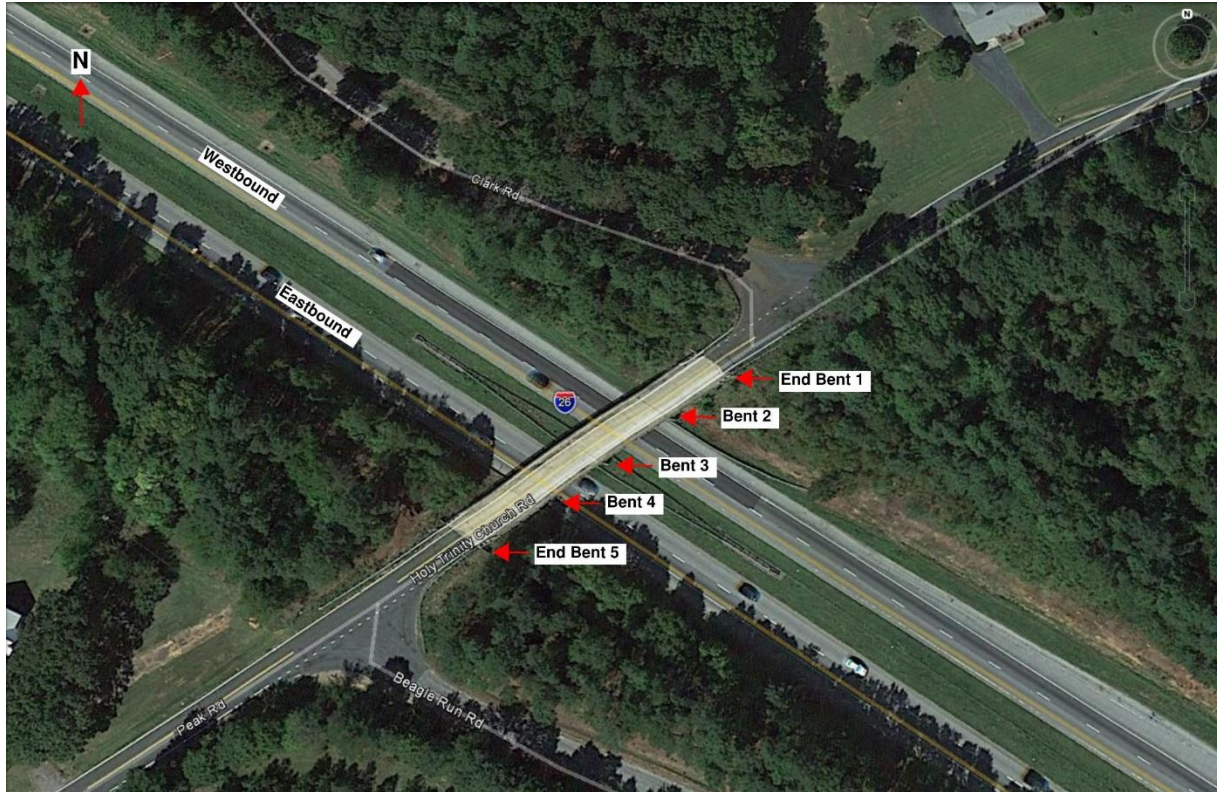


Figure 3 - Existing Bridge Layout

BRIDGE TYPICAL SECTION

The existing bridge typical section consists of a 26'-0" roadway width (gutter-gutter). Currently, two 10'-0" travel lanes exist, one in each direction, with 3' shoulders on each side. There are 2'-6½" tall concrete railings on both sides of the deck. The total out-to-out bridge width is 31'-6".

DECK

The existing deck thickness is approximately 6½" per the construction documents.

CONCRETE BEAMS

The superstructure is made up of four (4) prestressed concrete beams spaced at 8'-0".

EXPANSION JOINTS

There are three deck expansion joints located within the bridge. They are located at Interior Bent 2, Interior Bent 3, and Interior Bent 4.

DIAPHRAGMS

The superstructure has intermediate concrete diaphragms. The semi-integral end bent serves as the end diaphragm.

LIGHTING

The existing bridge has no overhead lighting.

DRAINAGE

Deck drains are located on each side of the existing deck. The deck drains discharge directly below to the existing shoulders.

BEARINGS

Based on original bridge plans, the existing bearings at the interior bents are rocker bearings.

END BENTS

The existing end bents consist of a concrete cap on timber piling with concrete end walls (semi-integral end bents).

INTERIOR BENTS

The interior bents consist of a concrete cap and concrete columns on concrete spread footings.

SIGNS

There are no signs located on the existing bridge.

TRAFFIC COUNTS

ADT (2015)	425
ADT (2035)	591
ADTT (2015)	30 (7%)

II. BRIDGE ASSESSMENT PHYSICAL CONDITION

GENERAL

STV Incorporated performed a visual assessment on September 19, 2016. The assessment was performed in order to determine the physical condition of the existing structure and to identify items that will need to be addressed during the construction phase of the I-26 widening project. Accessible areas were visually assessed from either above or below without the aid of ladders, man lifts, etc. The roadway was not closed during the visual assessment.

SUPERSTRUCTURE CONDITION

DECK

The existing reinforced concrete deck was observed from the shoulder since the roadway wasn't closed. Overall, the bridge deck shows little deterioration. The most recent Bridge Inspection Report does document some delamination, map cracking, and light scaling. The concrete end walls showed very little deterioration.

CONCRETE BEAMS

The existing prestressed concrete beams were assessed from accessible areas on the ground for deterioration and cracks. A piece of the beam has cracked off at one of the bearing locations (see Figure 4). There is also a small spall on the bottom of one of the concrete beams where reinforcing steel is exposed and corroded (see Figure 5). The most recent Bridge Inspection Report does document some light collision damage that has been repaired.



Figure 4 – Portion of Beam cracked off



Figure 5 – Exposed Rebar in Beam



Figure 6 – Superstructure (from underneath) and Collision Damage to Bottom of Beam

DIAPHRAGMS

The intermediate and end diaphragms (semi-integral end bents) were visually assessed from accessible areas and no deterioration was observed.

BEARINGS

A portion of the end bent bearings were visible due to the semi-integral end bent and very little deterioration was observed. The exterior bearings showed more deterioration than the interior bearings at the end bents. The interior bent bearings were not accessible from short distance, but were viewed from the ground and appeared to be in a medium state of deterioration with moderate to severe corrosion.



Figure 7 - Bearing Corrosion and Expansion Joint material falling through joint opening

EXPANSION JOINTS

There are three deck expansion joints located within the bridge. They are located at Interior Bent 2, Interior Bent 3, and Interior Bent 4. All three expansion joints were observed from the shoulders due to the roadway not being closed. The joint filler is falling through the opening at several locations (see Figure 7). Where the joint filler hasn't fallen through, the material is in an advanced state of deterioration (see Figure 8).

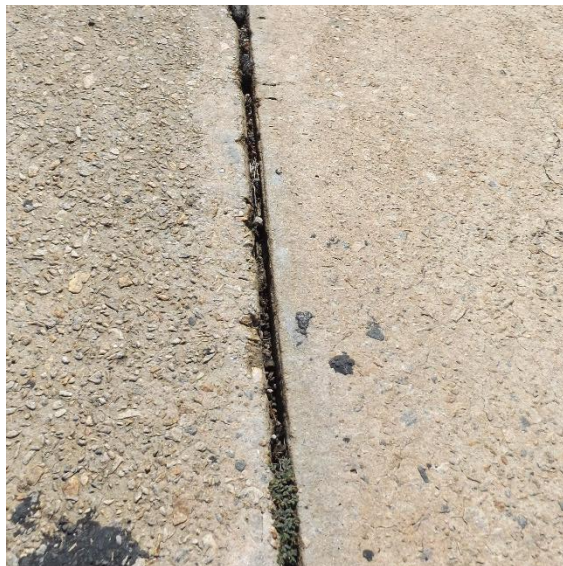


Figure 8 - Expansion Joint

BRIDGE RAILING

The bridge railing (Figure 9) is a concrete railing on a concrete curb and showed minimal signs of deterioration.



Figure 9 - Bridge Railing

SUBSTRUCTURE CONDITION

INTERIOR BENTS

The interior bents show minimal signs of deterioration with the exception of a large spall on the top of one of the concrete caps where the concrete has spalled off and exposed the bottom of the bearing (see Figure 10). The columns also show minimal signs of deterioration with the exception of a large spall where the reinforcing steel is exposed and corroded with vertical cracks (See Figure 11). The most recent Bridge Inspection Report documents some spalling on all columns and the bottom of all interior bent caps along with a diagonal crack on one interior bent.



Figure 10 - Spall on Top of Pier Cap



Figure 11 - Spall on Column

END BENTS

The end bent caps and wing walls show minimal signs of deterioration with the exception of a few small spalls on the face of the end bent cap where reinforcing steel is exposed (see Figure 12).



Figure 12 - End Bent Spalling

UTILITIES

There are no visible utilities attached to or in close vicinity to the bridge.

MISCELLANEOUS

The guardrail in the median of I-26 at this bridge location is damaged in a few locations (see Figures 13 and 14).



Figure 13 – Guardrail Damage



Figure 14 – Guardrail Damage

CLEARANCES

HORIZONTAL CLEARANCE

The horizontal clearance between the faces of the columns underneath the bridge (Spans 2 and 3) is approximately 52.6'± per the construction documents. There are currently two (2) lanes under each of these two spans. Adding a lane in each direction under the bridge will leave a total of approximately

16.6'± for shoulders and pier protection between the column faces in each direction. The 16.6'± dimension was verified during the field investigation.

VERTICAL CLEARANCE

The posted vertical clearances under the existing bridge are 15'-3" (I-26 EB) and 15'-6" (I-26 WB). Neither of these meet the 16'-0" minimum specified for freeway under existing overpassing bridges in the SCDOT Highway Design Manual. The most recent Bridge Inspection Report documents collision damage to the beams that has been repaired.



Figure 15 - Vertical Clearance

OTHER FACTORS

STRUCTURE INVENTORY AND APPRAISAL (SI&A) REPORT

In the most recent SI&A Report, this bridge has a sufficiency rating of 75.8 and is not classified as structurally deficient or functionally obsolete.

INSPECTION REPORT

The most recent Bridge Inspection Report documents numerous hairline cracks and spalls in various members of the bridge. The report also mentions light collision damage to multiple girders that has been repaired.

AGE

This bridge was constructed in 1959 and is 57 years old. This age likely puts it at or near the end of its design life.

OPTIONS

The two options to consider for this bridge are replacement and rehabilitation. Rehabilitation for this existing Holy Trinity Church Road bridge would consist of bearing replacement, joint replacement,

crack/spall repairs in beams, columns and caps, guardrail repair (underneath bridge), a potential closed drainage system, and either permanently raising the bridge (and likely a portion of the roadway approaches) or undercutting I-26 to achieve the required vertical clearance. The estimated cost of rehabilitating this bridge is approximately \$365,000. The estimated cost of replacing this bridge is approximately \$1.9 million.

III. RECOMMENDATIONS

The objective of this report is to assess the bridge and provide a recommendation based on this assessment. With that as the basis, the recommendation for this bridge is **Replacement**. This recommendation is based on the following factors:

- Sufficiency rating of 75.8
- Collision damage has occurred in one of the exterior beams
- Rebar exposed in the bottom line of the beams
- A piece of one of the beams has broken off behind one of the bearings
- One of the columns has a significant spall
- A portion of the cap under the bearing has broken off leaving the bottom of the bearing exposed
- Joints, bearings, vertical clearance would all be improved to meet current requirements
- New bridge can be designed for current live load requirements
- New bridge can be designed for current seismic requirements

Non-structural items, listed as follows, were not considered as part of this recommendation, but could be considered on a project-wide level (compared to structural consideration only) where they may enhance the replacement option:

- Limited width for I-26 shoulders and pier protection when I-26 is widened would not be an issue with a bridge replacement
- Lane and shoulder width on Holy Trinity Church Road would be updated to meet current requirements with a bridge replacement
- The age of the bridge would not be a factor with a bridge replacement
- Aesthetics and the general appearance of the corridor would be improved with a bridge replacement

Verify. This cost is less than the estimated costs of the two bridges that were recommended for rehab.

Is the broken piece part of the beam or is it part of an end diaphragm?

Markup Summary

4 Closed (3)



Subject: STRUCTURES

Author: BowersBW

Lock: Unlocked

Page Label: 4

Status:

1 Submitted set by BowersBW on 2/14/2017 at 2:37:42 PM

3 Resolved, Not Yet Implemented set by BowersBW on 3/2/2017 at 1:12:15 PM

4 Closed set by LiHongfen on 5/11/2017 at 1:53:35 PM

Date: 3/2/2017 1:14:24 PM

It appears spread footings were used at End Bent 5.



Subject: Re: STRUCTURES

Author: Joe Dichak

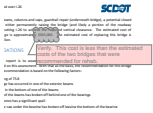
Lock: Locked

Page Label: 4

Status:

Date: 2/28/2017 10:16:56 AM

Agreed, End Bent 5 appears to be on a spread footing.



Subject: STRUCTURES

Author: BowersBW

Lock: Unlocked

Page Label: 14

Status:

1 Submitted set by BowersBW on 2/14/2017 at 2:37:51 PM

2 Unresolved set by BowersBW on 3/2/2017 at 1:17:13 PM

3 Resolved, Not Yet Implemented set by BowersBW on 3/15/2017 at 12:40:03 PM

4 Closed set by LiHongfen on 5/11/2017 at 1:55:53 PM

Date: 2/14/2017 2:22:10 PM

Verify. This cost is less than the estimated costs of the two bridges that were recommended for rehab.



Subject: Re: STRUCTURES

Author: Joe Dichak

Lock: Locked

Page Label: 14

Status:

Date: 2/28/2017 10:17:04 AM

This estimate should be more consistent with the other two bridges that are recommended for rehabilitation.



Subject: Re: Re: STRUCTURES

Author: BowersBW

Lock: Unlocked

Page Label: 14

Status:

Date: 3/2/2017 1:16:38 PM

If the cost is similar, what was the reason for recommending replacement for this bridge?

Subject: Re: Re: Re: STRUCTURES
Author: Joe Dichak
Lock: Unlocked
Page Label: 14
Status:
Date: 3/9/2017 1:02:12 PM

We went back and forth between replace and rehab on this one, but ended up going with replace because of the lower rating (7-10 points lower than the two other bridges that are recommended for rehabilitation), because the bridge has experienced some collision damage, and because of the overall signs of deterioration (large cap and column spalls, significant rebar exposure at end bent, rebar exposure in bottom of beam at 1 location). If SCDOT is satisfied with the collision damage repairs and feels like rehabilitation is the best path forward for this bridge, especially if the bridge can be raised so it minimizes future collision damage, we won't object to changing the recommendation.

Subject: Re: Re: Re: Re: STRUCTURES
Author: BowersBW
Lock: Unlocked
Page Label: 14
Status:
Date: 3/15/2017 12:39:52 PM

If the bridge is repairable and the repair cost is less than the other two bridges that are recommended for repair, I have no objection to a change in the recommendation. If it cannot be satisfactorily repaired or the repair costs are excessive, then that should be stated to support the replacement recommendation.

Subject: STRUCTURES
Author: BowersBW
Lock: Unlocked
Page Label: 14
Status:
1 Submitted set by BowersBW on 2/14/2017 at 2:37:45 PM
2 Unresolved set by BowersBW on 3/2/2017 at 1:15:15 PM
3 Resolved, Not Yet Implemented set by BowersBW on 3/15/2017 at 12:34:31 PM
4 Closed set by LiHongfen on 5/11/2017 at 1:46:08 PM
Date: 2/14/2017 1:22:32 PM

Is the broken piece part of the beam or is it part of an end diaphragm?

Subject: Re: STRUCTURES
Author: Joe Dichak
Lock: Locked
Page Label: 14
Status:
Date: 2/28/2017 10:16:59 AM

It may be part of the diaphragm.

Subject: Re: Re: STRUCTURES
Author: BowersBW
Lock: Unlocked
Page Label: 14
Status:
Date: 3/2/2017 1:14:51 PM

This should be clarified here and at two locations on page 7.

Subject: Re: Re: Re: STRUCTURES
Author: Joe Dichak
Lock: Unlocked
Page Label: 14
Status:
Date: 3/9/2017 1:01:37 PM

We will update.