INSPECTION AND RATING OF TEN BRIDGES

Executive Summary
Project Number ST 2019–15

by

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The research project was sponsored by the State of Alabama Highway Department. The traffic control, bridge inspection vehicles and operators were provided by the Alabama Highway Department's Division and District offices. The cooperation and assistance of personnel from the Alabama Highway Department is gratefully acknowledged. Particular appreciation is expressed to Mr. Mike Harper, Chief of the Maintenance Bureau, and Mr. Fred Conway,Chief of the Bridge Bureau, for their interest in and support of this project. Mr. Terry McDuffie who was appointed as a state liaison was extremely helpful as he provided prompt and able assistance throughout the project.

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ABSTRACT

A total of twelve truss bridges in Alabama were inspected and load rated in this project. The Federal Highway Administration and the Alabama Highway Department have established guidelines and requirements related to highway bridges to ensure the safety of the monitoring public. To remain in compliance with these requirements each highway bridge must be periodically inspected and the safe load capacity of the bridge must be established through a load rating. Load ratings of a number of major bridges in Alabama have never been established because adequate information about the bridge structures is not available.

The primary objective of this project was to provide a bridge inspection and load rating for twelve bridges for which a load rating had never been established. The specific project objectives were (1) to perform a thorough field inspection of the bridges, (2) to collect all pertinent field data on the geometry and details of the bridges, and (3) to perform a structural analysis and load rating of each bridge based on the superstructure load carrying capacity.

An examination of the field inspection and load rating results for all the bridges leads to the following concluding remarks.

1. The load capacity of the truss spans was typically limited by the capacity of the stringers or floorbeams instead of the capacities of the truss members or truss connections.

2. All twelve bridges exhibit signs of deterioration to varying degrees. The major causes of deteriorations are: corrosion (loss of member cross sectional area), vehicle impacts due to overheight vehicles and narrow lanes, and fatigue fracture of members and rivets. Most of the bridges exhibited deterioration from all of these.

3. Corrosion of a number of stringers, floorbeams, and bearing assemblies was found to result from leakage of water through deck joints or from drainage through deck drains onto structural members below.

4. Fatigue sensitive details were created in a number of fracture critical members by field welding performed to repair corrosion or impact damage.

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I. INTRODUCTION

The Federal Highway Administration and the Alabama State Highway Department have established guidelines and requirements related to highway bridges to ensure the safety of the motoring public. To remain in compliance with these requirements each highway bridge must be periodically inspected and the safe load capacity of the bridge must be established through a load rating. Proper load ratings of a number of major bridges in Alabama have never been established because adequate information about the bridge structures is not available. The construction plans for the bridges are no longer available.

The primary objective of this project was to provide a bridge inspection and load rating for twelve bridges for which a load rating had never been established. The specific project objectives were: (1) to perform a thorough field inspection of each bridge, (2) to collect all pertinent field data on the geometry and details of each bridge, and (3) to perform a structural analysis and load rating of each bridge based on the superstructure load carrying capacity.

An inspection and load rating of all spans of the first ten bridges listed in Table 1 was provided under the initial contract. The last two bridges were added as an extension to the contract. The inspections and ratings of those two bridges covered only the truss spans. The bridge structural analyses and load ratings were performed by Auburn University personnel. The field inspections and data collection were provided by A. G. Lichtenstein & Associates under a subcontract with Auburn University. A.G. Lichtenstein & Associates provided a Condition Summary Report, Inspection Field Notes, Inspection Photographs, and As–Built Field Drawings for each bridge.

Table 1. Bridges for Inspection and Load Rating

County	Structure No.	Location
St. Clair	004-58-021.9 Simple Thru Truss	Riverside on US 78 over Coosa River at MP 142.68
Morgan	003-52-021.9A Bascule Lift Spans Concrete Arch	City of Decatur on US 31 over Tennessee River, L&N & Southern Railroad at MP 360.50
Jackson	035-36-009.8A Continuous & Simple Thru Truss	0.5 Mile North of Junction AL 40 on AL 35 over Tennessee River at MP 47.42
Morgan Madison	053-52-008.7B Thru Truss	Morgan/Madison County line on US 231 over Tennessee River at MP 307.30
Mobile	013-49-003.2 Continuous Movable Swing Span	2.6 Miles North of Bankhead Tunnel on US 43 over Three Mile Creek at MP 3.21
Montgomery	009-51-040.7B Simple Thru Truss	Montgomery/Elmore Co. Line on US 231 over Tallapoosa River MP 115.70
Wilcox	021-66-023.2 Simple Thru Truss	4.6 Miles North of Furman on S.R. 21 over Cedar Creek at MP 96.70
Mobile Baldwin	016-49-037.6B Simple Thru Truss with Lift Span	Mobile/Baldwin County line on US 90 over Tensaw River at MP 37.53
Lauderdale	002-39-008.7A Simple Thru Truss	0.72 Miles West of junction US 43 over Shoal Creek at MP 40.20
Coffee	125-016-000.2 Simple Thru Truss	City of Elba on Alabama 125 over White Water Creek at MP 0.1
Cherokee	68-10-19.9 Simple Thru Truss Span	Over Chattooga River near Gaylesville
Wilcox	028-66-012.0 1 Thru Truss Span 4 Deck Truss Spans	Over Alabama River on Highway 28

II. RATING METHODOLOGY

Introduction

A structural analysis and load rating was carried out for each bridge according to accepted engineering practice and applicable AASHTO standards. As with any evaluation of an existing structure, it was necessary to make some assumptions in the analysis and ratings. For example, judgments had to be made about support conditions, whether or not connections were rigid or pinned, the effects of damage and deterioration on the load carrying capacity of individual members, etc. Assumptions of this type were made based on normal standards of engineering practice.

The ratings were performed under the guidelines described by AASHTO (Manual 1983). Two types of rating methodologies are described by AASHTO (Manual 1983): the allowable stress method, and the load factor method. The allowable stress method is currently used by the Alabama Highway Department for establishing ratings for steel bridges. Hence, the allowable stress method was used in all rating calculations performed for steel bridges members under this project. The load and resistance factor method was used for reinforced concrete members where reinforcement details were available.

Structural Analysis and Rating

Structural analyses were performed to determine the dead load and live load stresses for each bridge member. These analyses were carried out using a general structural analysis program BRIDGE developed by the principal investigator, Dr. J. Michael Stallings. Three dimensional analyses for a limited number of cases were performed using the general purpose finite element analysis program ABAQUS (Hibbitt et al. 1989).

The structural analysis results were used to calculate the load capacities of each bridge member. The load capacities of the connections and member

splices were also investigated to insure that the connections could safely transfer the member loads. The rating results for each bridge were then summarized in an Interim Report that was submitted to the Alabama Highway Department Maintenance Bureau for use in updating bridge inventory records. The Interim Reports contained ratings for each major group of members and connections (such as the truss members, stringers, and floorbeams) which were based on the member from each group with the lowest load capacity. The ratings were further summarized by identifying the lowest member capacity, or rating, in the entire bridge.

Details of the amounts and locations of the steel reinforcement in the concrete members (concrete girders in the approach spans or the roadway decks) were generally not available. Judgments about the capacities of concrete members are discussed for each bridge in an Interim Report and in the Final Report. Where reinforcement details were available, ratings were calculated according to the load factor method described by AASHTO (Manual 1983).

The remaining fatigue lives of the bridge members were not considered in the calculations of the load ratings. Calculations of remaining bridge fatigue life and/or using fatigue requirements to establish allowable stress is not a part of the normal bridge rating process used by the Alabama Highway Department. However, comments are provided for some bridges where details especially prone to fatigue problems were identified during the field inspections.

Quantitative bridge ratings were not calculated for substructure elements. Such calculations were outside the project scope. Quantitative calculations of ratings for substructure elements are not commonly performed when the details of the original construction are unknown. Typically because it is impossible to

establish details such as amounts and locations of reinforcement by visual inspection as per AASHTO (Manual 1983) 5.1.2. Qualitative information on the condition of the substructure elements are given in the condition reports for each bridge.

Inventory and Operating Ratings

The rating results for each bridge are given in terms of Inventory and Operating ratings as defined by AASHTO (Manual 1983). Standard truck loadings given in Figure 1 were provided by the Alabama Highway Department for use in the rating calculations. The type 3S3 (AL) truck loading was added after the project started and was used in rating eight of the twelve bridges. For short spans, loadings created by a single standard truck in each lane controlled the ratings. Equivalent lane loadings were used to calculate ratings for long spans (greater than 200 feet) as per provision 5.2.2 of AASHTO (Manual 1983).

Ratings for each bridge are given for two different cases referred to here as "As–Designed" and "Present–Condition". As–Designed ratings were calculated without regard for damage and deterioration. The As–Designed ratings provide an upper bound on the bridge capacity that can be used in making maintenance decisions concerning future repairs and/or strengthening. The Present–Condition ratings reflect the effects that damage and deterioration identified by the field inspections have on the load capacity of the bridge.

III. RATING RESULTS

St. Clair County Structure No. 004–58–021.9

The St. Clair County bridge spans the Coosa River near Riverside, Alabama on U.S. Highway 78 at Mile post 142.68. The bridge was constructed in 1932 and underwent a major lift operation in 1972. The original bridge was made of three steel truss spans and eight reinforced concrete approach spans.

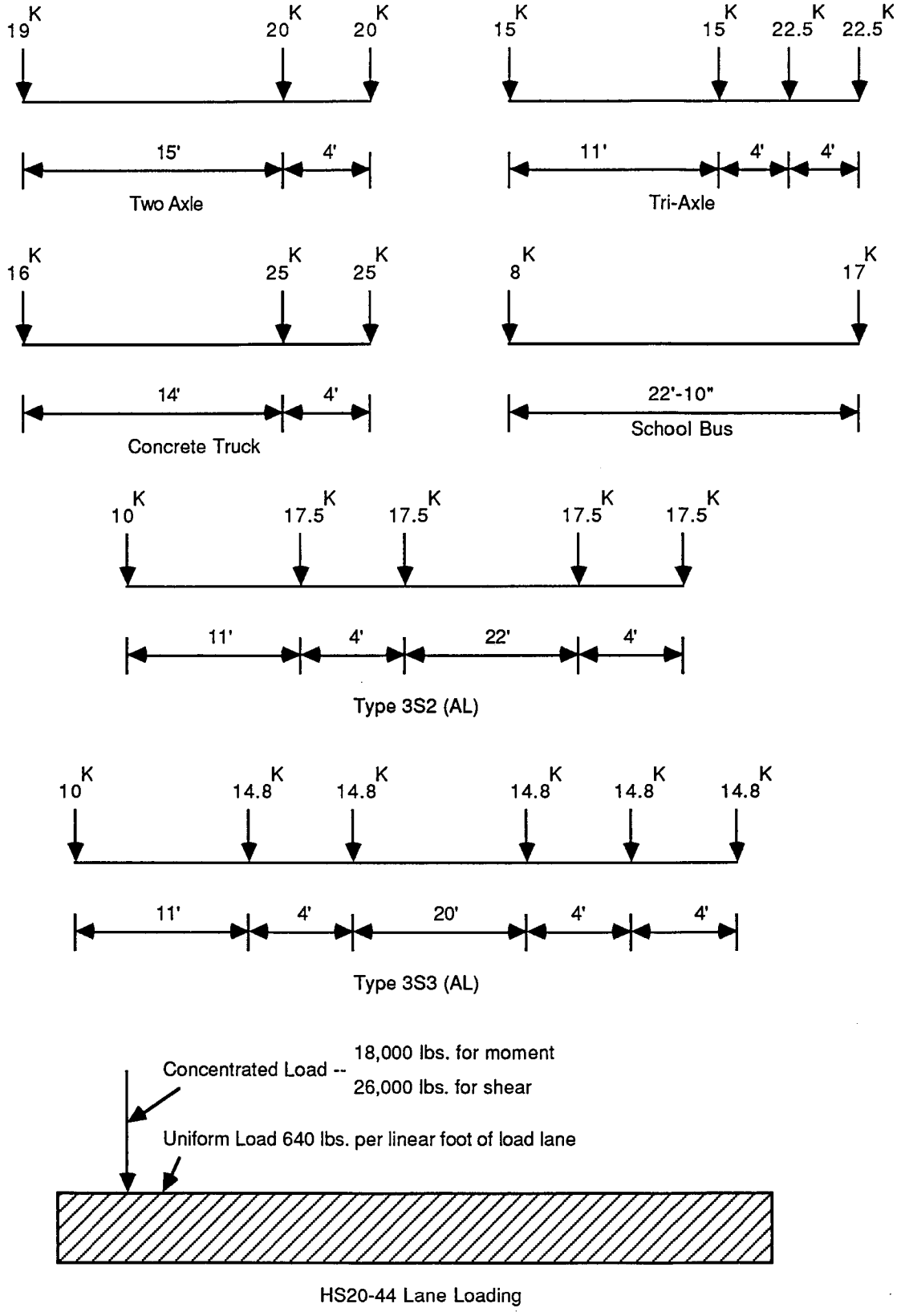

Figure 1. Standard Truck Loadings

The three truss spans are still in service. The approach spans were replaced by 12 reinforced concrete tee beam spans in 1972. Structural analyses and load ratings of the bridge indicate that the flexural capacity of the floorbeams of the center bearing swing span controls the bridge ratings. A summary of the load rating results is given in Table 2.

Morgan County Structure No. 003–52–021.9A

Morgan County structure No. 003–52–021.9A is commonly known as the Keller Memorial Bridge. It was originally constructed in 1927 and currently carries U.S. Route 31 traffic over the Tennessee River and the L&N and Southern Railroad at Decatur, Alabama. The bridge consists of steel stringer spans, southern arch spans, a bascule span, and northern arch spans. Structural analyses and load ratings of various spans of the Keller Memorial Bridge indicate that the load capacity of the short spandrel columns of the concrete arch spans controls the ratings. A summary of the Present–Condition ratings based on the spandrel columns is given in Table 3.

Jackson County Structure No. 035–36–009.8A

Jackson County structure No. 035–36–009.8A is commonly known as the B.B. Commer bridge. It was constructed in 1930 and currently carries Alabama Route 35 traffic over the Tennessee River from Section to Scottsboro. The bridge consists of main spans (four simple span through trusses and one three–span–continuous through truss), thirteen steel I–beam approach spans, and one reinforced concrete tee beam approach span. Structural analyses and load ratings of the bridge indicate that the flexural capacity of the exterior stringers of the three–span–continuous truss floor system controls the bridge ratings. A summary of the Present–Condition ratings for the bridge is given in Table 4.

Table 2. Summary of Present-Condition Ratings for St. Clair County Structure No. 004-58-021.9

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.73	22	1.19	>29.5
Tri-Axle	37.5	0.54	20	0.89	33
Concrete Truck	33	0.62	20	1.01	>40
3S2 (AL)	40	0.78	31	1.21	>40
School Bus	12.5	1.81	>12.5	2.82	>12.5

Table 3. Summary of Present-Condition Ratings for Morgan County Structure No. 003-52-021.9A

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.50	15	0.84	25
Tri-Axle	37.5	0.34	13	0.57	21
Concrete Truck	33	0.39	13	0.66	22
3S2 (AL)	40	0.51	20	0.86	34
School Bus	12.5	1.41	>12.5	2.35	>12.5

Table 4. Summary of Present-Condition Ratings for Jackson County Structure No. 035-36-009.8A

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.37	11	1.04	>29.5
Tri-Axle	37.5	0.29	11	0.73	27
Concrete Truck	33	0.33	11	0.83	27
3S2 (AL)	40	0.28	11	0.87	35
School Bus	12.5	0.88	11	2.07	>12.5

Morgan/Madison County Structure No. 053–52–008.7B

Morgan/Madison County Structure No. 053–52–008.7B was constructed in 1933 and currently carries U.S. Route 231 and Alabama Route 53 traffic over the Tennessee River from Laceys Spring to Huntsville. The bridge consists of six steel I–beam approach spans and seven truss spans. The truss spans consists of four 200 feet long simple span through trusses and one three–span continuous through truss. Structural analyses and load ratings of the bridge indicate that the final bridge ratings are controlled by the flexural capacity of the exterior stringers of the three–span–continuous truss, the flexural capacity of the approach stringer spans, and the main truss member capacity. A summary of the Present–Condition ratings for the bridge is given in Table 5.

Mobile County Structure No. 013–49–003.2

Mobile County Structure No. 013–49–003.2 was constructed in 1933 and currently carries U.S. Route 43 traffic over the Three Mile River. The original bridge consisted of one deck–girder swing span and one reinforced concrete T–beam approach span. The manually operated swing span was apparently converted to a fixed bridge as it does not appear to have been opened for several years. Structural analyses and load ratings of the bridge indicate that the final bridge ratings are controlled by the trussed floorbeams. However, the rating factors for the other elements (plate girder floorbeams and interior stringers) of the bridge are not substantially greater than those for the trussed floorbeams. A summary of the Present–Condition ratings for the bridge is given in Table 6.

Montgomery County Structure No. 009–51–040.7B

Montgomery County Structure No. 009–51–040.7B was constructed in 1920 and currently carries U.S. Route 231 traffic over the Tallapoosa River from Montgomery to Wetumpka. The original bridge consisted of 13 reinforced

Table 5. Summary of Present-Condition Ratings for Morgan/Madison County Structure No. 053-52-008.7B

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.57	17	1.00	29.5
Tri-Axle	37.5	0.42	16	0.77	29
Concrete Truck	33	0.47	16	0.84	28
3S2 (AL)	40	0.47	19	0.86	34
School Bus	12.5	1.36	>12.5	2.21	>12.5

Table 6. Summary of Present-Condition Ratings for Mobile County Structure No. 013-49-003.2

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.60	18	0.83	24
Tri-Axle	37.5	0.42	16	0.59	22
Concrete Truck	33	0.47	16	0.66	22
3S3 (AL)	42	0.60	25	0.84	35
3S2 (AL)	40	0.64	26	0.90	36
School Bus	12.5	1.28	>12.5	1.79	>12.5

concrete stringer spans (6 on the west approach and 7 on the east approach) and four truss spans. The two center trusses were camel back Pratt type, and the two outer trusses are standard Pratt trusses. The two outer Pratt trusses were damaged by traffic impact (in separate incidents) and replaced in 1970 (west) and 1977 (east) with two steel stringer spans in each location (one steel bent was erected in the middle of the original truss span).

The results of the field inspection, structural analyses, and load ratings indicate that there are a number of alternatives that should be considered in setting the final ratings of the bridge. First, as described by A.G. Lichtenstein & Associates (Montgomery County 1991), the bearing capacity of the ends of the approach span concrete T–beam stringers is questionable. Due to the nature of the cracking and structural details at the bearings it is not possible to calculate quantitative ratings for the bearings. It is recommended that positive action to improve the conditions at the ends of the concrete T–beam stringers should be taken.

Rating calculations indicate that the load capacities of the riveted truss connections are very low when the allowable shear stress for Grade 1 rivets is used. The truss connections do not control the bridge ratings when the allowable shear stress for Grade 2 rivets is used. Because it is not known whether Grade 1 or Grade 2 rivets were used in the connections, it would be conservative to assume that Grade 1 rivets were used. It is suggested that such a conservative assumption is not necessary since no distress of the riveted connections was found during the bridge inspection. It is recommended that load restrictions not be placed on the bridge based on the connection capacities. If future inspections reveal distress of the connections, this recommendation should be reconsidered.

The final Present–Condition ratings for the bridge are controlled by the flexural capacities of the stringers of the truss floor systems. A summary of the ratings based on the present capacity of the fascia stringers in given in Table 7. The ratings given in Table 7 are based on the continued use of two traffic lanes on the bridge. The bridge ratings can be significantly improved by providing a positive means to restrict traffic to a single lane along the center of the deck. Ratings based on the interior stringer capacities for a single traffic lane are shown in Table 8. The ratings based on the interior stringer capacities would control the bridge ratings for all trucks except for one case noted in Table 8.

Wilcox County Structure No. 021–66–023.2

Wilcox County Structure No. 021–66–023.2 was constructed in 1939 and currently carries AL Route 21 traffic over Cedar Creek between Furman and Bragg. The bridge consists of an 80 feet pony truss, three timber stringer approach spans, and 10 steel stringer approach spans. The steel stringer approach spans are three–span continuous and two–span continuous configurations. Structural analyses and load ratings of the bridge indicate that the final bridge ratings are controlled by the flexural capacities of the timber approach span stringers. A summary of the Present–Condition ratings for the bridge is given in Table 9.

Mobile/Baldwin County Structure No. 016–49–037.6B

Mobile/Baldwin County Line Structure No. 016–49–037.6B was constructed in 1925 and currently carries U.S. Route 90 traffic over the Tennessee River from Mobile to Baldwin County. The original bridge consisted of 12 steel stringer spans (6 spans each approach) and 5 camel back Pratt truss spans, the center span being a lift span. The lifting machinery and towers were removed in 1978 leaving the lift span permanently in the down position.

Table 7. Present-Condition Ratings for Fascia Stringers of Truss Spans of Montgomery County Structure No. 009-51-040.7B

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.29	9	0.57	17
Tri-Axle	37.5	0.21	8	0.40	15
Concrete Truck	33	0.23	8	0.46	15
3S2 (AL)	40	0.33	13	0.65	26
School Bus	12.5	0.58	7	1.14	>12.5

Table 8. Present-Condition Ratings for Interior Stringers of Truss Spans of Montgomery County Structure No. 009-51-040.7B

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.74	22	1.19	>29.5
Tri-Axle	37.5	0.52	20	0.85	32
Concrete Truck	33	0.59	20	0.95	31
3S2 (AL)	40	0.84	34	1.36*	>40
School Bus	12.5	1.48	>12.5	2.39	>12.5

*Controlling value is 1.03 for truss connections.

Table 9. Summary of Present-Condition Ratings for Wilcox County Structure No. 021-66-023.2

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.66	19	0.97	29
Tri-Axle	37.5	0.48	18	0.71	27
Concrete Truck	33	0.53	17	0.78	26
3S3 (AL)	42	0.67	28	0.99	42
3S2 (AL)	40	0.75	30	1.11	>40
School Bus	12.5	1.22	>12.5	1.79	>12.5

Structural analyses and load ratings of the bridge indicate that the final bridge ratings are controlled by the flexural capacity of the fascia stringers of truss span 8. The fascia stringers were found to have a great deal of corrosion damage. A summary of the Present–Condition ratings for the bridge is given in Table 10.

Lauderdale County Structure No. 002–39–008.7A

The Shoal Creek bridge, Lauderdale County Structure No. 002–39–008.7A, was constructed in 1924 and currently carries the westbound traffic of U.S. Route 72, U.S. Route 43, and Alabama Route 13 over Shoal Creek from Killen to Florence. The bridge consists of five identical 157.5 feet long camel back Pratt truss spans with no approach spans. Structural analyses and load ratings of the bridge indicate that the final bridge ratings are controlled by the flexural capacity of the stringers. A summary of the Present–Condition ratings for the bridge is given in Table 11.

Coffee County Structure No. 125–16–000.2

Coffee County Structure No. 125–16–000.2 was constructed in 1940 and currently carries Alabama Route 125 over the White Water Creek. The bridge consists of 8 steel stringer approach spans and a single span camel back pony truss. A sidewalk runs the full length of the bridge along the west side. Rating calculations indicate that the load capacities of the riveted truss connections are very low when the allowable shear stress for Grade 1 rivets is used. The truss connections do not control the bridge ratings when the allowable shear stress for Grade 2 rivets is used. Because it is not known whether Grade 1 or Grade 2 rivets were used in the connections, it would be conservative to assume that Grade 1 rivets were used. It is suggested that such a conservative assumption is not necessary since no distress of the riveted connections was found during the bridge inspection. It is recommended that load restrictions not be placed on

Table 10. Summary of Present-Condition Ratings for Mobile/Baldwin County Structure No. 016-49-037.6B

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.34	10	0.57	17
Tri-Axle	37.5	0.25	9	0.41	15
Concrete Truck	33	0.27	9	0.46	15
3S3 (AL)	42	0.34	14	0.57	24
3S2 (AL)	40	0.38	15	0.64	26
School Bus	12.5	0.75	9	1.27	>12.5

Table 11. Summary of Present-Condition Ratings for Lauderdale County Structure No. 002-39-008.7A

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.66	19.5	0.99	29.5
Tri-Axle	37.5	0.47	18	0.70	26
Concrete Truck	33	0.53	17	0.79	26
3S3 (AL)	42	0.64	27	0.97	41
3S2 (AL)	40	0.75	30	1.13	>40
School Bus	12.5	1.28	>12.5	1.94	>12.5

the bridge based on the connection capacities. If future inspections reveal distress of the connections, this recommendation should be reconsidered.

The suggested final bridge ratings are controlled by the flexural capacities of the floorbeams of the truss span. A summary of the Present–Condition ratings for the bridge based on the load capacity of the floorbeams is given in Table 12.

Cherokee County Structure No. 068–10–19.9

Cherokee County Structure No. 068–1–19.9 was constructed in 1930 and currently carries AL Route 68 traffic over the Chattooga River at Cedar Bluff. The bridge consists of a 120 feet long Pratt thru–truss with three steel stringer approach spans on the west approach and twelve steel stringer approach spans on the east approach. Ratings and condition inspections for the steel stringer approach spans are not included in the project. The bridge is currently posted for a 10 ton limit on all truck loads. Structural analyses and load ratings of the truss indicate that the final truss ratings are controlled by the flexural capacity of the stringers in the truss floor system. A summary of the Present–Condition ratings for the truss is given in Table 13.

Wilcox County Structure No. 028–66–12.0

Wilcox County Structure No. 28–66–12.0 was constructed in 1929 and currently carries AL Route 28 traffic over the Alabama River (William Donnelly Reservoir) in the town of Millers Ferry. The bridge consists of 89 steel stringer approach spans, four Warren deck truss approach spans, and one main span through truss. Ratings for the steel stringer approach spans are not included in the project. The four approach trusses have a span length of 160 feet. The main span has a span length of 160 feet 1 inch. The bridge is currently posted for a maximum HS20–44 load of 30 tons. Structural analyses and load ratings

Table 12. Summary of Present-Condition Ratings for Coffee County Structure No. 125-16-000.2

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.58	17	1.27	>29.5
Tri-Axle	37.5	0.41	15	0.90	34
Concrete Truck	33	0.46	15	1.01	>33
3S3 (AL)	42	0.58	24	0.95	40
3S2 (AL)	40	0.63	25	1.03	>40
School Bus	12.5	1.27	>12.5	2.08	>12.5

Table 13. Summary of Present-Condition Ratings for Truss Span Cherokee County Structure No. 068-10-19.9

Truck Type	Standard Weight (tons)	Inventory Rating Factor	Inventory Rating (tons)	Operating Rating Factor	Operating Rating (tons)
Two Axle	29.5	0.69	20	1.03	>29.5
Tri-Axle	37.5	0.51	19	0.77	29
Concrete Truck	33	0.55	18	0.82	27
3S3 (AL)	42	0.72	30	1.08	>42
3S2 (AL)	40	0.78	31	1.17	>40
School Bus	12.5	1.21	>12.5	1.81	>12.5

of the five truss spans indicate that the final bridge ratings are controlled by the flexural capacity of the stringers and the floorbeams. A summary of the Present–Condition ratings for the truss spans is given in Table 14.

IV. CONCLUDING REMARKS

Inspections and load ratings were performed for twelve bridges on this project. The main spans of most of the bridges were truss structures. Load ratings for the twelve bridges had never been established because sufficient information about the bridge structures was not available. The specific project objectives were (1) to perform a thorough field inspection of each bridge, (2) to collect all pertinent field data on the geometry and details of each bridge, and (3) to perform a structural analysis and load rating of each bridge based on the superstructure's load carrying capacity. Each of the project objectives was achieved. The results for each bridge were documented with interim reports of sufficient detail, and in the necessary format, for use by the Maintenance Bureau in updating the bridge inventory records.

An examination of the field inspection and load rating results for all the bridges leads to the following concluding remarks.

1. The load capacity of the truss spans was typically limited by the capacity of the stringers or floorbeams instead of the capacities of the truss members or truss connections.

2. All twelve bridges exhibit signs of deterioration to varying degrees. The major causes of deterioration are: corrosion (loss of member cross sectional area), vehicle impacts due to overheight vehicles and narrow lanes, and fatigue fracture of members and rivets. Most of the bridges exhibited deterioration from all of these.

Table 14. Summary of Present-Condition Ratings for Truss Spans Wilcox County Structure No. 28-66-12.0

Truck Type	Standard Weight (tons)	Inventory		Operating	
		Rating Factor	Rating (tons)	Rating Factor	Rating (tons)
Two Axle	29.5	0.55	16	1.12	>29.5
Tri-Axle	37.5	0.40	15	0.81	30
Concrete Truck	33	0.45	15	0.91	30
3S3 (AL)	42	0.59	25	1.19	>42
3S2 (AL)	40	0.63	25	1.27	>40
School Bus	12.5	1.33	>12.5	2.17	>12.5

3. Corrosion of a number of stringers and floorbeams, and bearing assemblies was found to result from leakage of water through deck joints or from drainage through deck drains on to structural members below.

4. Fatigue sensitive details were created in a number of fracture critical members by field welding performed to repair corrosion or impact damage.

V. REFERENCES

American Association of State Highway and Transportation Officials (1983). Manual for Maintenance Inspection of Bridges, Washington, D.C.

American Association of State Highway and Transportation Officials (1989). Standard Specifications for Highway Bridges, Washington, D.C.

Hibbitt, Karlsson, & Sorensen, Inc. (1989). ABAQUS User's Manual, Version 4.8, Newark, CA.