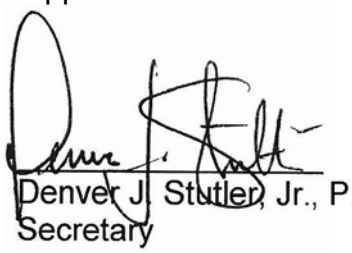
Approved:



Denver J. Stutler, Jr., P.E.
Secretary

Effective: October 19, 2006
Office: Maintenance
Topic No.: 850-010-035-b

BRIDGE LOAD RATING, PERMITTING AND POSTING

PURPOSE:

To establish procedures for load rating structures, establishing the safe load carrying capacity of structures for permitting overweight vehicles and posting structures that cannot safely carry legal loads.

AUTHORITY:

Sections 316.535, 334.044, 334.045, 334.046, and 335.074, Florida Statutes (F.S.)

REFERENCES:

Standard Operating System, Procedure No. 025-020-002

SCOPE:

The requirements related to this procedure affect all Department personnel involved in load rating and posting bridges. In addition, consultants performing load ratings for the Department may be required by contract to follow requirements of this procedure.

DISTRIBUTION:

One official copy of this manual will be held by each District Maintenance Office, each District Structures and Facilities Office, each District Structures Design Office, each District Traffic Engineer, the Structures Design Office, the Engineer of Maintenance Operations, the State Bridge Evaluation Engineer, and the Forms and Procedures Office. Additional official holders may be specified by the Office of Maintenance. The Office of Maintenance will maintain a master list to ensure additions and revisions are distributed to all official holders of the manual.

Each office may obtain additional copies of this manual, but it will be the individual office's responsibility to ensure that these additional manuals are updated.

Interested parties may obtain copies of this manual from the Forms and Procedures website.

REVISIONS AND UPDATES:

Modifications may be the result of changes in FDOT specifications, FDOT organization, Federal Highway Administration (FHWA) regulations, and AASHTO requirements.

All revisions and updates will be coordinated with the Forms and Procedures Office prior to distribution to ensure conformance with and incorporation into the Department's ***Standard Operating System, Procedure No. 025-020-002***.

The Manual Review Committee will consist of all District Structures and Facilities Engineers, the State Bridge Evaluation Engineer and the Engineer of Maintenance Operations. The State Bridge Evaluation Engineer shall periodically convene the Manual Review Committee to review the manual and to consider any proposed revisions. The committee shall meet at least every other year

Requests for revisions to this manual shall be submitted in writing to the State Bridge Evaluation Engineer, Florida Department of Transportation, M.S. 52, 605 Suwannee Street, Tallahassee, Florida 32399-0450. Minor revisions to this manual may be issued by the Director of the Office of Maintenance after approval of the Manual Review Committee and consultation with any other affected parties; e.g., Federal Highway Administration, and the Forms and Procedures Office.

Major revisions, as determined by the Manual Review Committee, will be approved by the Secretary following the process established in the Department's ***Standard Operating System, Procedure No. 025-020-002***.

TRAINING:

None required

FORMS:

Form No. 850-010-06 Load Capacity Information may be accessed from the Department's Forms Library

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SECTION 1 – GENERAL

1. LOAD RATING AND INSPECTION

While the Bridge Load Rating, Permitting and Posting is a separate procedure, the load rating process is a component of the inspection process and consists of determining the safe load carrying capacity of structures, determining if specific legal or overweight vehicles can safely cross the structure and determining if a structure needs to be restricted and the level of posting required. During and as a result of each inspection, the Districts will determine if the load rating on file reflects the current capacity of the bridge and will update the rating and Pontis if necessary.

The bridge management system consists of the following existing or planned volumes:

(A) **Volume 1** – Bridge and Other Structures Inspection and Reporting Procedures Manual; (Topic No. 850-010-030-e). Specifically defines standards for inspection and reporting practices.

(B) **Volume 2** – Bridge Maintenance Repair Methods Handbook; defines standard maintenance and repair details including repair equipment, material and manpower.

(C) **Volume 3** – Bridge Load Rating, Permitting and Posting Procedure; (Topic No. 850-010-030-b). Specifically establishes procedures for load rating structures, establishing the safe load carrying capacity of structures for permitting overweight vehicles and posting structures that cannot safely carry legal loads.

(D) **Volume 4** – Bridge Underwater Operations Manual; (Topic No. 850-010-011) defines the procedures and safety requirements for diving operations to perform underwater bridge inspections. (Note: This manual is currently referred to as the Dive Manual).

(E) **Volume 5** – Bridge Operations and Maintenance Manual; (Topic No. 850-010-031) defines the organization, responsibilities and functions involved in bridge inspection, maintenance and operations. (Future Volume).

1.1 OBJECTIVES

The objectives of this procedure are to codify the procedures and to detail the concepts for the load rating, posting and permitting process. Specific examples of load rating are not included.

1.2 DEFINITIONS

All Engineering decisions shall be documented.

(A) Decision based on Engineering Judgment – Decisions made by a registered Professional Engineer based on knowledge and experience of applied engineering principles, recognized formulae, computer programs, or load tests. Such judgment should be used to evaluate the validity of the initial input and the final output.

(B) Governing Component – That component of a structure with the least live load carrying capacity.

(C) Inventory Rating or "Design" Load Rating – The rating which represents the load level which can safely utilize an existing structure for an indefinite period of time.

(D) Live Load Distribution Factor – The fraction of a rating truck wheel line or lane load assumed to be carried by a structural component.

(E) Load Rating – The process of determining the live load capacity of a structure based on its current condition through analysis and Engineering Judgment. Load tests may be used as load rating provided that all the trucks required to be evaluated for a standard load rating are also evaluated based upon the test results.

(F) Operating Rating – The rating which represents the absolute maximum permissible load level to which the structure may be subjected.

(G) Rating Factor – The ratio of the available Live Load Moment or Shear Capacity to the Moment or Shear produced by the load being investigated.

(H) Redundant – A structure for which multiple load paths exist, where if one element fails, alternate load paths will allow the load to be redistributed. Redundancy can also be Structural or Internal.

(I) Marginal Rating – For bridges Designed for HS 20 or HS 25 loading, an HS 20 Operating Rating less than 60 Tons. For Bridges Designed for HL 93, FL 120 rating Factor less than 1.0.

SECTION 2 – PROCEDURES GOVERNING THE LOAD RATING PROCESS

2. GENERAL

The specifications governing this work is the current version of the ***"Manual for Condition Evaluation of Bridges and LRFR of Highway Bridges"*** including interim specifications, published by AASHTO and as modified by the specifications included herein. An additional reference for details of the analytical process is ***Vol. 8*** of the ***Structures Manual*** maintained by the Structures Design Office. The District Maintenance Engineer and appropriate staff are responsible to ensure that every bridge structure within their jurisdiction is properly load rated.

2.1 CONCEPTS

The following concepts are to be applied to the load rating process:

(A) Substructures generally do not control the load rating. However, after the superstructure has been load rated, the load rater shall determine if the substructure can carry an equivalent or greater load than the superstructure. If not, the substructure will be load rated and the load rating adjusted. A complete or partial analysis of the substructure is not required if, in the engineering judgment of the load rater, the substructure has equivalent or greater capacity than the superstructure. The load Rater must be aware that short span bridges capacity based upon superstructure evaluation may allow vehicles with weights exceeding 500,000 lbs to cross generating significant impact on the substructure.

(B) Reinforced concrete bridge decks on redundant, multi-girder bridges will not normally be rated unless damage, deterioration, or other reasons merit this analysis. All other bridge deck systems shall be rated.

(C) Utilizing engineering judgment, all superstructure spans and components of the span shall be load rated for both moment and shear until the governing component is established. For example, a two girder superstructure system with floor beams and stringers would require the rating of stringers, floor beams and girders to establish the governing component. If the engineer, using engineering judgment determines that certain components will not control the rating, then a full analysis of the non-controlling elements is not required. Typically, certain components such as barriers or joints are not load rated.

(D) For most bridges, the governing rating shall be the lesser of the shear capacity or moment capacity of the critical component. For more complex

structures, other stresses such as principal web tension in concrete post-tensioned segmental bridges at service limit states will be investigated.

(E) Some composite prestressed concrete girder bridges were designed with the deck continuous over the supports in order to eliminate transverse deck joints. The girders of these bridges were not made continuous over the support. Bridges meeting this description shall be load rated as simple spans.

(F) The load and resistance factor rating method as modified by the Department is the required method for load rating new structures designed with the Load and Resistance Factor Design method. The LRFR method is the preferred method of analysis. Load Factor Rating may be used for existing structures not Designed using the LRFD method. When a load test has been performed on a structure the load ratings determined by the load test should be entered in the database.

(G) The AASHTO supported software VIRTIS is the preferred load rating program to load rate all bridges that meet the bridge configurations and capabilities of the program.

(H) Deck panel systems which are in poor condition (exhibiting either transverse or longitudinal spalling), shall have the live load distribution factors established as if the deck slabs act as simple spans between girders.

(I) Approximate methods are load rating calculations based upon line girder approximation. It shall consist of computations made from design plans, shop drawings, as-built plans, or field measurements.

(J) Refined methods consist of methods adjusted for actual material properties as determined from field sampling and tests of the materials. Refined methods should require the use of 3-D models such as the model used in the BRUFEM software. Refined methods may be performed before attempting load tests.

(K) When consultants perform load ratings, they will follow the requirements of this manual and the current version of the Manual for Condition Evaluation of Bridges and LRFR of Highway bridges as modified by Volume 8 of the Structures Manual. The district load rating staff will review the consultant's load ratings and perform spot checks to confirm accuracy of the consultant's work. Consultant load ratings shall be signed and sealed by a professional engineer. The consultant shall have quality control procedures in place to assure the accuracy and completeness of the load ratings.

(L) Load ratings for existing bridges must be performed using the load factor, load test or the load and resistance factor rating methods. An existing load rating performed with load factor does not have to be reanalyzed with newer methods.

(M) When an existing bridge with a working stress load rating requires reanalysis that structure should be reanalyzed with load factor or load resistance factor rating methods.

(N) Historical commentary. In 1993 the FHWA requested that all bridges on the National Highway System be load rated using the load factor method. After discussion with the FHWA the Department agreed to load rate all functionally obsolete and structurally deficient bridges on the National Highway System with the load factor method. This agreement does not prevent new bridges on the National Highway System and reanalysis of existing bridges on the National Highway System from being performed with the load resistance factor method.

2.2 PROCEDURE FOR POSTING OF WEIGHT RESTRICTIONS ON DEPARTMENT MAINTAINED STRUCTURES

If load rating calculations indicate that any of the Florida legal loads have an Operating Rating level less than 1.0, then the bridge must be posted for weight. A load test may be performed to determine if the actual stress levels induced by Florida legal loads are in excess of the operating rating stresses.

When weight restrictions on Department maintained structures are required, the following procedure shall be followed:

(A) To initiate weight limit restrictions, the recommendations shall be developed by the District Structures and Facilities Engineer and endorsed by the District Maintenance Engineer.

(B) The request for weight limit restrictions, load rating calculations, the load rating summary sheet, computer output or load test results and sign configuration are to be submitted to the Engineer of Maintenance Operations for processing through the Director of the Office of Maintenance to the Secretary of the Department of Transportation for approval. The recommendations should be accompanied by the following:

(1) an explanation of the cause of the low rating
(2) what repairs are planned
(3) when the repairs will be performed
(4) will the repairs be performed by state forces or by contract
(5) the cost of repairs

(6) if and when the bridge is scheduled for rehabilitation or replacement
(7) what effect posting the bridge will have on local traffic and emergency vehicles, including detour routes for affected vehicles

(C) Upon approval of the weight limit restrictions, the District Traffic Operations Engineer and the State Bridge Evaluation Engineer shall be sent a copy of these restrictions. The District Traffic Operations Office shall notify the appropriate local governments that a weight limit regulation has been approved.

(D) A request for removal of weight limit restrictions shall be initiated by the District Structures and Facilities Engineer with the District Maintenance Engineer's approval. This request should indicate that the structure has been restored to legal load capacity. This request must be sent to the Engineer of Maintenance Operations for review. Before processing the request, the office of Maintenance may perform a review of the load rating. Removal of weight limit restrictions must have the approval of the Secretary of the Department of Transportation, prior to removal of posting signs.

(E) If the bridge is permanently taken out of service, then the District Structures and Facilities Engineer must notify the Engineer of Maintenance Operations in writing of this occurrence so that the Office of Maintenance removes the bridge from the list of posted bridges. The Road Use Permits Office shall be notified that the bridge has been permanently removed from service.

(F) Weight limits to be shown on the posting signs at a bridge site, shall represent the gross vehicular weight (GVW) in tons for a maximum of three truck types. However, no more than one or two truck symbols may be needed. Bridge capacity is calculated for the SU4, C5 &ST5 trucks. A graphic depiction of the general weight limit is shown on the ***Standard Index No. 17357***. The three truck types are as follows:

(1) Single unit trucks. (SU2, SU3 or SU4)
(2) Combination trucks with a single trailer. (C3, C4 or C5)
(3) Combination trucks with two trailers or a single unit truck with one trailer. (ST5

(G) The following are the requirements for weight limit signs:

(1) The location and construction of weight limit posting signs shall be in accordance with the Design Standard Index No. 17357. This standard index has been prepared to meet or exceed the

requirement established in Section 2B-41 of the Manual on Uniform Traffic Control Devices.

(2) After approval of the weight limit restrictions by the Secretary of the Department of Transportation, the District Maintenance Engineer shall solicit the recommendations of the District Traffic Operations Engineer for sign location and design.

(3) After receiving the District Traffic Operations Engineer's recommendations, the District Maintenance Engineer shall order the signs from the sign shop and direct the sign crew to immediately install them upon receipt.

(H) Bona Fide Emergencies: In case of bona fide emergencies, the District Maintenance Engineer shall take the necessary steps to protect the public safety. Corrective action may be initiated while seeking approval of weight limit posting. Such action may consist of restricting the traffic to certain lanes or posting the structure for no trucks or only trucks below a specified gross weight, while analysis and or repairs are performed and the official request is prepared and sent to the Engineer of Maintenance Operations. The office of Maintenance and the Overweight /Oversized Permit Office should be notified in writing of these temporary restrictions as well as the time the restrictions are lifted or modified.

(I) The bridge file should contain all pertinent information concerning posting and removal of posting actions.

2.3 PROCEDURE FOR POSTING OF WEIGHT RESTRICTIONS ON LOCAL GOVERNMENT STRUCTURES

Local government agencies are responsible for load posting of their structures. The Department, or its consultant, may load rate local government structures. When local government structures require weight restrictions the following procedure shall be followed:

(A) The Department, or its consultant, will develop recommendations for weight restrictions and notify the Department's local government bridge inspection project manager.

(B) The project manager will send the recommendations for weight restrictions to the local government agency. The agency will be required to perform the necessary actions to post the structure. The agency may elect to use their own forces or hire a consultant engineer to perform additional testing and analysis as described in ***Section 3*** of this manual.

(C) The local government agency should respond to the weight restrictions recommendations by posting the structure as recommended, or commencing further testing and analysis. The Department should be notified of the agency's action within 30 days of receipt of the weight restriction recommendations. If further testing or analysis is to be performed this should be accomplished and the results should be reported to the Department within 90 days of first notifications.

(D) The Department should be kept informed of all posting actions accomplished by the local government agency. This should include copies of all calculations and testing results.

(E) Weight limit signs shall conform to the requirements stated in this manual. Exceptions to these requirements may be approved by the project manager on a case by case basis.

2.4 PROCEDURE FOR LOAD TESTING OF BRIDGES

2.4.1 General

Analysis methods by their very nature represent engineering approximations of the stresses in a structure. Assumptions are made at every step of the analysis process. For example, a steel girder without shear connectors is assumed to act non-compositely with the concrete deck. Experiments have shown that a girder without shear connectors will have a portion of the composite action of a girder with shear connectors. Stiffness provided to the deck by concrete barriers aids in distributing live load. The cumulative effects of these assumptions may result in actual safe load carrying capacity to be significantly larger than that calculated by analysis. These conservative assumptions are generally good in that they provide a safe conservative approach and simplify the analysis.

For some critical structures, it may be desirable to establish a higher safe load carrying capacity. The following types of structures are candidates for load testing:

(A) Bridges that restrict the flow of overweight vehicles.
(B) Bridges that are posted for weight restrictions.
(C) Bridges that are difficult to analyze.
(D) Bridges for which plans are not available.

2.4.2 Load Test Candidate List

Periodically, the Bridge Evaluation Engineer in coordination with the District Structures and Facilities Engineers will develop a list of candidate bridges for load testing. Following is the process for the development of the load test candidate list

(A) The District Structures and Facilities Engineers will develop a list of bridges for load testing.

(B) The District Structures and Facilities Engineer should assign a priority order to this list and submit the list to the Bridge Evaluation Engineer who will compile a statewide list of bridges to be load tested, possibly adding bridges to the list considering routing and permitting requirements.

(C) The Bridge Evaluation Engineer will send the statewide list to the Structures Research Center.

(D) The Structures Research Center will schedule the load tests with the Districts using the established priority ranking modified to reduce travel time from site-to-site.

(E) The Structures Research Center will send the load test report within 60 days of completion of the field load test to the District Structures and Facilities Engineer with copies to the State Bridge Evaluation Engineer. If it is anticipated that the evaluation requires more time due to the complexity of the analyses performed, the Structures Research Center will provide a written notification to the Office of Maintenance including the anticipated date until completion.

(F) The District Structures and Facilities Engineer will within 14 days enter the ratings from the load test reports into the database and Section D (Load Rating) of the Bridge Record.

2.4.3 Load Test Reports

Load Tests shall be performed in conformance with the direction provided in ***the current version*** of the ***"Structures Manual"***. The Structures Research Center will verify that the load tested span(s) control the load rating for the structure. Results should be obtained for a single lane loaded and then 2 lanes loaded simultaneously. The results obtained for single versus double lane loadings are important for permitting decisions. If a load test is performed on a bridge having a twin structure, the Research Center will state if the results apply to both structures. The load test report should at a minimum contain the following information, determined during the load test or assumed during the analysis of data gathered during the load test:

(A) Date load test performed.

(B) Brief description of bridge and condition.

(C) Controlling span and length.

(D) Rating controlled by shear, positive moment, or negative moment or other.

(E) Controlling element.

(F) Impact factor.

(G) Live load distribution factor.

(H) Truck(s) used for load test.

(I) General assumptions made.

(J) Load test static or dynamic.

(K) Available live load moment and shear.

(L) Applied moment and shear.

(M) Ratings for HS20 vehicle(s) as well as HL93 vehicle(s) and all Florida legal trucks.

(N) Longitudinal location of controlling axle. For GFS (Girder – Floor-Beam - Stringer) systems as well as for postensionned Segmental bridges, transverse location of controlling axles.

(O) Signature and Seal of the professional engineer performing the load test

SECTION 3 – HIERARCHY OF ANALYSIS AND TESTING

3. GENERAL

The level of analysis chosen is a trade off between sophistication of analysis and required work effort. The simpler methods are chosen as a first choice due to the need to analyze many structures with limited resources. When this analysis yields satisfactory results, there is no need to perform a more sophisticated analysis. Satisfactory results would be the establishment of a safe load carrying capacity that does not require posting the structures and does not unduly restrict the flow of permitted overweight trucks. A more sophisticated analysis is justified to avoid posting the bridge or to ease restrictions on the flow of permitted overweight trucks.

3.1 ROUTINE ANALYSIS WITH LINE MODEL PROGRAMS

This model assumes the structure acts as separate lines, in a girder-slab structure, each girder is basically assumed to act independently with limited distribution between the girders. The advantages of this model are that it is relatively easy to apply and that the computer generated output is easy to check long hand. Load distribution is achieved by use of the LLDF (live Load distribution factor). The VIRTIS program is a line model program.

3.2 ANALYSIS WITH 2D OR 3D PROGRAMS

This model looks at the structure globally and treats a girder-slab structure as a system using finite element methods. The SALOD program approximates this by comparing the structure to stored finite element solutions. The BRUFEM program is a sophisticated program that creates a finite element model of the structure to analyze and rate the structure.

3.3 LIMITED MATERIAL TEST TO AUGMENT ANALYSIS

When analysis is performed, certain minimum material properties are assumed based on design criteria or assumed material properties based on year of construction. Actual material properties may be significantly better due to suppliers exceeding minimum standards, concrete increasing in strength with age, or structures material properties being higher grade that assumed. Therefore, testing material may result in higher material property values thus increasing the rating of the structure. Conversely, the opposite of the above statement is true for deteriorated conditions

3.4 FULL SCALE LOAD TEST

The load test procedure is a process where a structure is instrumented and then subjected to a known test load which is progressively increased. This determines the safe carrying capacity by measuring the actual load the structure can carry without distress. Since even the most sophisticated analysis contains assumptions, this method is the most accurate. However, the process is expensive and time consuming and therefore should be selected judiciously. For a structure to be load tested it must be on the load test candidate list.

SECTION 4 – WORKING RESPONSIBILITIES

4. DISTRICT STRUCTURES AND FACILITIES OFFICE

The responsibilities of the District Structures and Facilities Office are:

(A) Perform load ratings.

(B) Administer consultant contracts performing load ratings. Review Load ratings prepared by consultants for new and existing bridges.

(C) Enter results of load ratings into the database and Section D (Load Rating) of the Bridge Record. Final load ratings should be entered into the database within 90 days of final Acceptance by Construction for State bridges and 180 days for Local Government bridges. All Districts shall obtain the initial design load rating performed at 90 % of the Design phase from the Engineer of Record and enter the data in Pontis within 14 days from acceptance by construction. If no initial Design Load rating is available, or if the District deems the load rating not to be applicable to the current condition, the bridge will be restricted to legal load traffic and no permitted vehicles will be permitted to cross. In case the District recommends that overweight vehicles cross a bridge for which no load rating is provided yet, the District shall contact the EOR and provide to the office of Maintenance and the State Bridge Evaluation Engineer a written notification of the temporary load rating recommendations In this case for bridges load rated using the LRFR method, FL120 rating will be provided. For bridges rated with any other method, a temporary HS20 rating will be provided at the operating level. When changing conditions require a new load rating, the new load rating data should be entered into the database within 90 days for state bridges and 180 days for local government bridges. District should make every attempt to incorporate the load rating performed at the end of the design phase into the Bridge Database (Pontis) as soon as the bridge is opened to traffic to enhance mobility.

(D) Recommend bridges to be load tested to the office of Maintenance for coordination and prioritization.

(E) For State bridges, Immediately Inform in writing the Office of Maintenance and the State Bridge Evaluation Engineer of any decrease in load rating capacity (HS20 operating rating level for all rating methods excluding LRFR, and FL120 for LRFR) exceeding 3 % of the original value. reductions or increases of the safe load

carrying capacity of structures immediately. Update the capacity information in the bridge database (Pontis) immediately.

(F) Initiate requests for load postings and removal of load postings.

(G) Maintain bridge design plans as-built plans and shop drawing inventory.

(H) Review bridge inspection reports to determine when reanalysis is required.

(I) Once a year, in a format acceptable to Office of Maintenance, update and maintain the district county bridge maps and provide copies to the Office of Maintenance.

(J) Provides information to the Road Use Permit Office to determine potential conflicts of a temporary nature to moving oversized/overweight vehicles (see section 9).

4.1 OFFICE OF MAINTENANCE

The responsibilities of the Office of Maintenance are:

(A) Quality assurance review.

(B) Establish procedures.

(C) Training.

(D) Assist Districts and Road Use Permits Office when requested.

(E) Act on software computer program malfunctions for Virtis.

(F) Inform districts of new procedures and concerns.

(G) Review load posting and load posting removal requests.

4.2 STATE STRUCTURES DESIGN OFFICE

The responsibilities of the State Structures Design Office are:

(A) Assist the State Maintenance Office in establishing load rating procedures.

(B) Propose analysis programs.

(C) Revisions and updates to the AASHTO LRFR Manual (Volume 8 of the Structures Manual.

(D) Address software malfunctions in software approved by the State Structures Design Office.

(E) Quality Assurance review based on new proposed software or methods

SECTION 5 – COLLECTION OF EXISTING DATA

NOTE: ***The first step is the collection of relevant existing data required to perform the load rating.***

5. EXISTING PLANS

Existing plans are used to determine loads, bridge geometry, section and material properties. Design plans are created by the designer and used as a contract document for bidding the job. Certain structures (generally flat slab bridges and culverts) are built from standard drawings. These standard drawings have been changed and revised over time. The specific standard drawings used for construction are generally identified in the roadway plans for the project under which the bridge was built. Construction record plans (as-built plans) are contract design plans which have been modified to reflect changes made during construction. Shop drawings are also useful sources of information about the bridge. Plans may not exist for some bridges. In these cases field measurements will be required.

5.1 INSPECTION REPORTS

Inspection reports must be reviewed prior to load rating to determine if there is deterioration or other damage present that may change the carrying capacity of the structure and whether or not the load rating in the file is valid.

5.2 OTHER RECORDS

Other appropriate bridge history records, such as repair or rehabilitation plans, should be reviewed to determine their impact on the load carrying capacity of the structure.

SECTION 6 – LOAD RATING VEHICLES

6. VEHICLES USED WITH THE LOAD FACTOR RATING METHOD (LFR) (See *Table 6-1*)

Each load factor rating will include the following:

(A) HS20 (lane or truck which governs the rating) at the operating and inventory level

(B) SU4, C5 and ST5 Legal trucks at the operating level (Florida legal vehicles).

(C) If the SU4 or C5 or ST5 Legal Load ratings are less than one; ratings at operating level may be required for SU2, SU3, C3 and C4**.**

6.1 VEHICLE USED WITH THE LOAD AND RESISTANCE FACT0R RATING METHOD (LRFR) (See *Table 6-1*)

(A) HL93 at the Design Operating and Inventory level

(B) SU4, C5 and ST5 Legal trucks at the operating level if the rating factor for HL 93 is less than 1.0

(C) If the SU4 or C5 or ST5 Legal Load ratings are less than one, ratings at operating level may be required for SU2, SU3, C3 and C4.

(D) FL120. This rating is required for permitting operations at both strength and service levels.

6.2 TRANSITION FROM LFR TO LRFR METHODS

During the transition, software, procedures and manual have to be updated. Temporarily, if the LRFR rating result for HL93 (Design Inventory and operating levels) is expressed as a factor, the value entered in the bridge database (pontis) should be the rating factor multiplied by 36 tons. If the results are already expressed as tonnage, enter directly the value obtained into the bridge database. The value for the FL120 should be entered as soon as the field is available in the bridge database. It is paramount that the proper rating method be accurately included in the bridge database. Error in the input may generate bridge overloading.

CONVERSION OF RATING VEHICLES

The following process used to convert an HL-93 rating to another truck type assumes that the bridge is a simple span bridge controlled by bending. This process might not be valid to convert to FL120 ratings as the number of lane loaded with the same truck is different. First Using one of the truck types defined in Tables 6-1 and 6-2 determine the percent of HL-93 design load for the same span length as the rated bridge. Second, divide the HL-93 rating factor by the table value for the truck type in question and multiply this ratio by the GVW weight of the truck type in question. Follow the same procedures for conversion of other trucks using ***Tables 6.1 and 6.3.***

Example:

105' simple span controlled by bending and the HL-93 rating factor is 1.0.

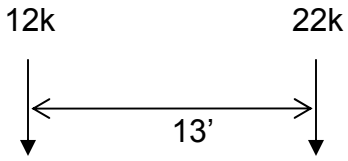
Determine the GVW equivalent rating capacity of an SU4 truck.

$$\frac{1.0}{.66}(35\text{t}) = 53 \text{ tons}$$

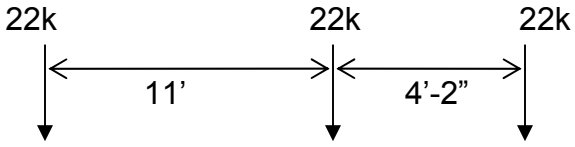
TABLE 6-1
TRUCK AXLE AND WEIGHT CONFIGURATIONS

TRUCK TYPE **AXLE WEIGHTS AND SPACINGS**

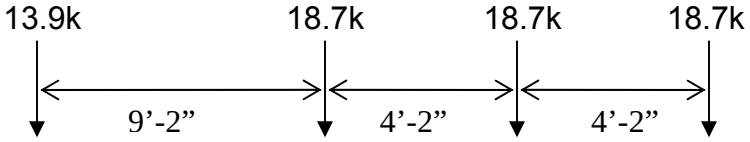
SU 2
34k



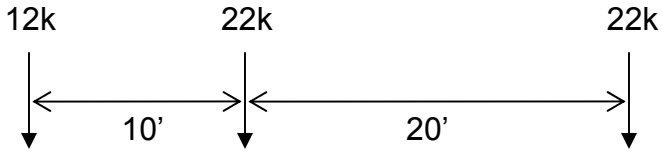
SU 3
66k



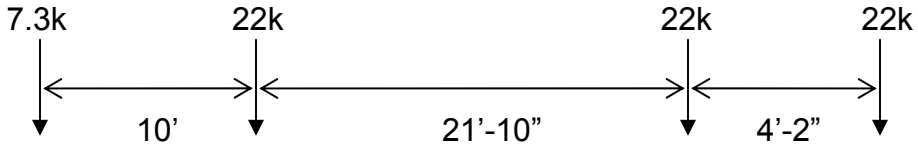
SU 4
70k



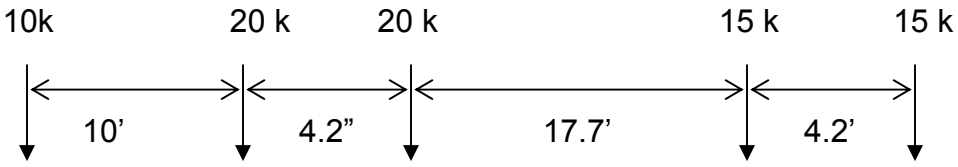
C 3
56k



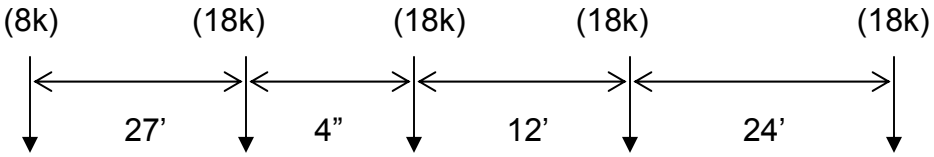
C 4
73.3k



C 5
80.0 k



ST5
Tandem
Trailer
80k



FL120
Permit
Vehicle
120k

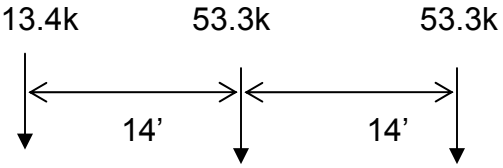


TABLE 6-2

MAXIMUM MOMENT COMPARISON OF TRUCK LOADS COMPARED TO HL-93 DESIGN LOAD FOR SIMPLE SPANS IN TERMS OF A FRACTION OF THE HL-93 LOADING

SPAN LENGTH	SU2	SU3	SU4	C3	C4	C5	STD TRCTR TRLR	TANDEM TRAILER	FL120 Permit Vehicle
15	0.52	.77	.83	.52	.77	.7	.64	.64	1.27
25	.45	.79	.87	.5	.73	.7	.61	.63	1.1
35	.46	.84	.91	.50	.70	.71	.60	.68	1.23
45	.44	.82	.88	.52	.67	.72	.58	.67	1.28
55	.41	.78	.83	.52	.66	.73	.54	.63	1.25
65	.38	.73	.78	.51	.65	.72	.51	.6	.1.21
75	.37	.7	.75	.51	.65	.72	.54	.61	1.18
85	.36	.68	.72	.5	.64	.71	.56	.61	1.14
95	.34	.65	.69	.49	.63	.69	.56	.61	1.11
105	.33	.63	.66	.48	.62	.68	.57	.62	1.08
115	.31	.61	.65	.47	.6	.67	.56	.60	1.05
125	.31	.59	.63	.46	.59	.65	.56	.6	1.02
135	.3	.57	.61	.45	.58	.64	.55	.58	.99
145	.29	.55	.59	.44	.56	.62	.55	.58	.97
155	.28	.54	.57	.43	.55	.61	.54	.57	.94
165	.27	.53	.56	.42	.54	.59	.53	.56	.92
175	.27	.51	.54	.41	.53	.59	.53	.55	.90
185	.26	.5	.53	.4	.52	.57	.52	.54	.88

195	.25	.49	.51	.39	.51	.56	.51	.53	.86
200	.25	.48	.51	.39	.5	.55	.51	.52	.85

TABLE 6-3

MAXIMUM MOMENT COMPARISON OF TRUCK LOAD CASES TO HS20 DESIGN LOAD FOR SIMPLE SPAN

SPAN LENGTH	SU2	SU3	SU4	C3	C4	C5	STD TRCTR TRLR	TANDEM TRAILER	FL120 Permit Vehicle
15	0.69	1.02	1.09	0.69	1.02	.92	0.84	0.85	1.67
25	0.68	1.20	1.31	0.75	1.12	1.07	.92	0.95	1.67
35	0.62	1.14	1.23	0.67	0.94	0.96	0.82	0.92	1.67
45	0.57	1.07	1.15	0.67	0.87	0.94	0.75	0.86	1.67
55	0.55	1.04	1.11	0.70	0.88	0.98	0.72	0.84	1.67
65	0.53	1.01	1.08	0.71	0.90	1.00	0.70	0.83	1.67
75	0.52	1.00	1.06	0.72	0.92	1.02	0.76	0.86	1.67
85	0.52	0.99	1.05	0.73	0.93	1.03	0.81	0.89	1.67
95	0.51	0.98	1.04	0.74	0.94	1.04	0.85	0.92	1.67
105	0.51	0.97	1.03	0.74	0.96	1.06	0.87	0.94	1.67
115	0.50	0.97	1.03	0.74	0.96	1.06	0.90	0.96	1.67
125	0.50	0.96	1.02	0.75	0.96	1.06	0.91	0.97	1.67
135	0.50	0.96	1.02	0.75	0.97	1.07	0.93	0.98	1.67
145	0.50	0.95	1.01	0.75	0.97	1.07	0.94	0.99	1.66
155	0.47	0.91	0.97	0.72	0.93	1.03	0.92	0.96	1.6

165	0.45	0.88	0.93	0.70	0.90	0.99	0.89	0.93	1.53
175	0.44	0.84	0.89	0.67	0.87	0.96	0.86	0.90	1.48
185	0.42	0.81	0.86	0.65	0.84	0.92	0.84	0.87	1.42
195	0.40	0.79	0.82	0.63	0.81	0.89	0.82	0.85	1.37
200	0.40	0.76	0.81	0.62	0.80	0.88	0.80	0.83	1.35

SECTION 7 – UTILIZATION OF CONSULTING ENGINEERS FOR BRIDGE RATING

7. GENERAL

Consultants may be used for load rating state owned bridges when in-house resources are lacking. Consultants are used to load rate local agency bridges as part of the local government bridge inspection contracts. If conditions are found during the consultant's inspection that would change the load rating of the structure, the Department's project manager may direct the consultant to determine a new load rating for the structure based on the results of the inspection.

7.1 CONTROLS

Consultants shall load rate structures in accordance with this procedure, the current version of the AASHTO ***"Manual for Condition Evaluation of Bridges and LRFR of Highway Bridges ",*** the current version of the Structures Manual, Volume 8, and other documents included and referred to in the contract. Those documents should be reviewed by the consultant to determine if any questions arise from using those manuals and procedures. Questions should be directed in writing to both the Office of Maintenance, State Bridge Evaluation Engineer and the Structures Design Office

7.2 CONSULTANT QUALIFICATIONS

For the load rating of routine structures the consultant must have experience in the design or load rating of bridges. For the load rating of complex structures, the consultant's engineer performing the load rating must have experience in designing that type of structure. Examples of complex structures are segmental concrete bridges, post tensioned bridges, curved steel box girder bridges, curved steel girder bridges, and trusses. If the consultant changes the individual or individuals performing the load rating of a complex structure, the new individual must be approved by the Department's project manager.

SECTION 8 – QUALITY ASSURANCE REVIEW OF LOAD RATINGS

8. GENERAL REQUIREMENTS

The mission of the department is to provide a safe transportation system that ensures the mobility of people and goods. The load rating process recognizes a balance between safety and economics. Both in-house and consultants' load rating results should be checked for accuracy as part of the quality control process. Specifically when the rating for a new bridge is marginal, the rating should be reviewed to determine the reason(s). If the consultant performs the rating, he or she should provide in writing the reason(s) why the rating is marginal. The following reasons are the most commonly recognized reasons for marginal ratings:

(A) The bridge has not been designed to its intended level

(B) Modifications were made during the construction that changed the bridge design level

(C) The load rating is inaccurate

8.1 SPECIFIC CHECK AND REVIEW REQUIRED

8.1.1 Computer Programs

Whenever possible, the load rater should perform long hand checks of a portion of the computer analysis to satisfy the load rater that the computer program is accurate. It is of utmost importance that the load rater understands when computer results are reasonable. Blind faith in any computer program should be avoided.

8.1.2 Checking

An independent check of the analysis shall be performed. When computer programs are used, the checker should verify all input data, verify that the summary of load capacity information accurately reflects the analysis, and be satisfied with the accuracy and suitability of the computer program.

8.1.3 Review

The analysis must be performed under the supervision of a Professional Engineer. If the load rater is not a Professional Engineer, then the Professional Engineer in charge must review the work for accuracy and completeness

8.1.4 Quality assurance review

Each year, the office of Maintenance will perform quality assurance review of the load rating performance for each District. The current schedule, monitoring plan and critical requirements and compliance indicators are included in the Quality Assurance Plan available on the Office of Maintenance website.

8.1.5 Reanalysis

When the condition of a structure changes a reanalysis of the structure may be required. Conditions that may require reanalysis are; structural deterioration, damage due to vessel or vehicular hits or specification changes. Every bridge inspection report and accident report should be reviewed by a person knowledgeable in load rating concepts to determine if reanalysis is required. All bridge inspection reports are to be reviewed by the load rating section. The District Quality Control Plan shall include a method to document that this review is performed for every routine bridge inspection event.

8.1.6 Load Rating File

Computer input and output files, hand calculations, field measurements, catalogs and other pertinent information, used in performing load rating, shall be stored in the load rating file. This will provide easy access for reviewing or revising the load rating.

8.1.7 Bridge Management System Data

The accuracy of this data is vital to the operation of the Road Use Permits Office. Therefore, the load rating section will obtain an output of the ***Comprehensive Inventory Data Report (CIDR)*** after the inspection report has been reviewed. If no reanalysis is required, the load rating section will verify the load rating data for Items 67 and 48. After reanalysis, the load rating section will either update the database or provide the person responsible for updating the database with the proper values and back check the data after the database has been updated.

SECTION 9 – PERMITTING OPERATIONS

One of the most important internal recipient of the load rating information is the Road Use Permit Office which issues permits for overweight-over dimensional vehicles. The traveling public, as well as the commercial trucking industry, are directly impacted by the load rating values in the Pontis database. Based upon this Pontis information, the Office of Maintenance is responsible to make decisions about safe level of permit truck weight allowed to cross the current bridge inventory.

However, to facilitate the mobility of certain types of vehicles and moves, the office of Maintenance consults with the Districts to determine potential conflict of a temporary nature. Examples of such conflict are:

(A) Temporary clearance restriction(s) due to widening

(B) Time of movement occurring during higher levels of daily traffic

(C) Local event generating an unusual level of traffic

The District Maintenance Engineers have designated a single contact person (and a back-up person) to coordinate comments provided on specific moves.

To allow the Permit Office to route vehicles over the inventoried routes, each District office shall provide to the permit office detailed “bridge” maps indicating the location and the number for each bridge included within the District. Each District shall provide to the permit office a set of 2 hard copies of those bridge maps until an electronic format is feasible. Updates to these maps should be provided at least every year.

SECTION 10 – SUMMARY OF RATINGS

After the structure has been load rated FDOT ***Form 850-010-06 "Load Capacity Information"*** shall be completed and placed in ***Section D of the Bridge Record File***. For sample blank forms see ***Figures IX-1*** For sample completed forms see ***Figures IX-2*** This form may be obtained from Volume 8 of the current version the Structures Manual after January First 2007 and will be available in the Department's Forms Library. The form is used for all rating methods.

Instructions for completing ***Bridge Load Capacity Form***:

(A) Check all appropriate items, more than one item may be checked.

(B) Enter all data for all items corresponding to the vehicle type or axle weight for both the longitudinal and transverse capacities. Transverse capacities are generally not required except for box girder construction. Capacities for vehicles SU4, C5 and ST5 do not have to be calculated if the inventory rating for HL-93 is equal to or greater than 1.0.

(C) For the operating rating code the lowest rating (in tons) for each vehicle type.

(D) Enter the span length of the member measured center-line to center-line bearing.

(E) Enter "M" if moment controls. Enter "V" if shear controls. Enter "PT" if principal tension controls.

(F) LLDF is defined as Live load distribution factor.

(G) Enter all additional comments as required to clarify the load capacity calculations.

(H) The responsible engineer will sign and seal the ***"Bridge Load Capacity Summary"*** form.

BRIDGE LOAD CAPACITY SUMMARY

Figure IX-1

BRIDGE DATA

Bridge Number_____
STR Type Main [Item 43]_____
STR Type App [Item 44]_____

POSTING DATA

Current Restrictions_____
Item 41_____
Is Posting Needed_____
Proposed Restrictions_____
Item 70_____
Item 31_____

BASIS FOR ANALYSIS

Design Drawings_____
As-Built Drawings_____
Shop Drawings_____
Field Measurement_____
Coupon Testing_____
Other_____

LIVE LOAD DISTRIBUION

As Indicated on Plans_____
AASHTO LFD_____
AASHTO LRFD_____
SALOD_____
BRUFEM_____
Finite Element on Grillage_____

LONGITUDINAL GOVERINCOMPONENT

Main / Approach Span_____
Description_____
Material_____
Simple / Continuous Span_____
Span Length_____
Flexure, Shear or Principal Tension_____

TRANSVERS GOVERNING COMPONANT

Main / Approach Span_____
Description_____
Material_____
Deck, Box or Substructure_____
Flexure, Shear or Principal Tension_____

COMMENTS BY ENGINEER

Concrete Box Girder Transverse Capacity – Operating Rating (Tons)
Design Loading Inventory Rating Factor_____ Operating Rating Factor____
Single Axle _____ Tandem Axle (Total 2 Axles) _____

Longitudinal Capacity – Operating Rating (Tons)						
Design Loading Inventory Rating Factor_____Operating Rating Factor____						
Vehicle Type	Vehicle GVW	Operating Rating	Span No.	Span Length	M/S or PT	LLDF
SU4						
C5						
ST5						
FL120						

RESPONSIBLE ENGINEER

Name_____
Date_____
Seal

RATING METHOD

LFR_____
LRFR_____

BRIDGE LOAD CAPACITY SUMMARY

Figure IX-2

BRIDGE DATA

Bridge Number 570091 Mid-Bay Bridge
STR Type Main [Item 43] 22119265 (all of bridge)
STR Type App [Item 44] N/A

POSTING DATA

Current Restrictions N/A
Item 41
Is Posting Needed
Proposed Restrictions
Item 70
Item 31

BASIS FOR ANALYSIS

Design Drawings X
As-Built Drawings
Shop Drawings
Field Measurement
Coupon Testing
Other

LIVE LOAD DISTRIBUTION

As Indicated on Plans
AASHTO LFD
AASHTO LRFD Homberg/Single Box
SALOD
BRUFEM
Finite Element on Grillage

LONGITUDINAL GOVERNING COMPONENT

Main / Approach Span Main
Description Post-tensioned box girder
Material Post-tensioned Concrete
Simple / Continuous Span Continuous
Span Length 136 ft.
Flexure, Shear or Principal Tension Flexure

TRANSVERSE GOVERNING COMPONENT

Main / Approach Span Main
Description Post-tensioned Cantilever Wing
Material Post-tensioned Concrete
Deck, Box or Substructure Deck
Flexure, Shear or Principal Tension Flexure

COMMENTS BY ENGINEER

The HL-93 rating is less than 1.0 ; however HS truck longitudinal I rating is 1.48. See Table for transverse capacity at a stress limit of $6\sqrt{f'_c}$

RESPONSIBLE ENGINEER

Name John Doe
Date 12-8-05
Seal

RATING METHOD

LFD
LRFR LRFR with Homberg curves for transverse Single Box Supports all Lanes

Concrete Box Girder Transverse Capacity – Operating Rating (Tons)	
Design Loading Inventory Rating Factor 0.64 Operating Rating Factor 0.98	
Single Axle	20.4
Tandem Axle (Total 2 Axles)	31..2

Longitudinal Capacity – Operating Rating (Tons)

Design Loading
Inventory Rating Factor 0.71 Operating Rating Factor 0.99

Vehicle Type	Vehicle GVW	Operating Rating	Span No.	Span Length	M/S or PT	LLDF
SU4	35	47.25	1/6	136	M	2.0
C5	36.6	57. 1	1/6	136	M	2.0
ST5	40	61.6	1/6	136	M	2.0
HS32	57.6	0.93	1/6	136	M	2.0
T160	80	0.99	1/6	136	M	2.0