

TO: <p style="text-align: center;">SUPERSEDED BY <u>E105-034</u> EFFECTIVE 10/18/2005</p>	<p style="text-align: center;">ENGINEERING INSTRUCTION</p> <p style="text-align: center;">NEW YORK STATE DEPARTMENT OF TRANSPORTATION</p> <p>SUBJECT: Technical Policy and Procedures Manual: Bridge Load Posting Guidelines For State Owned Bridges Subject Code: 7.35-11</p>
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APPROVED: <p style="text-align: center;"><i>[Signature]</i> _____ Acting Deputy Chief Engineer (Structures)</p>	Date: <u>January 21, 1988</u> Supersedes: <p style="text-align: center;">EI 83-57</p>

I. PURPOSE

The purpose of this Engineering Instruction is to provide Bridge Load posting guidelines. Included with these guidelines is a paper entitled Method For Establishing Bridge Load Postings From Load Ratings, which provides a procedure and tables for using load rating analysis values to determine postings. The guidelines are to be used as an aid for determining load postings for State owned bridges.

II. GENERAL

These guidelines are to be used for determining load postings for State owned bridges. Because of the varying nature of structural systems, materials, frequency of loadings and other factors which may affect a load posting, no rigid set of rules can be adopted that would be appropriate in every case. For this reason, these guidelines are intentionally flexible. Engineers determining posting values should be familiar with the materials referenced at the end of these guidelines, as they contain important background information on inspection, analysis, and posting of bridges. The AASHTO Manual for Maintenance Inspection of Bridges is of special significance because it is considered the basic policy for bridge posting in this country. It defines load ratings used for posting bridges including inventory and operating ratings and states that the bridge owner may use either for posting at his discretion. Parties responsible for establishing posting for State owned bridges should also be familiar with the portion of the Manual of Administrative Procedures (MAP) concerning posting. The MAP issuance deals with the administrative aspects of posting bridges, while this document deals with determining at what value to post a bridge.

Although these guidelines allow flexibility in setting the load rating level used to determine posting, bridges should never be posted for loads exceeding the operating rating, or for less than 3 tons. If a bridge is not capable of carrying 3 tons, it should be closed to vehicular traffic.

These guidelines should not be used without first thoroughly reviewing the AASHTO Manual and all NYSDOT issuances relating to bridge rating and posting.

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III. INSPECTION

Bridges being investigated for possible load posting should be inspected in the field to verify the accuracy of existing plans, should they exist, or to determine section properties and other basic data if plans do not exist. In either case, the Inspector should make a careful field check of dead loads, including deck and overlay thickness and check for the presence of utilities. The Field Inspector should also make a careful check for deterioration, substructure problems, and other forms of distress that could affect the capacity of the bridge. This is especially important when evaluating metal superstructures, where measurement for section loss must be made and a close visual inspection must be performed in tension areas likely to develop cracks.

IV. STRENGTH EVALUATION

The field investigation should be made in conjunction with a Level 1 analysis of the bridge superstructure. Refer to EI88-4 Technical Policy and Procedures Manual: Load Rating of Bridges for a definition of a Level 1 analysis. This analysis should include all elements of the bridge superstructure defined as "primary members" in the New York Bridge Inspection Manual 82. It is not necessary to analyze concrete bridge decks and a bridge should not be posted based on an analysis of a concrete deck. Metal and timber decks should be analyzed and postings may be necessary depending on their calculated capacity. The vehicles used for analysis purposes shall be the HS20 and H20 vehicles. If it is determined that no posting is required when an HS20 truck is used, there is no need for further analysis. However, if the analysis for an HS 20 truck indicates a possible need for posting, the bridge shall also be analyzed for an H type vehicle. The H vehicle rating is required for the posting evaluation procedure presented in this instruction.

Occasionally, the evaluating engineer may determine that a full-scale load test would be beneficial in making a posting determination. When this is done, the testing should include the use of vehicles of known weight distribution and field measurement of induced strains used to determine inventory and operating levels. The results of the tests may be used to establish a posting, even if the results are different from those determined by an analytical approach.

Unless unusual conditions exist, concrete and masonry substructures do not have to be analyzed when investigating the need for posting. Metal substructure elements, such as metal piers, should be analyzed. In some cases, substructure conditions such as scour, loss of support for bearings, tilting, or other deficiencies may govern the posting of a bridge. When this occurs, posting will be subjective in nature and a precise analysis cannot be performed.

Both working stress and load factor analysis are acceptable methods for determining rating values. The engineer performing the evaluation will determine the method to be used. Different methods of analysis can be used for different structural elements on the same bridge.

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V. SIGNING

Signing shall be done in conformance with the current Manual of Uniform Traffic Control.

VI. DETERMINING POSTING VALUES

Refer to the Method For Establishing Bridge Load Postings From Bridge Ratings.

1. Special Case: Concrete Superstructure with no Plans Available:

When an analysis cannot be performed because there are no plans and the concrete superstructure has been carrying legal loads without inducing visual signs of distress, it is not necessary to post the bridge based on superstructure capacity.

VII. DOCUMENTATION

- A. All Bridges - The party initiating the posting or change in posting shall notify the Regional Structures Engineer, in writing, about the posting change. The Regional Structures Engineer will update the inventory file to reflect the change. If a bridge receives a full-scale load test, a report shall be prepared describing testing procedures, measured structural response, and conclusions drawn. A copy of this report should be forwarded to the Bridge Inspection Unit of the Structures Division.
- B. State Owned Bridges - Copies of all correspondence relating to the determination for the need for posting including calculations, inspection reports, full-scale testing reports, etc., shall be placed in the State Bridge Identification (BIN) File. Refer to the current portion of the Manual of Administrative Procedures for other administrative details on posting.
- C. Other Bridges - Should a bridge owner other than the State elect to use these guidelines the following applies. Copies of all correspondence relating to the determination for the need for posting including calculations, inspection reports, full-scale testing reports, etc. shall be placed in the owner's BIN File. Copies of this material would be forwarded by the bridge owner to the Regional Structures Engineer for inclusion in the State's copy of the Bridge Identification (BIN) File.

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References:

1. Manual for Maintenance Inspection of Bridges 1983 by American Association of State Highway Transportation Officials.
2. Bridge Inspection Manual 82, by NYSDOT
3. Technical Policy and Procedures Manual: Load Rating of Bridges by NYSDOT (E.I. 88-4)
4. New York State Standard Specifications for Highway Bridges by NYSDOT
5. New York State Manual of Administrative Practices, subject Closing or Posting of State Owned Bridges.

METHOD FOR ESTABLISHING BRIDGE LOAD POSTINGS FROM LOAD RATINGS

GENERAL:

The following method requires that the load ratings used are computed in accordance with the provisions of the AASHTO "Manual for Maintenance Inspection of Highway Bridges" and the New York State D.O.T. "Standard Specifications for Highway Bridges. These specifications, especially the provisions for load distribution and allowable stresses or capacities, provide for the implicit margins of safety on which this posting procedure is based. Either the service load (working stress) or load factor methods of analysis, as described in these specifications, may be used to determine the load rating.

Typically, all primary load carrying members must be load rated and evaluated for posting. The member or component with the lowest load rating will normally produce the posting value.

This posting evaluation procedure, specifically the criteria given for setting safe load capacity levels, is not intended to be applied to load ratings determined by direct measurements (e.g. load tests). Load test results require posting evaluations on an individual basis depending on the nature of the test and type of structure.

Briefly the procedure consists of the following parts:

1. Selecting an acceptable stress or capacity level to compute a Safe Load capacity rating. An acceptable stress level is one to which the bridge component can be safely subjected on a repetitive basis in its current condition.
2. Establishing the relationship between the "Design" vehicles which are used to compute load ratings and the actual loads applied to the bridge.

Safe Load Capacity (SLC):

This is a load rating value that is based on the stress level deemed acceptable to safely carry actual traffic loads. If the safe load capacity equals or exceeds the load rating equivalent of a legal load, the bridge does not need to be posted. Safe load capacities normally can be set between the limits defined by the inventory rating and the operating rating, with the operating rating being the upper limit.

Guidelines for Setting Safe Load Capacities:

Note: The following guidelines are for selecting a Safe Load Capacity based on computed Inventory and Operating Rating values. The relationship between the SLC and Inventory and Operating Ratings is primarily a function of the structure or member type and its structure condition.

A. SLC or at near the Inventory Rating (See Note A):

1. Steel main members that are both internally and load path non-redundant:
 - Welded girders, or rolled beams with partial length welded cover plates, on 2 or 3 girder bridges.
 - Truss members consisting of one or two (pinned) eyebars or threaded rods.
 - Truss members on fully welded trusses.
 - Pin and hanger girder connections.
 - Floorbeam hanger connections.
2. All Steel members with extensive loss of section in highly stressed regions in tension or shear.

Note A: For bridges in this category, the safe load capacity may be set at the inventory rating, or 60 percent of the operating rating, whichever is higher.

B. SLC at the midpoint between Inventory and Operating Ratings (See Note B):

1. All load path redundant steel members, including welded, riveted or rolled stringers and multi-girders.
2. All internally redundant members regardless of load path redundancy, including:
 - Riveted or rolled truss members
 - Riveted through or deck main girders
 - Rolled 2 girder bridges without partial length cover plates
3. All steel floorbeams and floorsystem stringers.
4. All concrete beam or slab members.

Note B: These members may, at the discretion of the evaluating engineer, have their safe load capacity increased to one of the following:

- a). $\text{Inv.} + \frac{2}{3} (\text{Oper.} - \text{Inv.})$, provided the ratings were computed using the service load (working stress) method of analysis.
- b). 80% of the operating rating.

The above SLC increases beyond the Inv. - Oper. midpoint shall not normally apply to floorbeams supporting timber or other non-rigid decks, or to load path non-redundant members, unless it can be demonstrated that the computed maximum loads would occur on an infrequent basis. Specific cases where infrequent maximum loadings will occur are bridges having excess roadway width, where the "specification" rating is computed assuming an eccentric load positioning which does not conform to the normal position of the traffic lanes.

C. SLC up to the Operating Rating.

1. This may be allowed for load path redundant members in good condition and floor systems where it can be demonstrated that there is capacity above that computed by the Load Rating Specification assumptions. This added capacity is normally attributed to excess roadway widths in comparison to the actual number of travel lanes and/or sufficient redundant members. A posting decision can be based on operating rating if it can be shown that there is at least 125% of equivalent legal load capacity available due to excess width or redundancy.

Example

Assume a 5 girder multi-girder bridge with girder spacing at 9'-6". The bridge carries 3 traffic lanes. To compute the girder load rating, the spec. live load distribution factor to each girder is

3 interior: $S/11 = 9.5/11 = .863$ lanes/girder	$\times 3 = 2.59$
2 fascia: $0.5(S)/(4 + 0.25S) = .745$	$\times 2 = 1.49$
	<u>4.08</u>

4.08/3 lanes actual: 1.36 G.T. 1.25
Thus operating rating can be used.

2. Values approaching the operating rating may be used for box or H shaped compression chords of trusses, provided they are in good condition with no signs of lateral movement, and have sound lateral support at the interval assumed in the rating analysis.

The SLC limits set forth in these guidelines are not intended to be entirely rigid. The evaluating engineer may exceed these limits based on engineering judgement or factors unique to the bridge, provided that the rationale for doing so is documented in the posting analysis. In no case, however, shall the Safe Load Capacity exceed the Operating Rating. Conversely, individual situations may warrant using lower SLC values than those presented in these guidelines.

Equivalent Legal Load

Although an equivalent legal load could be determined for any "design" rating vehicle, this procedure uses the AASHTO "H" - loading, since it gives more consistent results and can be applied more directly to posting loads than can the "HS" loading. For this procedure, the AASHTO H loading also includes the equivalent H lane loading.

The "H" - loading equivalents to legal loads are given in Table 1. Note that the H equivalent varies with the Effective Span of the member being load rated. The effective span is, by definition, the length of the live load influence line for the member action (moment, shear, etc.) that the member's rating is based on.

To simplify, the following lengths can be considered as the effective span.

<u>Member Type</u>	<u>Effective Span</u>
1. simple span stringers, girders	span length
2. continuous span stringers, girders	
a) positive moment, shear	span length
b) negative moment only	avg. of adj. spans
3. floorbeams	
a) end floorbeam	adj. stringer or panel length
b) intermediate floorbeams	sum of 2 adj. stringer spans or panel lengths
4. trusses	
a) chords, end posts	total span length
b) interior diagonals	included panel length + sum of panels to further support.
c) verticals	
1) floorbeam hanger or posts only	same as floorbeam
2) part of truss web	sum of panels to further support + 1 panel on other side.

Setting Posting Loads

IF THE SAFE LOAD CAPACITY RATING IS LESS THAN THE EQUIVALENT LEGAL LOAD FOR THE EFFECTIVE SPAN LENGTH AS SHOWN IN TABLE 1, THEN THE BRIDGE MUST BE POSTED FOR LOAD.

Posting levels are determined from the Safe Load Capacity ratings. If the Safe Load Capacity indicates that a bridge must be posted, consideration should be given to reducing the Safe Load Capacity to a more conservative level for determining the actual posting level. The reasons for this are (1) actual vehicle loadings at or near the posted load will be more frequent, thus there will be more stress repetition at the Safe Load Capacity level, than there would be for full legal loads on a non-posted bridge and (2) the probability of an illegal overload is greater on a posted bridge, than on one capable of carrying legal loads.

When determining a posting value, the Safe Load Capacity, should not exceed the midpoint between the inventory and operating ratings, unless it can be demonstrated that there exists excess capacity beyond that computed using the rating analysis specifications.

Table 2 is used to convert Safe Load Capacity rating to single value posting weights based on actual vehicle configurations. To determine posting from this Table, simply find the value that corresponds to the Safe Load Capacity "H" rating value and the Effective Span length.

Although portions of Table 2 provides postings to the nearest ton, it is recommended that the postings actually used be rounded down to one of the following frequently used values:

3 tons	10 tons	20 tons
4 tons	12 tons	22 tons
5 tons	15 tons	25 tons
8 tons	18 tons	30 tons

The more "exact" number from the Table may be used if it will permit a certain type vehicle to use the bridge, in order to meet a specific local traffic need.

Posting Procedure Summary:

Step 1: Compute the H-vehicle Inventory and Operating Ratings and determine which member controls.

Step 2: Determine the Safe Load Capacity rating (SLC) level for the member(s) with the controlling inventory and operating rating(s). Setting the SLC involves judgement; and it must account for structure type, condition, and load frequency.
Note: The SLC cannot exceed the operating rating.

Step 3: Determine the Effective Span of the member being analyzed; which equals the length of the live load influence line for the rated member.

Step 4: Use Table 1 to determine whether a bridge needs to be posted. Compare the SLC with the "Equivalent H-Rating" for the appropriate Effective Span. If the SLC is Less than the Equivalent H-Rating the bridge needs to be posted.

Step 5: If Step 4 indicates posting is needed, use Table 2 to determine the posting value. The posting value, in tons, is found at the intersect of the "Safe Load Capacity" column and "Effective Span" row.
Note: A bridge cannot be posted for less than 3 tons.

TABLE 1

"H" - LOADING EQUIVALENT TO LEGAL LOADS

<u>Effective Span Length</u>	<u>Equivalent H-Rating</u>
Up to 12 ft.*	H-16
13 ft. - 19 ft.*	H-18
20 ft. - 34 ft.	H-22
35 ft. - 45 ft.	H-23
46 ft. - 53 ft.	H-24
54 ft. - 75 ft.	H-25
76 ft. - 90 ft.	H-24
91 ft. - 105 ft.	H-23
106 ft. - 120 ft.	H-22
121 ft. - 140 ft.	H-21
over 140 ft.	H-20

TABLE 2

POSTING VALUES (TONS)

"Safe Load Capacity" (H-Rating Value)

<u>Eff. Span Length</u>		<u>3-9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>
Up to 12 ft.*		12	15	16	18	20	22	--									
13 ft. - 19 ft.*		10	12	14	15	16	18	20	22	--							
20 ft. - 34 ft.		10	12	12	14	15	16	16	18	18	20	22	22	--			
35 ft. - 45 ft.	Use	10	11	12	13	14	15	16	18	18	20	20	22	22	--		
46 ft. - 53 ft.	H	10	11	12	13	14	15	16	17	18	19	20	22	22	24	--	
54 ft. - 64 ft.	Rating	10	11	12	13	14	15	16	17	18	19	20	22	22	24	25	--
65 ft. - 75 ft.	Value	10	12	12	14	15	16	16	18	20	20	22	22	24	25	25	--
76 ft. - 90 ft.	(Tons)	10	12	14	15	16	18	18	20	20	22	24	25	25	25	--	
91 ft. - 105 ft.		10	12	15	16	16	18	20	22	22	24	25	25	28	--		
106 ft. - 120 ft.		12	14	15	18	18	20	22	22	25	25	28	28	--			
121 ft. - 140 ft.		12	16	18	20	20	22	25	25	28	28	30	--				
> 140 ft.		12	16	18	20	20	22	25	25	28	30	--					

* Generally applies to floorsystem members (stringers and floorbeams) only.

Note: When using Tables 1 and 2, H-Ratings shall be computed using either the H truck or lane loading, whichever is greater.