Appendix E - FHWA Coding Guide Excerpts

This Appendix presents excerpts from the FHWA Recording and Coding Guide for the Structure Inventory and Appraisal of the Nations Bridges, December 1995, describing the algorithms for calculating the following items:

1. NBI Structural Evaluation
2. NBI Deck Geometry
3. NBI Underclearances, Vertical and Horizontal
4. NBI Waterway Adequacy
5. NBI Approach Roadway Alignment
6. Sufficiency Rating
7. Structurally Deficient
8. Functionally Obsolete

NBI Items 67, 68, 69, 71, and 72 - Indicate the Appraisal Ratings

The items in the Appraisal Section are used to evaluate a bridge in relation to the level of service which it provides on the highway system of which it is a part. The structure will be compared to a new one which is built to current standards for that particular type of road as further defined in this section except for Item 72 - Approach Roadway Alignment. See Item 72 for special criteria for rating that item.

Items 67, 68, 69, 71, and 72 will be coded with a 1-digit code that indicates the appraisal rating for the item. The ratings and codes are as follows:

Code	Description
N	Not applicable
9	Superior to present desirable criteria
8	Equal to present desirable criteria
7	Better than present minimum criteria
6	Equal to present minimum criteria
5	Somewhat better than minimum adequacy to tolerate being left in place as is
4	Meets minimum tolerable limits to be left in place as is
3	Basically intolerable requiring high priority of corrective action
2	Basically intolerable requiring high priority of replacement
1	This value of rating code not used
0	Bridge closed

The FHWA Edit/Update computer program calculates values for Items 67, 68, and 69 according to the tables provided in this manual. These tables and the table for Item 71 shall be used by all evaluators to rate these items. They have been developed to closely match the descriptions for the appraisal evaluation codes of 0 to 9. The tables shall be used in all instances to evaluate the item based on the designated data in the inventory, even if a table value does not appear to match the descriptive codes. For unusual cases where the site data does not exactly agree with the table criteria, use the most appropriate table to evaluate the item. The code of N is not valid for use with Items 67 and 72.

Completed bridges not yet opened to traffic, if rated, shall be appraised as if open to traffic. Design values, for example ADT, shall be used for the evaluation. The data provided will include a code of G for Item 41 - Structure Open, Posted, or Closed to Traffic.

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NBI ITEM 67: Structural Evaluation

This item is calculated by the Edit/Update Program based on Table 1, and need not be coded by the bridge inspector. The following specifications are used by the Edit/Update Program:

- For structures other than culverts, the lowest of the codes obtained from Item 59 - Superstructure, Item 60 - Substructure, or Table 1 is used.
- For culverts, the lowest of the codes obtained from Item 62 - Culverts, or Table 1 is used.
- If Item 59, Item 60 or Item 62 is coded 1, then Item 67 is equal to zero (0), regardless of whether the structure is actually closed. However, if the structure is closed, it does not mean that this value is zero (0) unless the overall condition and appraisal ratings indicate that a code of 0 is appropriate.

Table 1 Notes:

1. Use the lower rating code for values between those listed in the table.
2. Inventory Ratings are shown in metric tons with decimal point.
3. To use Table 1, the Inventory Rating must be the coded MS rating or its equivalent. If the comparable MS equivalent is not calculated for the controlling rating, using a factor to determine the MS equivalent is acceptable even though converting other rating loads to an MS equivalent is not a constant.
4. All bridges with Item 26 - Functional Class coded Interstate, Freeway or Expressway shall be evaluated using the ADT column of >5000 regardless of the actual ADT on the bridge.

Table 1. Rating by Comparison of ADT - Item 29 and Inventory Rating - Item 66

Structural Evaluation Rating Code	Inventory Rating		
	Average Daily Traffic (ADT)		
	0-500	501-5000	>5000
9	>32.4 (MS18)*	>32.4 (MS18)	>32.4 (MS18)
8	32.4 (MS18)	32.4 (MS18)	32.4 (MS18)
7	27.9 (MS15.5)	27.9 (MS15.5)	27.9 (MS15.5)
6	20.7 (MS11.5)	22.5 (MS12.5)	24.3 (MS13.5)
5	16.2 (MS9)	18.0 (MS10)	19.8 (MS11)
4	10.8 (MS6)	12.6 (MS7)	16.2 (MS9)
3	Inventory rating less than value in rating code of 4 and requiring corrective action.		
2	Inventory rating less than value in rating code of 4 and requiring replacement.		
0	Bridge closed due to structural condition.		

*MS Designation (typical)

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NBI ITEM 68: Deck Geometry

This item is calculated by the Edit/Update Program and need not be coded by the bridge inspector. The overall rating for deck geometry includes two evaluations: (a) the curb-to-curb or face-to-face of rail bridge width using Table 2A, B, C or D and (b) the minimum vertical clearance over the bridge roadway using Table 2E. The lower of the codes obtained from these tables is used by the Edit/Update Program. When an individual table lists several deck geometry rating codes for the same roadway width under a specific ADT, the lower code is used. (For example, Table 2A lists deck geometry rating codes of 6, 7 and 8 for a 13.4 meter roadway width and an ADT of >5000. Use the code of 6.) For values between those listed in the tables, the lower code is used.

The curb-to-curb or face-to-face of rail dimension shall be taken from Item 51 - Bridge Roadway Width, Curb-to-curb. Item 53 - Minimum Vertical Clearance Over Bridge Roadway is used to evaluate the vertical clearance.

For culverts which have Item 51 - Bridge Roadway Width coded 0000, the Deck Geometry code will be equal to N.

The values provided in the tables are for rating purposes only. Current design standards must be used for structure design or rehabilitation.

Table 2A & 2B. Rating by Comparison of ADT - Item 29 and Bridge Roadway Width, Curb-to-Curb - Item 51

TABLE 2A							TABLE 2B	
Deck Geometry Rating Code	Bridge Roadway Width 2 Lanes; 2 Way Traffic						Bridge Roadway Width 1 Lane; 2-Way Traffic	
	ADT (Both Directions)						ADT (Both Directions)	
	0-100	101-400	401-1000	1001-2000	2001-5000	>5000	0-100	>100
9	>9.8	>11.0	>12.2	>13.4	>13.4	>13.4	-	-
8	9.8	11.0	12.2	13.4	13.4	13.4	<4.9	-
7	8.5	9.8	11.0	12.2	13.4	13.4	4.6	-
6	7.3	8.5	9.1	10.4	12.2	13.4	4.3	-
5	6.1	7.3	7.9	8.5	10.4	11.6	4.0	-
4	5.5	6.1	6.7	7.3	8.5	9.8 (8.5)*	3.7	-
3	4.9	5.5	6.1	6.7	7.9	9.1 (7.9)*	3.4	<4.9
2	Any width less than required for a rating code of 3 and structure is open.							
0	Bridge Closed							

* Use value in parentheses for bridges longer than 60 meters.

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Notes

1. Use the lower rating code for values between those listed in the table.
2. Dimensions are in meters.
3. For 1 lane of one-way traffic Table 2A is used.
4. For 3 or more undivided lanes of 2-way traffic, use Table 2C, Other Multilane Divided Facilities.
5. Do not use Table 2B for code 9 and for codes 8 through 4 inclusive when the ADT >100. Single lane bridges less than 4.9 meters wide carrying 2-way traffic are always appraised at 3 or below if they carry more than an ADT of 100.
6. One-lane bridges 4.90 meters and greater in roadway width, which are not ramps, are evaluated as a 2-lane bridge using Table 2A.

Table 2C & 2D. Rating by Comparison of Number of Lanes - Item 28 and Bridge Roadway Width, Curb-to-Curb - Item 51

TABLE 2C					TABLE 2D	
Deck Geometry Rating Code	Bridge Roadway Width 2 or More Lanes				Bridge Roadway Width 1-Way Traffic	
	Interstate and Other Divided Freeways			Other Multilane Divided Facilities	Ramps Only (Item 5C = 7)	
	2 Lanes 1-way	3 or more Lanes	2 Lanes 1-way	3 or more Lanes	1 Lane	2 or more Lanes
9	>12.8	>3.7N+7.3	>12.8	>3.7N+5.5	>7.9	>3.7N+3.7
8	12.8	3.7N+7.3	12.8	3.7N+5.5	7.9	3.7N+3.7
7	12.2	3.7N+6.1	11.6	3.7N+4.6	7.3	3.7N+3.0
6	11.6	3.7N+4.9	11.0	3.7N+3.7	6.7	3.7N+2.4
5	11.0	3.7N+4.3	10.1	3.4N+3.0	6.1	3.7N+1.8
4 4	10.4 (8.8)*	3.4N+3.7 (3.4N+2.1)*	9.1 9.1	3.4N+1.8 3.4N+1.8	5.5 5.5	3.7N+1.2 3.7N+1.2
3 3	10.1 (8.5)*	3.4N+3.4 (3.4N+1.8)*	8.2 8.2	3.4N+1.5 3.4N+1.5	4.9 4.9	3.7N+0.6 3.7N+0.6
2	Any width less than required for a rating code of 3 and structure is open.					
0	Bridge Closed					

* Use value in parentheses for bridges longer than 60 meters.
N = Total number of lanes of traffic on the structure.

Notes
1. Use the lower rating code for values between those listed in the tables.
2. Dimensions are in meters.
3. Use Table 2C, Other Multilane Divided Facilities, for 3 or more undivided lanes of 2-way traffic.

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Table 2E. Rating by Comparison of Minimum Vertical Clearance over Bridge Roadway - Item 53 and Functional Classification - Item 26

Deck Geometry Rating Code	Minimum Vertical Clearance		
	Functional Class		
	Interstate and Other Divided Freeways	Other Principal and Minor Arterial	Major and Minor Collectors and Locals
9	>5.18	>5.02	>5.02
8	5.18	5.02	5.02
7	5.10	4.72	4.72
6	5.02	4.41	4.41
5	4.80	4.34	4.34
4	4.57	4.26	4.26
3	Vertical clearance less than value in rating code of 4 and requiring corrective action.		
2	Vertical clearance less than value in rating code of 4 and requiring replacement.		
0	Bridge Closed		

* Use value in parentheses for bridges longer than 60 meters.

Notes
1. Use the lower rating code for values between those listed in the table.
2. Dimensions are in meters.

NBI ITEM 69: Underclearances, Vertical and Horizontal

This item is calculated by the Edit/Update Program and need not be coded by the bridge inspector. Vertical and horizontal underclearances are measured from the through roadway to the superstructure or substructure units, respectively. Code "N" is used unless the bridge is over a highway or railroad. The vertical underclearance is evaluated using Table 3A. The horizontal underclearance is evaluated using Table 3B. The lower of the codes obtained from Table 3A and Table 3B is used by the Edit/Update Program. Bridges seldom are closed due to deficient underclearances, however, these bridges may be good candidates for rehabilitation or replacement. Item 54 - Minimum Vertical Underclearance, Item 55 - Minimum Lateral Underclearance on Right, and Item 56 - Minimum Lateral Underclearance on Left are used to evaluate this item. The functional classification used in the table is for the underpassing route. Therefore, the functional classification is obtained from the record for the route "under" the bridge (see Item 5 - Inventory Route). If the underpassing route is not on a Federal-aid system, is not a defense route, or is not otherwise important, an "under" record may not be available. If no "under" record exits, it is assumed that the route under the bridge is a major or minor collector or a local road for the purpose of using Tables 3A and 3B.

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Table 3A. Rating by Comparison of Minimum Vertical Underclearance - Item 54 and Functional Classification of Underpassing Route - Item 26

Under-clearance Rating Code	Minimum Vertical Clearance			
	Functional Class			Railroad
	Interstate and Other Freeways	Other Principal and Minor Arterial	Major and Minor Collectors and Locals	
9	>5.18	>5.02	>5.02	>7.01
8	5.18	5.02	5.02	7.01
7	5.10	4.72	4.72	6.85
6	5.02	4.41	4.41	6.70
5	4.80	4.34	4.34	6.40
4	4.57	4.26	4.26	6.09
3	Underclearance less than value in rating code of 4 and requiring corrective action.			
2	Underclearance less than value in rating code of 4 and requiring replacement.			
0	Bridge Closed			

Notes
1.Use the lower rating code for values between those listed in the tables.
2.Dimensions are in meters.
3.The functional classification of the underpassing route shall be used in the evaluation. If an "under" record is not coded, the underpassing route shall be considered a major or minor collector or a local road.

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Table 3B. Rating by Comparison of Minimum Lateral Underclearances Right & Left - Items 55 & 56 and Functional Classification of Underpassing Route - Item 26

Under-clear-ance Rating Code	Minimum Vertical Clearance						
	Functional Class						Railroad
	1-Way Traffic				2-Way Traffic		
	Principal Arterial-Interstate, Freeways or Expressways				Other Principal and Minor Arterial	Major and Minor Collectors and Locals	
	Main Line		Ramp				
	Right	Left	Right	Left			
9	>9.1	>9.1	>1.2	>3.0	>9.1	>3.7	>6.1
8	9.1	9.1	1.2	3.0	9.1	3.7	6.1
7	5.5	6.4	0.9	2.7	6.4	3.4	5.2
6	1.8	3.7	0.6	2.4	3.7	3.0	4.3
5	1.5	3.4	0.6	1.8	3.0	2.4	3.4
4	1.2	3.0	0.6	1.2	1.8	1.2	2.4
3	Underclearance less than value in rating code of 4 and requiring corrective action.						
2	Underclearance less than value in rating code of 4 and requiring replacement.						
0	Bridge Closed						

Notes

1. Use the lower rating code for values between those listed in the tables.
2. Dimensions are in meters.
3. When acceleration or deceleration lanes or ramps are provided under 2-way traffic, use the value from the right ramp column to determine code.
4. The functional classification of the underpassing route shall be used in the evaluation. If an "under" record is not coded, the underpassing route shall be considered a major or minor collector or a local road.

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NBI Item 71 - Waterway Adequacy

This item appraises the waterway opening with respect to passage of flow through the bridge. The following codes shall be used in evaluating waterway adequacy (interpolate where appropriate). Site conditions may warrant somewhat higher or lower ratings than indicated by the table (e.g., flooding of an urban area due to a restricted bridge opening). Where overtopping frequency information is available, the descriptions given in the table for chance of overtopping mean the following:
Remote - greater than 100 years
Slight - 11 to 100 years
Occasional - 3 to 10 years
Frequent - less than 3 years

Adjectives describing traffic delays mean the following:
Insignificant - Minor inconvenience. Highway passable in a matter of hours.
Significant - Traffic delays of up to several days.
Severe - Long term delays to traffic with resulting hardship.

Functional Classification

Principal Arterials - Interstates, Freeways, or Expressways	Other Principal and Minor Arterials Collectors	Minor and Major Locals	Description Collectors Code
N	N	N	Bridge not over a waterway.
9	9	9	Bridge deck and roadway approaches above flood water elevations (high water). Chance of overtopping is remote.
8	8	8	Bridge deck above roadway approaches. Slight chance of overtopping roadway approaches.
6	6	7	Slight chance of overtopping bridge deck and roadway approaches.
4	5	6	Bridge deck above roadway approaches. Occasional overtopping of roadway approaches with insignificant traffic delays.

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Functional Classification

Principal Arterials - Interstates, Freeways, or **Expressways**	Other Principal and Minor Arterials **Collectors**	Major and Minor Collectors **Locals**	Description **Code**
3	4	5	Bridge deck above roadway approaches. Occasional overtopping of roadway approaches with significant traffic delays.
2	3	4	Occasional overtopping of bridge deck and roadway approaches with significant traffic delays.
2	2	3	Frequent overtopping of bridge deck and roadway approaches with significant traffic delays.
2	2	2	Occasional or frequent overtopping of bridge deck and roadway approaches with severe traffic delays.
0	0	0	Bridge closed.

NBI Item 72 - Approach Roadway Alignment

Code the rating based on the adequacy of the approach roadway alignment. This item identifies those bridges which do not function properly or adequately due to the alignment of the approaches. It is not intended that the approach roadway alignment be compared to current standards but rather to the existing highway alignment. This concept differs from other appraisal evaluations. The establishment of set criteria to be used at all bridge sites is not appropriate for this item. The basic criteria is how the alignment of the roadway approaches to the bridge relate to the general highway alignment for the section of highway the bridge is on. The individual structure shall be rated in accordance with the general appraisal rating guide described on page 453 in lieu of specific design values. The approach roadway alignment will be rated intolerable (a code of 3 or less) only if the horizontal or vertical curvature requires a substantial reduction in the vehicle operating speed from that on the highway section. A very minor speed reduction will be rated a 6, and when a speed reduction is not required, the appraisal code will be an 8.

Additional codes may be selected between these general values.

For example, if the highway section requires a substantial speed reduction due to vertical or horizontal alignment, and the roadway approach to the bridge requires only a very minor additional speed reduction at the bridge, the appropriate code would be a 6. This concept shall be used at each bridge site. Speed reductions necessary because of structure width and not alignment shall not be considered in evaluating this item.

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Sufficiency Rating Formula and Example

The sufficiency rating formula described herein is a method of evaluating highway bridge data by calculating four separate factors to obtain a numeric value which is indicative of bridge sufficiency to remain in service. The result of this method is a percentage in which 100 percent would represent an entirely sufficient bridge and zero percent would represent an entirely insufficient or deficient bridge.

An asterisk prefix is used to identify a sufficiency rating that was calculated even though some essential data was missing or coded incorrectly. The Edit/Update Program will substitute a value for the unusable data (which will not lower the rating) and calculate the sufficiency rating. The asterisk is dropped when the unusable data is corrected. It is normal that all culverts with Bridge Roadway Width, Curb-to-Curb - Item 51 coded '0000' will have an asterisk prefixed sufficiency.

Sufficiency Rating Formula

1. Structural Adequacy and Safety (55% maximum)
   a. Only the lowest rating code of Item 59, 60, or 62 applies.

If Item 59 (Superstructure Rating) or		
Item 60 (Substructure Rating) is	$\leq$ 2 then	A = 55%
	= 3	A = 40%
	= 4	A = 25%
	= 5	A = 10%
If Item 59 and Item 60 = N and		
Item 62 (Culvert Rating) is	$\leq$ 2 then	A = 55%
	= 3	A = 40%
	= 4	A = 25%
	= 5	A = 10%

   b. Reduction for Load Capacity:
   Calculate using the following formulas where IR is the Inventory Rating (MS Loading) in tons or use Figure 2:

   $B = (32.4 - IR)^{1.5} \times 0.3254$ or

   If $(32.4 - IR) \leq 0$, then B = 0
   "B" shall not be less than 0% nor greater than 55%.

   $S_1 = 55 - (A + B)$

   S_1 shall not be less than 0% nor greater than 55%.

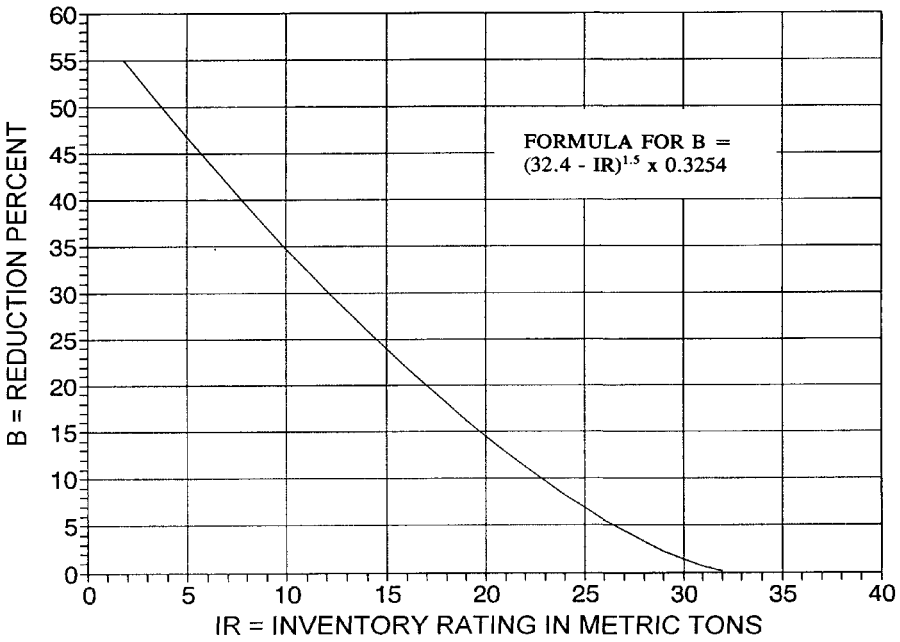

Figure 2. Reduction for Load Capacity

2. Serviceability and Functional Obsolescence (30% maximum)
   a. Rating Reductions (13% maximum)

If #58 (Deck Condition) is	≤ 3 then	A = 5%
	= 4	A = 3%
	= 5	A = 1%
If #67 (Structural Evaluation) is	≤ 3 then	B = 4%
	= 4	B = 2%
	= 5	B = 1%
If #68 (Deck Geometry) is	≤ 3 then	C = 4%
	= 4	C = 2%
	= 5	C = 1%
If #69 (Underclearances) is	≤ 3 then	D = 4%
	= 4	D = 2%
	= 5	D = 1%
If #71 (Waterway Adequacy) is	≤ 3 then	E = 4%
	= 4	E = 2%
	= 5	E = 1%
If #72 (Approach Road Alignment) is	< 3 then	F = 4%
	= 4	F = 2%
	= 5	F = 1%

J = (A + B + C + D + E + F)
J shall not be less than 0% nor greater than 13%.

b. Width of Roadway Insufficiency (15% maximum)
Use the sections that apply:

(1) applies to all bridges;
(2) applies to 1-lane bridges only;
(3) applies to 2 or more lane bridges;
(4) applies to all except 1-lane bridges.

Also determine X and Y:

$$X\ (\text{ADT/Lane}) = \frac{\text{Item 29 (ADT)}}{\text{first 2 digits of \#28 (Lanes)}}$$

$$Y\ (\text{Width/Lane})^* = \frac{\text{Item 51 (Bridge Rdwy. Width)}}{\text{first 2 digits of \#28 (Lanes)}}$$

*A value of 10.9 Meters will be substituted when Item 51 is coded 0000 or not numeric.

(1) Use when the last 2 digits of #43 (Structure Type) are not equal to 19 (Culvert):
If(#51 + 0.6 meters) < #32 (Approach Roadway Width) G = 5%

(2) For 1-lane bridges only, use Figure 3 or the following:
If the first 2 digits of #28 (Lanes) are equal to 01 and

$Y < 4.3$	then	$H = 15\%$
$Y \geq 4.3$ and < 5.5		$H = 15\left[\frac{5.5 - Y}{1.2}\right]\%$
$Y \geq 5.5$		$H = 0\%$

(3) For 2 or more lane bridges. If these limits apply, do not continue on to (4) as no lane width reductions are allowed.

If the first 2 digits of #28	= 02 and $Y \geq 4.9$,	then	$H = 0\%$
	= 03 and $Y \geq 4.6$,		$H = 0\%$
	= 04 and $Y \geq 4.3$,		$H = 0\%$
	$\geq$ 05 and $Y \geq 3.7$		$H = 0\%$

(4) For all except 1-lane bridges, use Figure 3 or the following:

If $Y < 2.7$ and	$X > 50$	then	$H = 15\%$
$Y < 2.7$ and	$X \leq 50$		$H = 7.5\%$
$Y \geq 2.7$ and	$X \leq 50$		$H = 0\%$

If $X > 50$ but ≤ 125 and

$Y < 3.0$	then	$H = 15\%$
$Y \geq 3.0 < 4.0$		$H = 15\ (4\text{-}Y)\%$
$Y \geq 4.0$		$H = 0\%$

If $X > 125$ but ≤ 375 and

$Y < 3.4$	then	$H = 15\%$
$Y \geq 3.4 < 4.3$		$H = 15\ (4.3\text{-}Y)\%$
$Y \geq 4.3$		$H = 0\%$

f X > 375 but ≤ 1350 and
Y < 3.7 → then $H = 15\left[\frac{4.9 - Y}{1.2}\right]\%$
Y ≥ 3.7 < 4.9

Y ≥ 4.9 H = 0%

If X > 1350 and Y < 4.6 H = 15%

Y ≥ 4.6 < 4.9

Y ≥ 4.9 → then $H = 15\left[\frac{4.9 - Y}{1.2}\right]\%$

G + H shall not be less than 0% nor greater than 15%

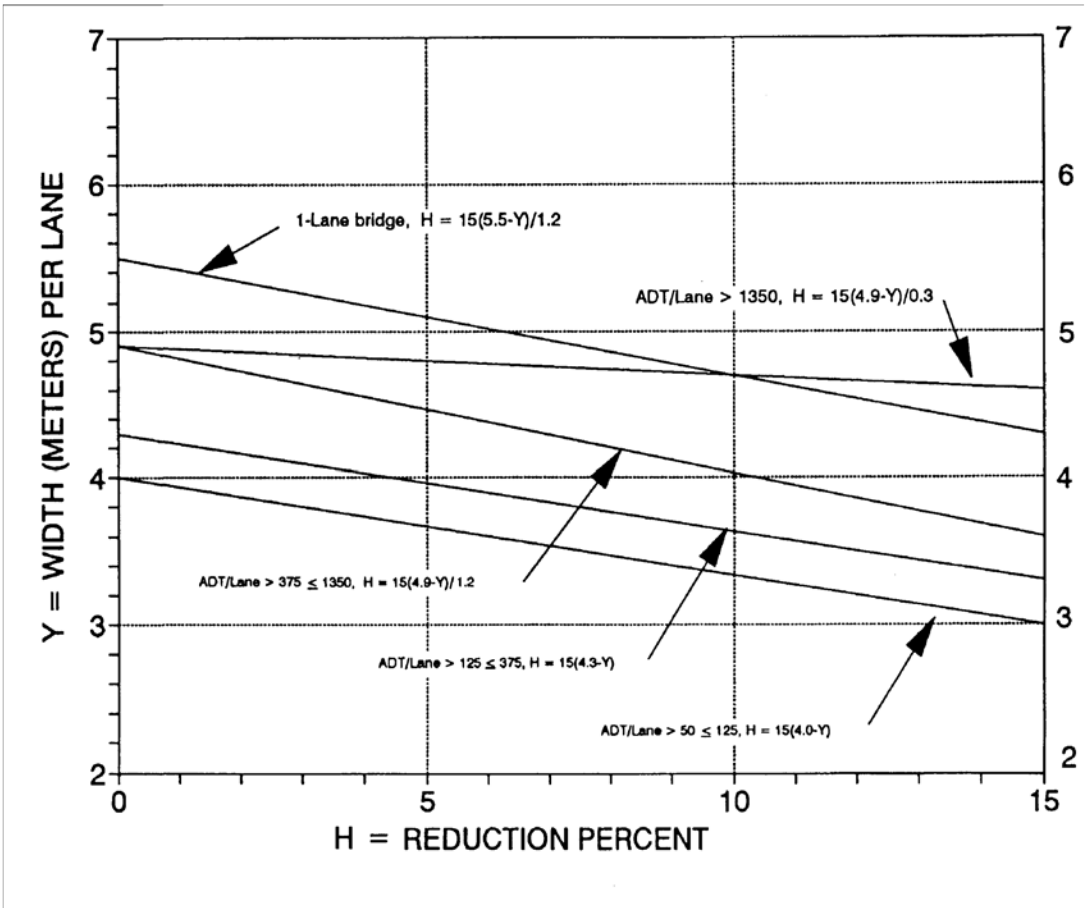

Figure 3. Width of Roadway Insufficiency

c. Vertical Clearance Insufficiency - (2% maximum)

If #100 (STRAHNET Highway Designation) > 0 and

#53 (VC over Deck) $\geq$ 4.87	then	I = 0%
#53 < 4.87		I = 2%

If #100 = O and

#53 $\geq$ 4.26	then	I = 0%
#53 < 4.26		I = 2%

$S_2 = 30 - [\ J + (G + H) + I\ ]$

S_2 shall not be less than 0% nor greater than 30%.

3. Essentiality for Public Use (15% maximum)

a. Determine

$$K = \left[\frac{S_1 + S_2}{85} \right]$$

b. Calculate:

$$A = 15 \left[\frac{\#29(ADT) \times \#19(DetourLength)}{320{,}000 \times K} \right]$$

"A" shall not be less than 0% nor greater than 15%.

c. STRAHNET Highway Designation:

If #100 is > 0	then	B = 2%
If #100 = 0		B = 0%

$S_3 = 15 - (A + B)$

S_3 shall not be less than 0% nor greater than 15%.

4. Special Reductions (Use only when $S_1 + S_2 + S_3 > 50$)

a. Detour Length Reduction, use Figure 4 or the following:

$A = (\#19)^4 \times (7.9 \times 10^{-9})$ "A" shall not be less than 0% nor greater than 5%.

b. If the 2nd and 3rd digits of #43 (Structure Type, Main) are equal to 10, 12, 13, 14, 15, 16, or 17; then B = 5%

c. If 2 digits of #36 (Traffic Safety Features) = 0 then C = 1%
If 3 digits of #36 = 0 C = 2%
If 4 digits of #36 = 0 C = 3%

$S_4 = A + B + C$

S_4 shall not be less than 0% nor greater than 13%.

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Sufficiency Rating = $S_1 + S_2 + S_3 - S_4$

The Rating shall not be less than 0% nor greater than 100%.

Example Calculation of Sufficiency Rating

1. Structural Adequacy and Safety
   A = 10%
   B = [32.4 - (19.8 metric tons)]$^{1.5}$ x 0.3254 = 14.6

   S_1 = 55 - (10 + 14.6) = 30.4

2. Serviceability and Functional Obsolescence
   A = 3%, B = 1%, C = 4%, D = NA, E = NA, F = NA
   J = (3 + 1 + 4) = 8%

   X = 18500 / 2 = 9250 Y = 7.9 m / 2 = 3.95

   (1) If (7.9 + 0.6) < 12.2 then G = 5
   (2) Not Applicable
   (3) Not Applicable
   (4) If X = 9250 and Y = 3.95 then H = 15

   G + H = 5 + 15 = 20 (however, maximum allowable = 15)
   I = 0

   S_2 = 30 - [8 + (15) + 0] = 7.0
3. Essentiality For Public Use

$$K = \left[\frac{30.4 + 7.0}{85}\right] = 0.44$$

$$A = 15\left[\frac{18{,}500 \times 12.8\text{Km}}{320{,}000 \times 0.44}\right] = 25.2(\text{however, maximum allowable} = 15)$$

   B = 0
   S_3 = 15 - (15 + 0) = 0

4. Special Reductions
   $S_1 + S_2 + S_3$ = (30.4 + 7.0 + 0.0) = 37.4 < 50

   S_4 = NA

SUFFICIENCY RATING = 30.4 + 7.0 + 0.0 = 37.4

Appendix E - FHWA Coding Guide Excerpts

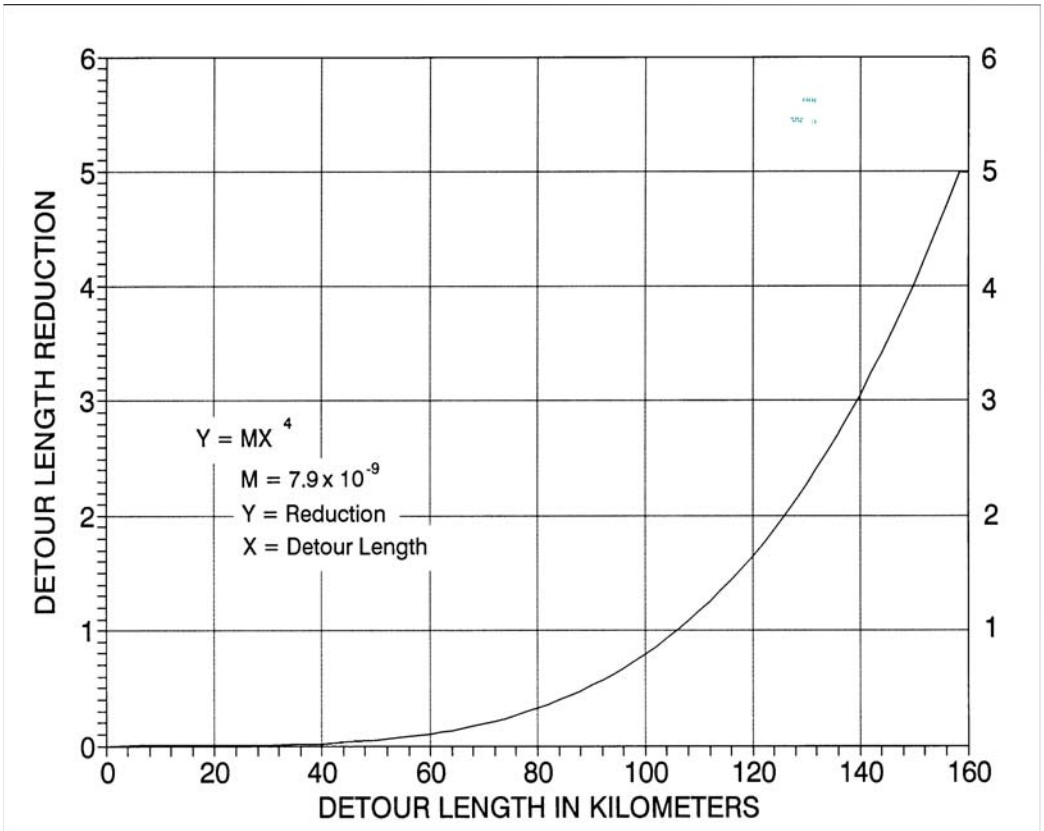

Figure 4. Special Reduction for Detour Length

Appendix E - FHWA Coding Guide Excerpts

EXAMPLE DATA

OMB No. 2125-0501

NATIONAL BRIDGE INVENTORY - - - - - - - STRUCTURE INVENTORY AND APPRAISAL 10/15/94

```
********** IDENTIFICATION **********
(1) STATE NAME - YOUR STATE NAME          CODE   999
(8) STRUCTURE NUMBER
(5) INVENTORY ROUTE (ON/UNDER) - ON     =  131000440
(2) HIGHWAY AGENCY DISTRICT                      03
(3) COUNTY CODE     075      (4) PLACE CODE    59767
(6) FEATURES INTERSECTED - SR 772, ROARING LION R. *
(7) FACILITY CARRIED      - STATE ROUTE 44
(9) LOCATION            - 9.7 KM SW. OF RICHMOND
(11) MILEPOINT/KILOMETERPOINT                0036.008
(12) BASE HIGHWAY NETWORK - PART OF NET     CODE    1
(13) LRS INVENTORY ROUTE & SUBROUTE     #000000277503
(16) LATITUDE              35 DEG  27 MIN  18.55 SEC
(17) LONGITUDE            081 DEG  05 MIN  50.65 SEC
(98) BORDER BRIDGE STATE CODE    888    % SHARE  40 %
(99) BORDER BRIDGE STRUCTURE NO.     #ABC003790243009

********** STRUCTURE TYPE AND MATERIAL *********
(43) STRUCTURE TYPE MAIN:  MATERIAL - STEEL
        TYPE - DECK TRUSS                    CODE 309
(44) STRUCTURE TYPE APPR:  MATERIAL - STEEL
        TYPE - GIRDER & FLOORBEAM SYSTEM     CODE 303
(45) NUMBER OF SPANS IN MAIN UNIT                 002
(46) NUMBER OF APPROACH SPANS                    0004
(107) DECK STRUCTURE TYPE - CONCRETE C-I-P      CODE 1
(108) WEARING SURFACE / PROTECTIVE SYSTEM:
   A) TYPE OF WEARING SURFACE - CONCRETE        CODE 1
   B) TYPE OF MEMBRANE        - NONE            CODE 0
   C) TYPE OF DECK PROTECTION - UNKNOWN         CODE 8

********** AGE AND SERVICE **********
(27) YEAR BUILT                                  1948
(106) YEAR RECONSTRUCTED                         0000
(42) TYPE OF SERVICE:  ON - HIGHWAY-PEDESTRIAN
        UNDER - HIGHWAY-WATERWAY             CODE  56
(28) LANES:  ON STRUCTURE   02    UNDER STRUCTURE  02
(29) AVERAGE DAILY TRAFFIC                     019500
(30) YEAR OF ADT    1993    (109) TRUCK ADT      05 %
(19) BYPASS, DETOUR LENGTH                     013 KM

********** GEOMETRIC DATA **********
(48) LENGTH OF MAXIMUM SPAN                  0097.5 M
(49) STRUCTURE LENGTH                       00312.0 M
(50) CURB OR SIDEWALK:   LEFT 00.0 M     RIGHT 02.5 M
(51) BRIDGE ROADWAY WIDTH CURB TO CURB       007.9 M
(52) DECK WIDTH OUT TO OUT                   011.8 M
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS)     12.2 M
(33) BRIDGE MEDIAN - NO MEDIAN              CODE   0
(34) SKEW     00 DEG     (35) STRUCTURE FLARED     NO
(10) INVENTORY ROUTE MIN VERT CLEAR          99.99 M
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR        07.9 M
(53) MIN VERT CLEAR OVER BRIDGE RDWY         99.99 M
(54) MIN VERT UNDERCLEAR      REF - HIGHWAY  10.46 M
(55) MIN LAT UNDERCLEAR RT    REF - HIGHWAY   06.2 M
(56) MIN LAT UNDERCLEAR LT                    00.0 M

********** NAVIGATION DATA **********
(38) NAVIGATION CONTROL - BR PERMIT REQ      CODE  1
(111) PIER PROTECTION - FUNCTIONING          CODE  2
(39) NAVIGATION VERTICAL CLEARANCE           18.3 M
(116) VERT-LIFT BRIDGE NAV MIN VERT CLEAR     __._ M
(40) NAVIGATION HORIZONTAL CLEARANCE         047.2 M

**********

SUFFICIENCY RATING =  37.4
STATUS = STRUCTURALLY DEFICIENT

********** CLASSIFICATION **********CODE
(112) NBIS BRIDGE LENGTH -                       YES
(104) HIGHWAY SYSTEM  -  ROUTE ON NHS              1
(26) FUNCTIONAL CLASS - OTHER PRIN ART URBAN       14
(100) DEFENSE HIGHWAY -  NOT DEFENSE               0
(101) PARALLEL STRUCTURE - NONE EXISTS             N
(102) DIRECTION OF TRAFFIC - 2 WAY                 2
(103) TEMPORARY STRUCTURE  - NOT TEMPORARY         _
(105) FEDERAL LANDS HIGHWAYS - NOT APPLICABLE      0
(110) DESIGNATED NATIONAL NETWORK - PART OF NET    1
(20) TOLL     - ON FREE ROAD                       3
(21) MAINTAIN - STATE HIGHWAY AGENCY              01
(22) OWNER    - STATE HIGHWAY AGENCY              01
(37) HISTORICAL SIGNIFICANCE - NOT ELIGIBLE        5

********** CONDITION ********** CODE
(58) DECK                                          4
(59) SUPERSTRUCTURE                                5
(60) SUBSTRUCTURE                                  6
(61) CHANNEL & CHANNEL PROTECTION                  8
(62) CULVERTS                                      N

********** LOAD RATING AND POSTING ******** CODE
(31) DESIGN LOAD      -      H-15  OR  M-13.5      2
(63) OPERATING RATING METHOD -     LOAD FACTOR     1
(64) OPERATING RATING -                 MS-14    25.2
(65) INVENTORY RATING METHOD -     LOAD FACTOR     1
(66) INVENTORY RATING -                 MS-11    19.8
(70) BRIDGE POSTING   - POSTING REQUIRED           2
(41) STRUCTURE OPEN, POSTED OR CLOSED -            P
        DESCRIPTION - POSTED FOR LOAD

********** APPRAISAL ********** CODE
(67) STRUCTURAL EVALUATION                         5
(68) DECK GEOMETRY                                 3
(69) UNDERCLEARANCES, VERTICAL & HORIZONTAL        6
(71) WATERWAY ADEQUACY                             8
(72) APPROACH ROADWAY ALIGNMENT                    8
(36) TRAFFIC SAFETY FEATURES                    1100
(113) SCOUR CRITICAL BRIDGES                       8

********** PROPOSED IMPROVEMENTS **************
(75) TYPE OF WORK - REPLACE FOR DEFICIENCY  CODE  311
(76) LENGTH OF STRUCTURE IMPROVEMENT        00317.0 M
(94) BRIDGE IMPROVEMENT COST              $ 4,200,000
(95) ROADWAY IMPROVEMENT COST             $   300,000
(96) TOTAL PROJECT COST                   $ 5,000,000
(97) YEAR OF IMPROVEMENT COST ESTIMATE           1995
(114) FUTURE ADT                               025600
(115) YEAR OF FUTURE ADT                         2014

********** INSPECTIONS **********
(90) INSPECTION DATE   03/94   (91) FREQUENCY   12 MO
(92) CRITICAL FEATURE INSPECTION:       (93) CFI DATE
  A) FRACTURE CRIT DETAIL - YES - 06 MO   A)    09/94
  B) UNDERWATER INSP      -  NO - __ MO   B)    __/__
  C) OTHER SPECIAL INSP   -  NO - __ MO   C)    __/__
```

Appendix E - FHWA Coding Guide Excerpts

ITEM: Structurally Deficient

Structurally Deficient is an FHWA term used to identify bridges which meet the following criteria:

NBI Item 58 - Deck Rating ≤ 4 or
NBI Item 59 - Superstructure Rating ≤ 4 or
NBI Item 60 - Substructure Rating ≤ 4 or
NBI Item 62 - Culvert and Retaining Wall Rating ≤ 4 or

An appraisal rating of 2 or less for
NBI Item 67 - Structural Condition Rating ≤ 2 or
NBI Item 71 - Waterway Adequacy Rating ≤ 2

ITEM: Functionally Obsolete

Functionally Obsolete is an FHWA term used to identify bridges which meet the following criteria:

NBI Item 68 - Deck Geometry Rating ≤ 3 or
NBI Item 69 - Underclearances Rating ≤ 3 or
NBI Item 72 - Approach Roadway Alignment Rating ≤ 3 or

Any bridge classified as structurally deficient is excluded from the functionally obsolete category.

NBI Item 67 - Structural Condition Rating ≤ 3 or
NBI Item 71 - Waterway Adequacy Rating ≤ 3 or

ITEM: Changes to Manual

Significant Changes to Last Version of Manual

* Bridge Inspection items were not described in the prior version

Possible Future Enhancements:

* Scour Critical field is stored in RC07 can be removed form RC05 when a comprehensive review can be made of all the places the data is being used.