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HIGHWAY SUFFICIENCY RATING
INTRODUCTION

In order to provide a sound and logical basis for determining the priority selections of a highway construction and improvement program, a method of rating highways has been developed. This method is now being used by the majority of states and the Federal Highway Administration at the present time. Such a rating is called a sufficiency rating and attempts to answer the question: how sufficient or adequate is each section of highway when compared to a highway properly constructed.

The present method consists of assigning a point rating to the various highway elements based on the actual condition, dimensions, and service of the highway and its ability or inability to carry the traffic efficiently when compared to a uniform set of standards.

The Vermont Agency of Transportation has developed a rating system, which when applied to each element in the highway will assign a numerical rating to each section which will show the relative adequacy of all highways. The highway standards used for comparison are based on those established by the American Association of State Highway and Transportation Officials (AASHTO) and the new Vermont State standards, dated October 22,1997. Many states are using similar standards which offers the possibility of being able to make comparisons on a nationwide basis.

EXPLANATION OF METHOD

The basis of the method is to assign a rating of 100 points to a perfect highway and to sub-divide the elements into three major criteria with par values as follows:

1. Structural Condition	50 Points
2. Safety	25 Points
3. Service	25 Points
Total for perfect score	100 Points

METHODS AND PROCEDURE

I. Structural Condition

This item is concerned with the structural design of the highway and is intended to indicate its ability to carry certain loads. Foundation, safe load capacity of bridges, slides, effectiveness of ditches and culverts, and condition of pavement surfaces are the main elements to be considered.

The condition of the foundation, pavements, ditches, culverts and slides is rated in the field by the district administrators in conjunction with engineers from the Central Office. All elements are rated according to a classification of good, fair, poor, and bad, and the assignment of a highway into any class will depend upon the degree of heaving, cracking, warping, scaling, rutting, raveling, and disintegration of the particular section. The rating is based upon the action of the highway during the spring break-up. Bridges are rated on the basis of the current Bridge Inspection reports.

Pavement surfaces are rated on the correlation with the Pavement Management=s system surface condition (International Roughness Index, or IRI), provided by the Maintenance Division of the VAOT.

II. Safety

Safety involves the elements of geometrical design which determines the degree of safety provided to the motorist. The principle elements to be considered are the roadbed width, surface width, stopping sight distance, bridge widths, accidents and consistency of alignment and grade.

Most of this data is obtained from office records with the exception of the stopping sight distance, which is obtained from field surveys and construction plans.

III. Service

Service is rated on how well the highway serves the motorist. This classification is concerned with the efficient movement of traffic, the average highway speed, or safe operating speed, the percent of passing sight distance available, the existence of steep grades, surface width, rideability, and restricted overhead clearances; in short, any combination of elements which curtails service.

The average highway speed is calculated from curvature data, the passing sight distance is obtained from the sight distance surveys, the excessive grades are obtained from office records and field surveys, rideability is correlated with pavement conditions, and restricted overhead clearances are obtained from office records.

BASIC RATING

The sum of the point values derived from the three major criteria minus the adjustments for floods and lack of an all weather surface equals the basic rating.

The basic ratings are adjusted for traffic volume to give a lower sufficiency (greater priority) to heavily traveled highways and a higher sufficiency (lesser priority) to low volume highways. The correction is made by means of the Moskowitz Formula (Ref. Rpt. No. DOT FH-11-7882).

The statewide average traffic volume on any group of highways is used as one of the major elements in the Moskowitz formula, and is obtained for the Interstate, Arterial, Major Collector, and Town Highways on the Federal-aid Systems in Vermont from Table TA-1 (Daily Vehicle-Miles Per Mile, Col. 5). The data year of the Table TA-1 must be consistent with the year of the traffic volumes used in the ratings.

The following is an example of how the correction works:

MOSKOWITZ FORMULA:

$$y = x + \frac{(x^2 - 100x)(\log T - \log T_s)}{50 \log T_s}$$

Where: y = adjusted rating
x = basic rating
T = actual traffic (AADT)
T_s = average traffic (AADT) for desired year on desired system

Example:

When T = 4500
T_s = 2750 (1981) F.A.P.

x = 50.0

$$y = 50 + \frac{(50^2 - 5000)(3.653 - 3.439)}{50 \times 3.439}$$

$$y = 50 + \frac{-535}{171.95}$$

y = 50 + (-3.1)

y = 46.9

When T = 1500
T_s = 2750 (1981) F.A.P.

X = 50

y = 50 + (+3.8)

y = 53.8

TOPOGRAPHY

The topography or type of terrain has a considerable influence on the type of standard which is economically feasible to adopt. The terrain is classified as flat (level), rolling, mountainous, suburban and urban on the basis of the extent to which the terrain actually influences the present highway condition. See Tables I, II and IIA in Appendix A, pages 26, 27, and 28 respectively.

<u>Explanation of Topography</u>

Flat (level): Very light grades - location of highway not restricted by land contour.
Example: None available.

Rolling: Medium grades - highway location affected somewhat by the contour of the hills in the area.
Example: VT 14, White River Junction to Barre.

Mountainous: Heavy grades unavoidable, highway location determined largely by the mountains.
Example: VT 9, Woodford-Searsburg.

Suburban: Restricted speed zones through villages or densely populated areas not used for Principal Arterial Highways,

Urban: Restricted speed zones through densely developed areas within the FA. Urban Areas not used for Principal Arterial Highways.

<u>General Comments</u>

Each highway rating section is homogeneous in character. A section ends at the point where a new characteristic appears; such as a change in the volume of traffic, in surface or roadway widths, in structural conditions, in the type of terrain, or in the geometries of the highway; and a new section is designated. Sections may, therefore, vary in length from a fraction of a mile to several miles.

On the average 1/3 of the state highways are checked in the field each year for possible changes in structural conditions, sight distance, improvements through maintenance or construction, or for any inconsistencies of sectioning or rating. All state highways are surveyed bi-annually for pavement conditions by the Maintenance Division.

The term DHV (Design Hour Volume) or 30th peak hour appears in the rating procedure and represents the 30th highest hourly traffic volume during the rating or existing year. The DHV is determined by first checking if the rating section is within the area of a traffic recorder station influence and if not, by classifying the highway as Interstate, General, or Recreational.

These factors may be readily determined from tables developed by the Traffic Research Section and are included in Appendix C, pages 32 - 37. Occasionally as conditions dictate other DHV formulas are used.

The standards used for rating are those in the recommended AASHTO minimum geometric design standards and the new Vermont State Standards, dated October 22, 1997. The standards employed are intended to provide a reasonable basis for arriving at a realistic evaluation of the existing highways. These standards are included in Appendix A, pages 26 - 29.

Note: Stopping and passing sight distance values are obtained by field surveys and construction plans, and are intended for planning purposes only in these ratings.

ASSIGNMENT OF POINT VALUES

SUMMARY

I STRUCTURAL CONDITION ....50 POINTS

A. Foundation 30 Points
Slides: deduct 1 to 3 points
Structural Evaluation: deduct 0 to 5 points

B. Drainage 8 Points
1. Culverts 4 Points
2. Ditches 4 Points

C. Pavement or Surface 12 Points

II SAFETY ....25 POINTS

A. Surface Width 6 Points

B. Roadbed Width 7 Points

C. Stopping Sight Distance 8 Points

D. Consistency of Alignment & Grade 4 Points

E. Accident Deduction: 0 to 5 points.

III SERVICE .... 25 POINTS

A. Average Highway Speed 12 Points

B. Passing Sight Distance 6 Points

C. Ease 7 Points
1. Surface Width 4 Points
2. Rideability 3 Points

D. Correction of Total Service rating
1. Correction for excessive grades, deduct 0 to 6 points
2). Correction for restricted vertical clearance, deduct 0 to 8 points

Basic Rating = 100 POINTS

Adjusted Rating = Basic Rating Less Corrections

For an example of a Vermont Highway Sufficiency Rating Form, see Appendix D, page 35.

I. STRUCTURAL CONDITION 50 POINTS

A . Foundation 30 Points

1.	Good	30 Points
2.	Fair+	24 Points
3.	Fair	18 Points
4.	Fair-	12 Points
5.	Poor	6 Points
6.	Poor-	3 Points
7.	Bad	0 Points

Rate on performance of pavement or degree of heaving, warping, cracking, rutting, pumping and frost heaves.

The following points shall be deducted from the foundation for slides and bridges:

Slide Deduction (Minus)

1.	Poor	1 Point
2.	Bad	2 Points
3.	Dangerous	3 Points

Based on the greatest deduction in each section - not prorated.

Structural Evaluation - Deduction
(Bridge 20.0' span and over)

Structural Evaluation No. [1]

7,8,9 - Good	0
4,5,6 - Poor	2
3 - Intolerable	4
2 - Intolerable	5

Based on the lowest capacity in each section - not prorated.

[1] Data obtained from Structures Division Computer Printout (Program No. H860).

B. Drainage________________________ 8 Points

1- Culverts ____________ 4 Points

Good	4 Points
Fair+	3 Points
Fair	2 Points
Fair-	1 Points
Poor	0 Points

2 - Ditches ______________ 4 Points

Good	4 Points
Fair+	3 Points
Fair	2 Points
Fair-	1 Points
Poor	0 Points

C. Surface ________________ 12 Points

The Surface Rating is correlated directly to the Present Serviceability Rating (PSR) which is correlated with pavement condition (IRI), provided by the Maintenance Division.

The correlation is as follows: Pavement Rating = $\frac{12(PSR)}{5}$

Note: Gravel surface = 0 Points

PSR RATING	SURFACE CONDITION	SUFFICIENCY RATING
0 to l.0	P (poor)	0 to 2. 4
1.1 to 2.0	F- (fair minus)	2.5 to 4.8
2.1 to 3.0	F (f air)	4.9 to 7.2
3.1 to 4.0	F+ (f air plus)	7.3 to 9.6
4.1 to 5.0	G (good)	9. 7 to 12.0

When more than one PSR Rating is contained within the sufficiency Rating Section, the actual PSR Rating is averaged based on weighted lengths.

Example : The section is 3.00 miles long.

0.50 miles has a PSR Rating of 3.30
2.50 miles has a PSR Rating of 4.30

Then: 0.50 miles X 3.30 = 1.65
+ 2.50 miles X 4.30 = 10.75
3.00 miles 12.40

12.4/ 3 = 4.1 (Averaged PSR Rating)

The above also applies for averaging Surface Widths, Roadbed Widths, Current AADT, and AADT for 5-Year Accident Period.

II. Safety ____ 25 Points

A. Surface Width

R = 6 + actual width - standard width

(1) Gravel surface i-s 2 feet less than roadbed.

(2) Where climbing lanes exist, the additional width shall not be used in computing the actual widths for rating purposes.

Bridge Width Correction

The surface width rating shall be corrected for each structure (including underpasses) having a lateral clearance less than the actual roadbed at the structure. Deduct 0.5 points for each foot less than the actual roadbed. Prorate total deductions on sections over 1 mile in length.

The surface width rating shall never be less than 0.

B. ROADBED WIDTH (Additional width for climbing lanes not used for rating purposes)

$$R = 7 \times \frac{\text{actual roadbed - standard surface}}{\text{standard roadbed - standard surface}}$$

C. Stopping Sight Distance (SSD) ________________ 8 Points

Rating = 8 - N/L

where N = number of SSD restrictions
L = section length in miles

In figuring restrictions use the lowest sub-standard sight distance whether it occurs on the initial or the return run.

Stopping Sight Distance Correction

Deduct 1 point for each restriction less than 1/2 the standard SSD: 275' @ 65 MPH, 260' @ 60 MPH, 225' @ 55 MPH, 200' @ 50 MPH, 165' @ 45 MPH, 135' @ 40 MPH. The rating for the stopping sight distance shall not be less than 0. Do not prorate.

D. Consistency of alignment and grade ________________ 4 Points

Rating = 4 - N/L

where N = number of inconsistent (substandard) curves and grades (include rail-highway grade crossings.)

L = section length in miles.

E. Accident Deduction from Total Safety Rating ________ (-5)

This deduction is based on the Rate - Quality Control Method (FHWA Sponsored) which is used to identify High Accident Locations by calculation of Actual Accident Rates (Ar) and Critical Accident Rates (Cr), then determines a Critical Rate Factor (CRf) by dividing the Actual Rate by the Critical Rate. Sections with CRf greater than 1.00 are considered a High Accident Location. Formulas for the Actual and Critical Rates (based on 5-year accident data) and the

Critical Rate Factor are presented below:

1. Actual Rate

Ar = (A x 1,000,000)/(AADT x 365 x N x S)

where:

Ar = Actual Accident Rate in Accidents per million vehicle miles

A = Total Number of Accidents (Years Analyzed) for the Section

AADT = Average A-ADT (5-Year Period of Accidents) for the Section
N = Number of Years Analyzed
S = Section Length in miles

2. Critical Rate

$$Cr = R_a + K \sqrt{(R_a/M)} - 1/2M$$

where:

C_r = Critical Accident Rate in Accidents per Million Vehicle Miles
R_a = Average Accident Rate for Highway System (Statewide for Years Analyzed) in Accidents per Million Vehicle Miles (from Table TA-1)
M = Vehicle Exposure in Million Vehicle Miles for the Section
K = A constant which determines a Confidence Level (one-sided). Currently, a value of 2.58 is used, which gives approximately a 99.5% Confidence Level

3. Critical Rate Factor

$$CR_f = A_r/C_r$$

where:

Cr_f = Critical Rate Factor
A_r = Actual Accident Rate
C_r = Critical Accident Rate

4. Application of Critical Rate Factors for Deduction from Safety Rating:

Deduction = 5

If $CR_f > 1.00$ then deduction = 5 . (Deduction is never greater than 5 points)

Note: If High Accident Locations determined from Accident Analysis Program for 0.30 mile sections and intersections are within section being rated, the full 5 point deduction is taken and the above procedure is not required.

III. SERVICE ____ 25 Points

A. Average Highway Speed _____________12 Points

The average highway speed rating is intended to reflect the safe operating speed, consistent with horizontal alignment, in comparison with the design speed standard being used, without the influence of traffic.

Average highway speed is defined in highway capacity procedures as the weighted average of the design speeds within the section, when each subsection within the section is considered to have an individual design speed.

The following method for computing average highway speed utilizes highway capacity procedural recommendation of approximately 800 feet (0.15 mile) for the effective length of each curve. Tangent sections are assumed to have a design speed consistent with the actual legal maximum speed limit within the section being rated. The maximum superelevation rate is assumed to be 0.08 ft./ft. This is reflected in the following curvature range table for each design speed:

Degree of Curvature Range	Approximate Design Speed (MPH)
75.1 - 90.0	15
43.1 - 75.0	20
28.0 - 43.0	25
19.5 - 27.9	30
14.0 - 19.4	35
11.0 - 13.9	40
8.5 - 10.9	45
7.0 - 8.4	50
5.5 - 6.9	55

4.5 -	5.4	60
3.5 -	4.4	65

The procedure for computing average highway speed as defined above is as follows:

where:

D = design speed standard for section, mph
n= number of curves within a specific curvature range
N= total number of curves
T= tangent length in miles
M= tangent travel time in minutes
d= design speed for specific curvature range, mph
R= curvature range travel time in minutes
C= total curve travel time in minutes
L= section length in miles
S= average highway speed, mph

$$\frac{L}{\left([L - (N \times 0.15)] \times \frac{60}{D}\right) + \left(\left[\left(\frac{60}{d} \times 0.15\right) \times n\right] + \left[\frac{60}{d_1} \times 0.15\right) \times n_1\right], \text{etc.}\right) \times 60} = S$$

Step 1: Determine the design speed (D) from Appendix A, Tables I or II, pages 23 and 24.

Step 2: Determine the number of curves within each curvature range (n) from the above curvature range table. Consider only those curvature ranges where the design speed (d) is less than the design speed (D).

Step 3: Multiply the total number of curves (N) by 0.15 miles and subtract this figure from the section length (L) to determine the tangent length (T) : (L-(N x 0.15) = T)

Step 4: Multiply the tangent length (T) by $\underline{\quad 60}$

design speed

or

$\frac{60}{D}$ to determine the tangent travel time (M) in minutes. $(T \times \frac{60}{D} = M)$

Step 5: Multiply $\frac{60}{\text{design speed for curvature range}}$

or

$\frac{60}{d}$ by 0.15 miles for each specific curvature range to determine the curvature range travel time in minutes (R).

$$\frac{60}{d} \times 0.15 = R$$

$$\frac{60}{d_1} \times 0.\ 15 = R_1$$

$$\frac{60}{d_2} \times 0.\ 15 = R_2$$

etc.

Step 6: Multiplv each curvature range travel time (R) bv the number of curves that fall within that range

(n) and then. add these figures together to determine the total curve travel time in minutes (C).

$$[(R \times n) + (R_1 \times n_1) + R_2 \times n_2) \text{ etc.}] = C$$

Step 7: Add the total curve travel time (C) to the tangent travel time (M) and then divide this figure into the section length (L). Multiply this figure by 60 to determine the average highway speed (S).

$$\frac{L}{C+M} \times 60 = S$$

See Page 19 for sample worksheet.

B. The formula, **12- 0.6(D-S) = rating**, is used to determine the rating for the average highway speed.

where:
D = design speed standard for section, mph
S = average highway speed, mph

This is based on assigning 12 points to a section where the average highway speed is equal to the design speed and deducting 3 points for every 5 mph difference between the average highway speed and the design speed.

SPEED CORRECTION

When the lowest individual design speed for any subsection within the section drops 20 or more mph less then the design speed standard for that section, a deduction is made in the average highway speed rating. The deduction shall never be more than 6 points and the average highway speed rating shall never be less than zero.

The formula used is: deduction = 6- 0.4(D-d)
where:
D = design speed standard for section, mph
d = lowest individual design speed for any subsection within the section, mph

If D-d $\geq$ 30, then deduction = 6
If D-d < 20, then deduction = 0

This is based on the premise that when D-d = 20 then deduct 2 points and increase the deduction by 2 points for every 5 mph increase in D-d until D-d >30, then always deduct 6 points.

WORKSHEET FOR CALCULATING-AVERAGE HIGHWAY SPEED (AHS)

Degree of Curvature Range	Approximate Design Speed (MPH) (d)	Number of Curves (n)	Total Travel Time (minutes) $\left(\frac{60}{d} \times 0.15\,n\right)$
75.1 - 90.0	15		
43.1 - 75.0	20		
28.0 - 43.0	25		
19.5 - 27.9	30		
14.0 - 19.4	35		
11.0 - 13.9	40		
8.5 - 10.9	45		
7.0 - 8.4	50		
5.5 - 6.9	55		

4.5 -5.4	60	|	|
3.5 - 4.4	65	|	|

Total number of curves (N)=

Curve travel time (C)=

Tangent travel time (M)=

Total travel time (C+M)=

Section Length (L)______ mi. * ***NOTE**: If 0.15 N≥ L,then let L = 0.15 N

minus total curve length (0.15N) - _____ mi. *

= Tangent Length (T) _____ mi.

times min. per mi. $(\underline{60}/D)$ x _____ min./mi.

= Tangent Travel Time (M) _____ min.

Average Highway Speed (S) = [Section Length (L) ________ mi. divided by Total Travel Time (C+M) ________ min.] x 60 = ________MPH.

NOTE: for maximum superelevation rate of 0.08 ft./ft.

B. Passing Sight Distance ________________________ 6 Points
(See example below)

The Passing Sight Distance rating may be determined by the following formula:

$$\text{Rating} = \frac{\text{Percent of Available Passing Sight Distance} > 1500'}{\text{Standard Percent of Passing Sight Distance} > 1500'} \times 6$$

The percent of Passing Sight Distance > 1500' shall be computed in both directions and averaged.

Where a climbing lane exists, the sight distance shall be computed as 100% over the

length of the climbing lane in that direction only.

PASSING SIGHT DISTANCE

EXAMPLE:

Section in Town of Ryegate is 7,000 feet long - see attached sheet.
For passing sight distance of 1,500 feet and over, shown here in checks, and using Table IV, Appendix A, page 25.

Initial Run =	1,375'
Return Run =	1,300'
Total Feet =	2,675'

Average = 1/2 of 2,675 = 1,338

Percent of passing sight distance >1500' $= \frac{1338'}{7{,}000} = 19\%$

Standard percent from Table IV = 30%

The rating is $\frac{19}{30} \times 6 = 3.78 = 3.8$

C. **EASE** (Width and Rideability) ____________________ 7 Points

1. Surface Width _______________ 4 Points
   R = 4 + actual width - standard width

2. The Rideability Rating is directly correlated to the Pavement Serviceability Rating (PSR) provided by the Agency's Director of Maintenance Management.

The correlation is as follows:

$$\text{Rideability Rating} = \frac{3(\text{PSR})}{5}$$

RIDEABILITY

PSR RATING	ACTUAL CONDITION	RATING
0 to 1.0	P (poor)	0 to 0.6
1.1 to 2. 0	F- (fair minus)	0.7 to 1.2
2.1 to 3.0	F (fair)	1.3 to 1.8
3.1 to 4.0	G (good)	1.9 to 2.4
4.1 to 5.0	E (excellent)	2.5 to 3.0

D. Corrections to Service Rating

1. Correction for **EXECESSIVE GRADES** (deduct 0 to 6 points)

where:
A = actual grade (percent)
S = standard grade (percent)
L = length of grade (Miles)
D = deduction (points)

a. Principal Arterial Highways (2-lane):

$$D = \sum [2(A-S) + 10 L - 1]$$

Deduction shall never be greater than 6 points.

If length of section is greater than I mile then prorate:

$$D = \frac{\sum \; [2\,(A\text{-}S) + 10\,L\text{-}\;1]}{\text{Section Length in miles}}$$

b. Rural Primary or Secondary Highways:

$$D= \sum \; (A\text{-}S + 10\,L\, -\, 1)$$

Deduction shall never be greater than 6 points

If length of section is greater than 1 mile then prorate:

$$D = \frac{\sum \; (A\text{-}S + 10\,L\, -\, 1)}{\text{Section Length in miles}}$$

Note: **Do not take excessive grade corrections where climbing lanes exist.**

2. Correction for Restricted **VERTICAL CLEARANCE** is based on the lowest clearance in each section as compared to a standard minimum clearance of 14' :

Deduction = -2(14-V)
where:
V = vertical clearance (feet)

If V = > 14 then deduct 0 points.

If V = < 11 then deduct 8 points.

Note: SERVICE RATING SHALL NOT BE LESS THAN 0.

IV **FLOOD CORRECTION** ____ (-10)
To be deducted from total basic rating (Condition + Safety + Service). See Appendix B.

V. Adjustment for lack of ALL **WEATHER SURFACE** (M&D) __________ (-15)
Deduct from total BASIC RATING

If AADT < 100 then deduct 0 points.

If AADT > 300 then deduct 15 points.

Otherwise, deduction = $15 - \frac{3}{50}(300 - AADT)$

This is based on the premise that for every AADT increase of 50 between 100 and 300, the deduction increases by 3 points.

The deduction shall never be greater than 15 points.

APPENDIX A

APPENDIX A
TABLE I
MINIMUM GEOMETRIC DESIGN STANDARDS BASED ON A.A.S.H.T.O. & A.O.T. STANDARDS
TO BE USED IN RATING INTERSTATE,
RURAL & URBAN PRINCIPAL ARTERIAL HIGHWAYS

INTERSTATE (NHS)

Traffic Volume	Design Speed (MPH)	Surface Width (ft)	Roadway Width (ft)	Gradient
ALL DHV	55/65	2 @ 24	2 @ 38	5% up 6% down

PRINCIPAL ARTERIAL (NHS)

Traffic Volume/Terrain	Design [1,2] Speed (MPH)	Surface Width (ft)	Roadway Width (ft)	Gradient(%)
over 800 DHV (4-Lane) :	55	24	40	5% up 6% down
up to 800 DHV:				
Flat	50	24	40	4%
Rolling	50	24	40	5%
Mountainous	50	24	40	7%

[1] Design speed for Principal Arterial is not reduced to legal speed limits for sufficiency rating computation.

[2] Where posted speed for 55 mph, the Design speed shall be considered 55 for sufficiency rating computation.

APPENDIX A

TABLE II

MINIMUM GEOMETRIC DESIGN STANDARDS BASED ON A.A.S.H.T.O. & A.O.T. STANDARDS

TO BE USED IN RATING RURAL HIGHWAYS OTHER THAN INTERSTATE AND PRINCIPAL ARTERIAL ROUTES

PRIMARY (MINOR ARTERIAL) AND SECONDARY (MAJOR COLLECTOR)

Traffic Volume /Terrain	Design [1] Speed (MPH)	Surface Widths (Ft)	Roadway Widths(Ft)	Gradient(%)
over 800 DHV				
Flat	50	24	40	4%
Rolling	50	24	40	5%
Mountainous	50	24	40	7%
Suburban	20-45	22	32	N/A
400 to 800 DHV				
Flat	50	22	32	4%
Rolling	50	22	32	5%
Mountainous	50	22	32	7%
Suburban	20-45	22	32	N/A
200 to 399 DHV				
Flat	50	22	30	4%
Rolling	50	22	30	5%
Mountainous	40	22	30	10%
Suburban	20-45	22	30	N/A
100 to 199 DHV				
Flat	50	*20/22	*26/30	4%
Rolling	50	*20/22	*26/30	5%
Mountainous	40	*18/22	*22/30	10%
Suburban	20-40	*18/22	*22/30	N/A
55 to 99 DHV				
Flat	50	*20/22	*24/30	4%
Rolling	50	*20/22	*24/30	5%
Mountainous	40	*18/22	*22/30	10%
Suburban	20-40	*18/22	*22/30	N/A
up to 54 DHV				
Flat	50	*18/22	*22/30	6%
Rolling	50	*18/22	*22/30	7%
Mountainous	40	*18/22	*22/30	12%
Suburban	20-40	*18/22	*22/28	N/A

[1] Suburban Design Speed is the same as Speed Limit in Villages. These areas should be rated as separate sections.

[*] Major Collector/Minor Arterial, respectively.

APPENDIX A

TABLE II-A

MINIMUM GEOMETRIC DESIGN STANDARDS BASED ON A.A.S.H.T.O. & A.O.T. STANDARDS

TO BE USED IN RATING STATE HIGHWAYS

OTHER THAN INTERSTATE AND PRINCIPAL ARTERIAL ROUTES

IN FEDERAL-AID URBAN AREAS [/1]

Traffic Volume	(MPH) Design Speed[/2]	Widths (Ft)	Surface Widths (Ft)	Roadway Gradient
Over 1200 DHV	20-45	24	36	N/A
600 - 1200 DHV	20-45	24	36	N/A
500 - 599 DHV	20-45	22	26	N/A
Up to 499 DHV	20- 45	22	26	N/A

[/1] These standards used only when the Speed Limit is less than 50 MPH in densely developed areas, otherwise use standards for Rural Highways (App. A, Tab. II).

[/2] Design Speed is the same as Speed Limit for rating purposes only.

APPENDIX A
TABLE III
DESIGN SPEED STANDARDS TO BE USED IN RATING RURAL & URBAN HIGHWAYS BASED ON A.A.S.H.T.O. & A.O.T. STANDARDS

Design Speed MPH	Curvature [1]	Stopping [2] Sight Distance (ft.)	Passing [3] Sight Distance (ft.)
65	3° 45'	550	2,300
60	4° 45'	525	2,100
55	6 °	450	1,950
50	7° 30'	400	1,800
45	9° 30'	325	1,650
40	12° 15'	275	1,500
35	16° 30'	225	l,300
30	22° 45'	200	l,100
25	33° 30'	150	950

[1] Maximum superelevation rate of 0.08 ft./ft.
[2] Use these standards when computing stopping sight distance.
[3] Passing distance standard is 1500 ft. as defined in the Highway Capacity Manual for all Average Highway Speeds (Design Speeds).

TABLE IV
PASSING SIGHT DISTANCE REQUIREMENTS TO BE USED IN RATING RURAL AND URBAN HIGHWAYS BASED ON HIGHWAY CAPACITY MANUAL INFORMATION

DHV	Percent
up to 100	10
100-199	20
200-399	30
400-599	40
600-699	50
700-749	60
750-799	80
over 800	80

Note: For rating Interstate (4-Lane) use 100%.
[1] Passing Sight Distance (%) greater than 1500 ft. which generally provides a minimum Level of Service

C as defined in the Highway Capacity Manual.

APPENDIX B

APPENDIX B
FLOOD CORRECTION CHART
Maximum Deduction = 10

DHV	Extra Length of Detour	Number of days per year impassible due to floods **1-3**	**3-7**	**7-10**	**10-14**	**14-20**	**over 20**
0-99	0-1 Mile	3	4	5	6	7	8
	1.1-5 Miles	4	5	6	7	8	9
	Over 5 Miles	5	6	7	8	9	10
100-199	0-1 Mile	4	5	6	7	8	9
	1.1-5 Miles	5	6	7	8	9	10
	Over 5 Miles	6	7	8	9	10	10
200-399	0-1 Mile	5	6	7	8	9	10
	1.1-5 Miles	6	7	8	9	10	10
	Over 5 Miles	7	8	9	10	10	10
400-800	0-1 Mile	6	7	8	9	10	10
	1.1-5 Miles	7	8	9	10	10	10
	Over 5 Miles	8	9	10	10	10	10
Over 800	0-1 Mile	7	8	9	10	10	10
	1.1-5 Miles	8	9	10	10	10	10
	Over 5 Miles	9	10	10	10	10	10

Based on the average number of days for the last 5 years.

APPENDIX C

Chart
Design Hour Volume vs. Average Daily Traffic
By Highway Class

DHV DETERMINATION BASED ON ADT AND HIGHWAY CLASS			
ADT	INTERSTATE	GENERAL HIGHWAYS	RECREATIONAL
50	20	10	
60	25	10	
70	30	11	
80	30	12	
90	33	13	
100	35	15	
125	40	18	
150	43	20	
175	45	25	
200	50	30	
225	55	32	
250	60	35	
275	65	37	
300	70	40	
330	72	45	
365	75	50	
400	85	55	
430	90	60	
465	95	65	
500	100	70	
530	105	75	
565	110	80	
600	115	85	
630	120	90	
665	125	95	
700	130	100	
730	135	105	
765	140	110	
800	145	115	
850	155	120	

900	165	125	
950	170	130	
1000	175	140	
1050	185	145	
1100	195	155	
1130	200	160	
1165	205	165	
1200	210	170	
1250	215	175	
1300	225	180	
1325	230	185	
1360	235	190	
1400	240	195	
1440	245	200	
1500	255	210	
1535	260	215	
1570	265	220	
1600	270	225	
1650	280	230	
1700	285	235	
1730	290	240	
1765	295	245	
1800	300	250	
1840	310	255	
1880	315	260	
1900	320	265	
1950	325	275	
2000	330	280	
2050	340	290	
2100	350	295	
2150	355	300	
2200	360	305	
2250	370	315	
2300	380	320	

2350	385	330	
2400	390	335	
2450	400	345	
2500	410	350	
2550	415	360	
2600	420	365	
2650	430	370	
2700	440	375	
2750	445	385	
2800	450	390	
2850	460	400	
2900	470	405	
2950	475	415	
3000	480	420	
3050	490	425	
3100	495	435	
3150	505	440	
3200	510	445	
3250	520	455	
3300	525	460	
3350	530	465	
3400	540	475	
3450	545	480	
3500	555	485	
3550	560	495	
3600	570	500	
3650	575	505	
3700	580	515	
3750	590	520	
3800	595	525	
3850	605	530	
3900	610	540	
3950	620	545	
4000	625	550	

4050	630	560	
4100	640	565	
4150	645	570	
4200	650	575	
4250	660	580	
4300	665	590	
4350	675	595	
4400	680	600	
4450	690	610	
4500	695	615	
4550	700	620	
4600	710	625	
4650	715	630	
4700	720	640	
4750	730	645	
4800	735	650	
4850	745	655	
4900	750	660	
4950	755	665	
5000	765	670	
5100	775	685	
5200	790	695	
5300	805	705	
5400	820	720	
5500	830	730	
5600	845	740	
5700	855	750	
5800	870	760	
5900	880	775	
6000	895	785	
6100	910	795	
6200	920	805	
6300	935	815	
6400	950	825	

6500	960	835	
6600	975	845	
6700	985	855	
6800	1000	865	
6900	1010	875	
7000	1025	885	
7100	1035	895	
7200	1050	900	
7300	1060	910	
7400	1075	920	
7500	1085	930	
7600	1100	940	
7700	1110	945	
7800	1120	955	
7900	1135	965	Use General
8000	1145	970	Highways Table
8100	1155	975	
8200	1170	990	
8300	1180	995	
8400	1195	1005	
8500	1205	1015	
8600	1215	1020	
8700	1230	1030	
8800	1240	1035	
8900	1250	1045	
9000	1260	1050	
9100	1275	1060	
9200	1285	1065	
9300	1295	1070	
9400	1310	1080	
9500	1320	1085	
9600	1330	1090	
9700	1340	1100	
9800	1350	1105	

9900	1360	1110	
10000	1375	1115	
10500	1430	1150	
11000	1480	1175	
11500	1530	1200	
12000	1580	1225	
12500	1630	10%	
13000	1675	10%	
13500	1720	10%	
14000	1765	10%	
14500	1805	10%	
15000	1850	10%	
15500	1890	10%	
16000	1930	10%	
16500	1965	10%	
17000	2000	10%	
17500	2035	10%	
18000	2070	10%	
18500	2100	10%	
19000	2130	10%	
19500	2160	10%	
20000	2190	10%	
20500	11%	10%	
21000	11%	10%	
21500	11%	10%	
22500	11%	10%	
23000	11%	10%	
23500	11%	10%	
24000	11%	10%	
24500	11%	10%	
25000	11%	10%	
26000	11%	10%	
27000	11%	10%	
28000	11%	10%	

29000	11%	2800*	
30000	11%	2800*	
* Starting at these corresponding ADT volumes, a constant "K" is assumed, under			
normal conditions and based on the histories of various high traffic volume highways.			
The stations used for the analysis were: D1, D2, W6, X11, D91, D92, D99, and R22.			
This relationship may vary depending on the nature of the highway usage.			

1996 AREAS OF STATION INFLUENCE (K% x AADT = DHV)

STATION NO	ROUTE	BEGIN TOWN	BEGIN POINT	END TOWN	END POINT	K%
Y 86	I-89	Hartford	Inter #l	Sharon	Inter #2	13.6
Y 1	I-89	Royalton	Inter #3	Randolph	Inter #4	l3.9
W 2	I-89	Berlin	Inter #7	Montpelier	Inter #8	12.3
W 89	I-89	Waterbury	Inter #l	Richmond	Inter #11	11.8
D 91	I-89	So. Burlington	Inter #14	Winooski	Inter #15	10.6
D 92	I-89	Winooski	Inter #16	Colchester	Inter #17	11.2
F 96	I-89	St. Albans	Inter #20	Swanton	Inter #21	11.7
X 71	I-91	Guilford	Mass.line	Brattleboro	Inter #l	15.7
X 72	I-91	Brattleboro	Interch.#2		Inter #3	12.2
X 74	I-91	Westminster	Inter #5	Rockingham	Inter #6	15.6
Y 76	I-91	Hartford	Inter #9	Hartford	Inter #l0	12.4
Y 2	I-91	Norwich	Inter #13	Thetford	Inter #14	11.8
N 2	I-91	Fairlee	Inter #15	Bradford	Inter #16	11.7
N 1	I-91	Thetford	Inter #14	Fairlee	Inter #15	12.5
C 9	I-91	Newbury	Inter #17	Barnet	Inter #18	15.0
C 2	I-91	Lyndon	Inter #24	Barton	Inter #25	13.8
P 82	I-91	Derby	Inter #28		Inter #29	14.5
X 73	I-91	Putney	Inter #4	Westminster	Inter 5	14.6
C 15	I-93	Waterford	N.H. Line		Inter #19	14.8
D 99	I-189	So. Burlington	Jct. U.S.7		Jct. I-89	10.4
G 25	US 2	Alburg	Jct. Vt.78	Colchester	Jct. TH 58	18.5
W 24	US 2	Montpelier	Jct. BR US 2		Jct. Vt. 12	11.1
C 28	US 2	Danville	Jct. Vt.15	St. Johnsbury	Jct. Vt. 2-B	11.6
R 84	US 4	Castleton	Inter #5	W. Rutland	Jct. Vt. 4-A	10.2
R 5	US 4	Mendon	Rutland T/L	Sherburne	Jct. Vt.100 (No.)	13.2
R 1	US 4	Fair Haven	Inter #2		Inter #3	13.1
Y 244	US 4	Woodstock	Jct. Vt. 12	-	Vill. Line (E)	11.8
X 11	US 5	Brattleboro	Jct. Vt.30	-	Jct. Vt. 9 (No.)	9.4
X 8	US 5	Rockingham	U.C.limit (No,)	-	Jct. Vt. 103	10.9
Y 31	US 5	Norwich	Jct.Norwich S.H	-	Jct. Vt. 132	12.0
B 37	US 7	Pownal	Mass. line	-	Jct. Vt. 346	13.7
D 132	US 7	Charlotte	F-5	Vergennes	Jct. Vt. 22A	10.3
B 282	US 7	Bennington	Inter #2	Arlington	Jct. Vt. 313	15.9
R 22	US 7	Rutland T.	Jct. US 4(W)	Rutland C.	Jct. US 4(E)	10.1
A 18	US 7	Brandon	Jct.Vt.73 (No)	Middlebury	Jct. Vt. 116	11.0
A 41	US 7	New Haven	Jct. Vt. 17	Middlebury	Jct. Vt. 125	10.8
D 2	US 7	Shelburne	Jct. SA 2	So. Burlington	Jct. TH 26	9.3
D 40	US 7	Colchester	Jct. I-89		Jct. Vt.127	11.4
F 29	US 7	Georgia	Jct. I-89	St. Albans C.	St. Albans SH So	10.9
W 6	US 302	Montpelier	Jct. US 2	Berlin	Jct. Berlin S.H.	10.5
W 14	US 302	Barre City	Jct. Vt. 62	Jct. Vt. 14		7.7
B 9	Vt. 7A	Shaftsbury	Jct. Vt. 67	Arlington	Jct. Vt.313 (So.)	14.7
B 41	Vt. 9	Bennington	N.Y. line		Jct. S.A.2	12.8
X 27	Vt. 9	Searsburg	Jct. Vt. 8	Wilmington	Jct. Vt.100 (No.)	17.8
Y 33	Vt. 10A	Norwich	Entire Length			11.1
B 272	Vt. 11	Manchester	Jct. Vt. 7A		Jct. US 7	12.5

1996 AREAS OF STATION INFLUENCE (K% x AADT = DHV) (con=t)

STATION NO	ROUTE	BEGIN TOWN	BEGIN POINT	END TOWN	END POINT	K%
B 26	Vt. 11	Winhall	Jct. Vt.30	Peru	Bromley Acc Rd.	18.2
L 47	Vt. 12	Worcester	Jct. SA l	Elmore	Jct. TH 7	13.8
C 7	Vt. 15	Morristown	Jct. Vt. 15-A	Hardwick	Jct. Vt.14 (No.)	11.2
A 19	Vt. 22A	Fair Haven	Jct. US 4	Orwell	Jct. Vt. 73	13.1
W 4	Vt. 62	Berlin	Jct. Berlin S.H.	Barre	Jct. US 302	11.9
X 64	Vt. 100	Wilmington	Jct. Vt. 9	Dover	Jct. TH 3 (N)	21.1
P 4	Vt. 100	Westfield	Jct. SA l	Troy	Jct. Vt. 101	11.1
R 17	Vt. 103	Ludlow	Jct. Vt.100(No.)	Mt. Holly	Jct. Vt. 140	11.0
X 249	Vt. 103	Rockingham	Jct. I-91 Inter #6	Chester	Jct. Vt. 11	15.7
L 57	Vt. 108	Stowe	Jct. TH 10	-	Jct. SF Rd.	27.5
D I	FAU 5009	Burlington	Entire Length	-		10.2
W 22	FAS 0243	E. Montpelier	FAU Limit	-	Jct. TH 4	12.5
R54	TH 2	Sherburne	US-4	-	Ski Area (TH 2)	20.3
W 62	TH 5	Warren	Vt. 100	-	Ski Area	25.2

IDENTIFICATION OF "RECREATIONAL HIGHWAYS" FOR DHV PURPOSES (1996)

ROUTE	BEGIN TOWN	BEGIN POINT	END TOWN	END POINT	
I-91	Norwich	Interch.#23	Derby	Canada line	*C2, P82
US 2	Alburg	Jct. Vt. 78	Colchester	Jct. I-89	* G25
US 2	Plainfeld	Jct. Vt. 214	W. Danville	Jct. Vt. 15	* C28
US 4	Mendon	Rutland T/L	Sherburne	Jct. S.A.2	* R5
VT 5-A	Burke	Jct. US 5	Charleston	Jct. Vt.105	
VT 9	Bennington	U.C.line (East)	Searsburg	Jct. Vt.8	
VT 9	Wilmington	Jct. Vt.100(No)	Brattleboro	Jct. I-91	
VT 11	Manchester	Jct. US 7	Londonderry	Jct. Vt. 100	*B26
VT 12	Worcester	Jct. SA1	Elmore	Jct. TH 7	*L47
VT 17	Bristol	Jct. Vt. 116	Waitsfield	Jct. Vt.100	
VT 30	Jamaica	Jct. Vt.100(No.)	Poultney	Jct. Vt.31	
VT 30	Castleton	Jct. US 4		Jct. TH 14	
VT 100	Wilmington	Jct. Vt 9	Dover	Jct. TH 53	*X64
VT 100	Warren	Jct. TH 5	Moretown	Jct. Vt.100B	
VT 102	Guildhall	Jct. US 2	Canaan	Jct. Vt.114	
VT 105	Brighton	Jct. Vt,114(No.)	Bloomfield	Jct. vt,102	
VT 108	Stowe	Jct. vt,100		Jct. TH 10	*L2
US 2	St. Johnsbury	Jct. VT 18	Guildhall	NH State line	
VT 18	Waterford	NH State Line	St. Johnsbury	US 2	
VT 114	Island Pond	VT 105	CanaanVT	102/VT 253	
VT 58	Irasburg	I 91 inter.#26	Brownington	VT 5A	
US 5	Lyndon	Lyndonville Vill.	Irasburg	Interch. #26 I 91	
VT 5A		Entire Length			
VT 111		Entire Length			
VT 129		Entire Length			
VT 141		Entire Length			
VT 232		Entire Length			
VT 236		Entire Length			
VT 253		Entire Length			
VT 314		Entire Length			
Maidstone S.H.		Entire Length			
So. Alburg S.H.		Entire Length			

*Partially or Totally superceded by Station Influence.

APPENDIX D

APPENDIX D

VERMONT HIGHWAY SUFFICIENCY RATING

ROUTE: _____ **STRUCTURAL CONDITION** condition rating

LENGTH: _____ SECTION#: ______ FOUNDATION (30):

SLIDES (-): _______

TOWNS: _____ LOG STA: ___+___ STRUCT (BR) EVAL (-): _______

TO: ___+___ SUB-TOTAL:

CULVERTS (4): _______

COUNTY: _____ DISTRICTS: _____ DITCHES (4): _______

SURFACE (12):

FUNCTIONAL CLASS: ______ TOTAL:

YEAR: 1996 AADT:_____ DHV: ____ **SAFETY** standard actual rating

SURFACE TYPE: ____ TERRAIN: ___ SURFACE WIDTH(6): ______ ______

BRIDGE WIDTH (-): ______ ______

SUB-TOTAL: ______ ______

PROJECTS ON SECTION ROADBED WIDTH (7): _______ ______

STOP SIGHT DIST (8): ______ ______

PROJECT # YEAR SIGHT DIST CORR (-): ______ ______

SUB-TOTAL:

___________ _____ INCONSISTENCY (4):

___________ _____ ACCIDENT DEDUCTION (-): ______

___________ _____ TOTAL:

___________ _____

SERVICE standard actual

rating

LOCATION: ________________________ AVG HWY SPEED (12): ______ ______

________________________ SPEED CORRECTION (-): ______ ______

________________________ SUB-TOTAL:

________________________ PS PASS SIGHT DIST>1500' (6): ______ ______

________________________ WIDTH (4): ______ ______

REMARKS: ________________________ RIDEABILITY (3):

________________________ EXCESSIVE GRADES (-): ______

________________________ VERTICAL CLEARANCE (-): ______ ______

________________________ TOTAL:

STRUCTURES IN SECTION 6 FEET AND OVER
(with vertical, width, & load corrections)

BRIDGE NO.	SPAN	WIDTH	STRU. EVAL	VERT CLR.	CORRECTIONS WIDTH	LOAD	TYPE
___	_____	_______	_____	____	_______	_____	____________
___	_____	_______	_____	____	_______	_____	____________
___	_____	_______	_____	____	_______	_____	____________
___	_____	_______	_____	____	_______	_____	____________

ADJUSTED TOTALS rating

STRUCTURAL COND:

SAFETY:

SERVICE:

FLOOD CORREC. (-):

MUD/DUST ADJ. (-):

BASIC RATING:

TRAFFIC ADJ (+,-).:

ADJUSTED RATING:

RESTRICTED STOPPING SIGHT DISTANCES | **SUBSTANDARD CURVES AND GRADES**

Mile Point	Ft.	Deduct.	Mile Point	Curve Deg.	Grade: %	Miles	Passing Lane ??		RR-X	Deduct.

ACCIDENT DATA
(93-97) [1]

TOTAL ACCIDENTS	FATAL ACCIDENTS	FATALITIES

ACCIDENT RATE	CRITICAL RATE	CRITICAL RATE FACTOR

SLIDES

MILE POINT	COND.	DEDUCTION

[1] The years analyzed (along with accident data) will change as data becomes available.

NOTES: