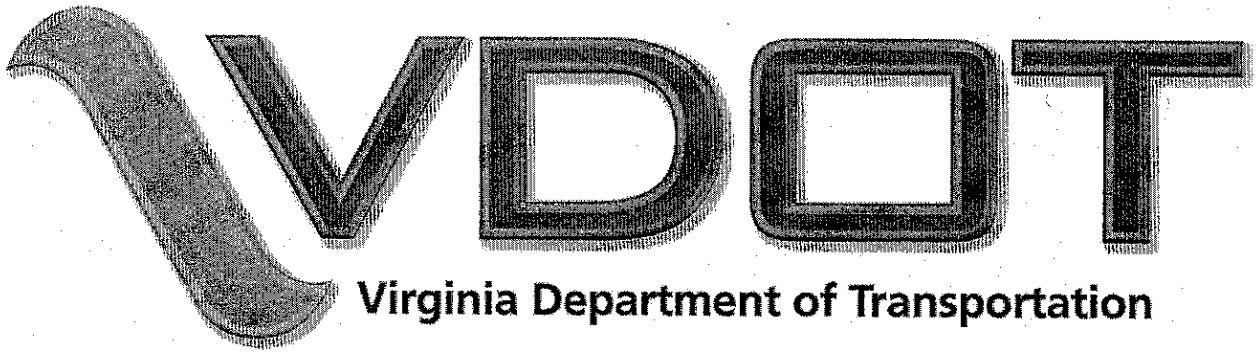


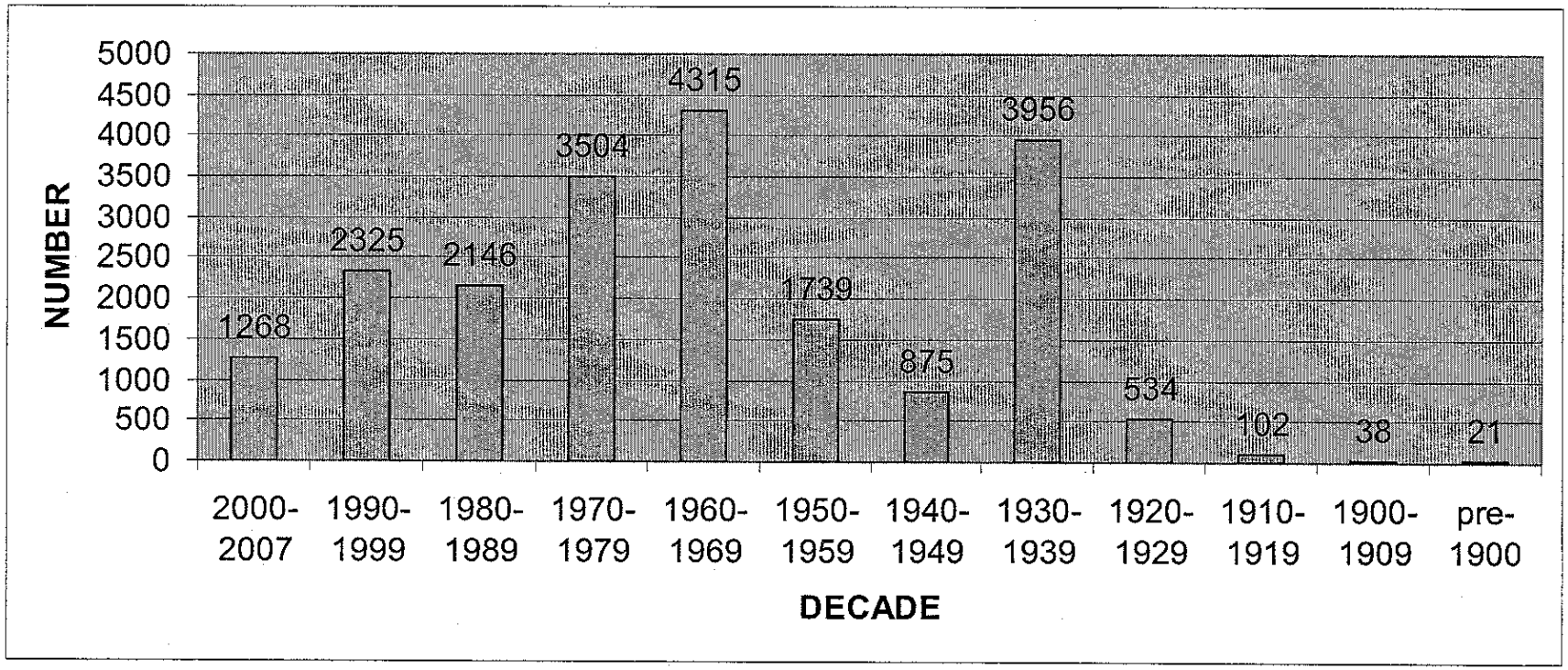
Structure and Bridge Division
Status of the Commonwealth's Structures
September 2007

Commonwealth's Structure Inventory

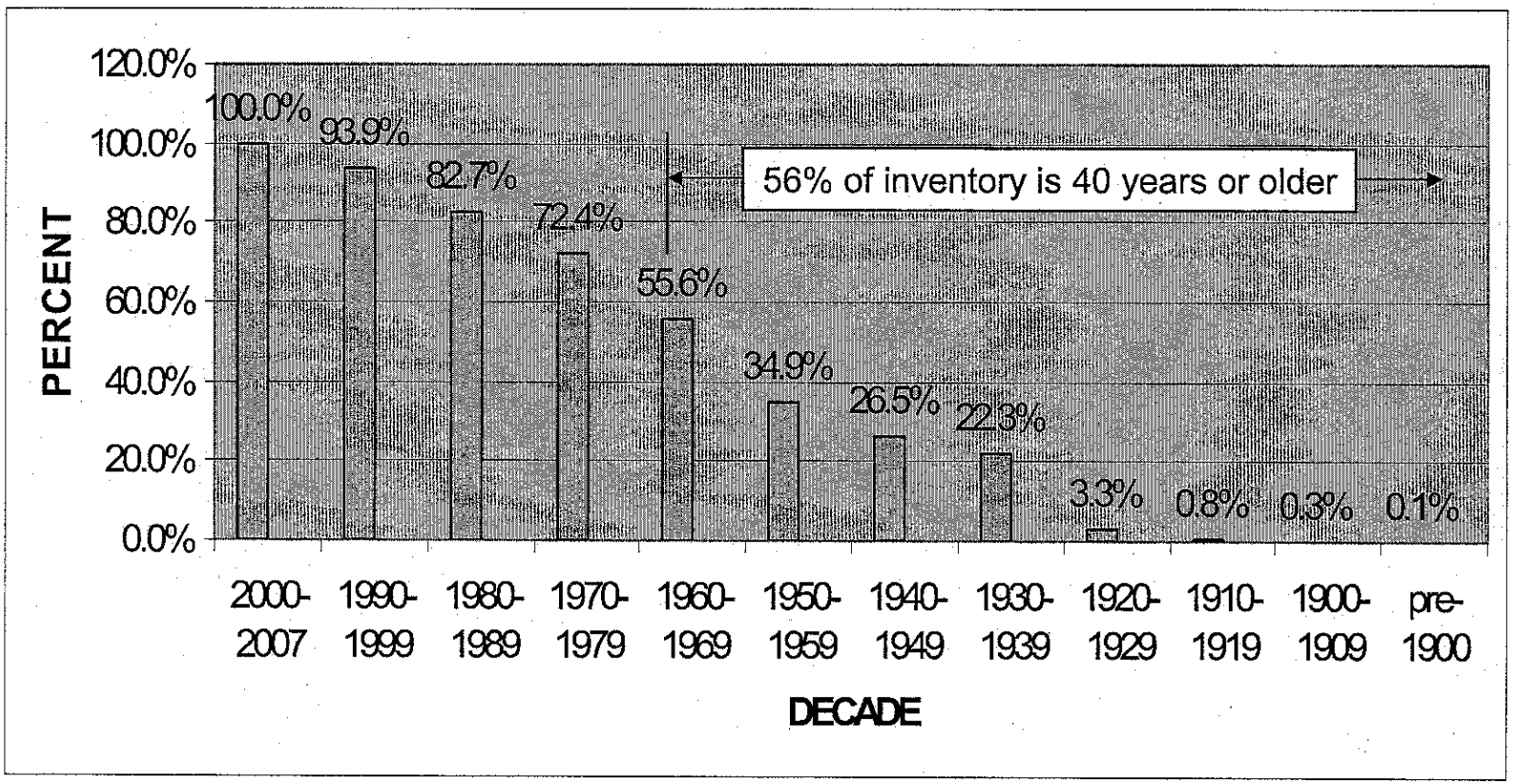
- NBI = National Bridge Inventory
- FHWA requires the states to provide only NBI data
- VDOT provides FHWA with NBI data in the month of April annually
- NBI structures include bridges and culverts that are more than 20 feet long (measured along the centerline of the road)
- Non-NBI structures include bridges that are equal to or less than 20 feet long and culverts that have an opening ≥36 SF

DISTRICT	No. of Structures		
	NBI	Non-NBI	Total
Bristol	1,846	1,430	3,276
Salem	1,802	1,246	3,048
Lynchburg	1,392	739	2,131
Richmond	1,964	681	2,645
Hampton Roads	1,390	321	1,711
Fredericksburg	519	286	805
Culpeper	1,023	670	1,693
Staunton	1,834	1,647	3,481
NOVA	1,348	685	2,033
Total =	13,118	7,705	20,823

Age of Inventory



Cumulative Percentage of Structures



Bridge Sufficiency Rating Formula

- The **Sufficiency Rating Formula** is a method of evaluating factors that indicate a bridge's sufficiency to remain in service. The result of the formula is a percentage in which 100 percent represents an entirely sufficient bridge and zero percent represents an entirely insufficient or deficient bridge. The sufficiency rating is never less than 0 or more than 100.

- **Federal Bridge Funding**

  - Applies only to NBI Structures (Bridges and Culverts > 20 feet in length)

  - Structure Replacement
    - Structure requires a Sufficiency Rating of less then 50

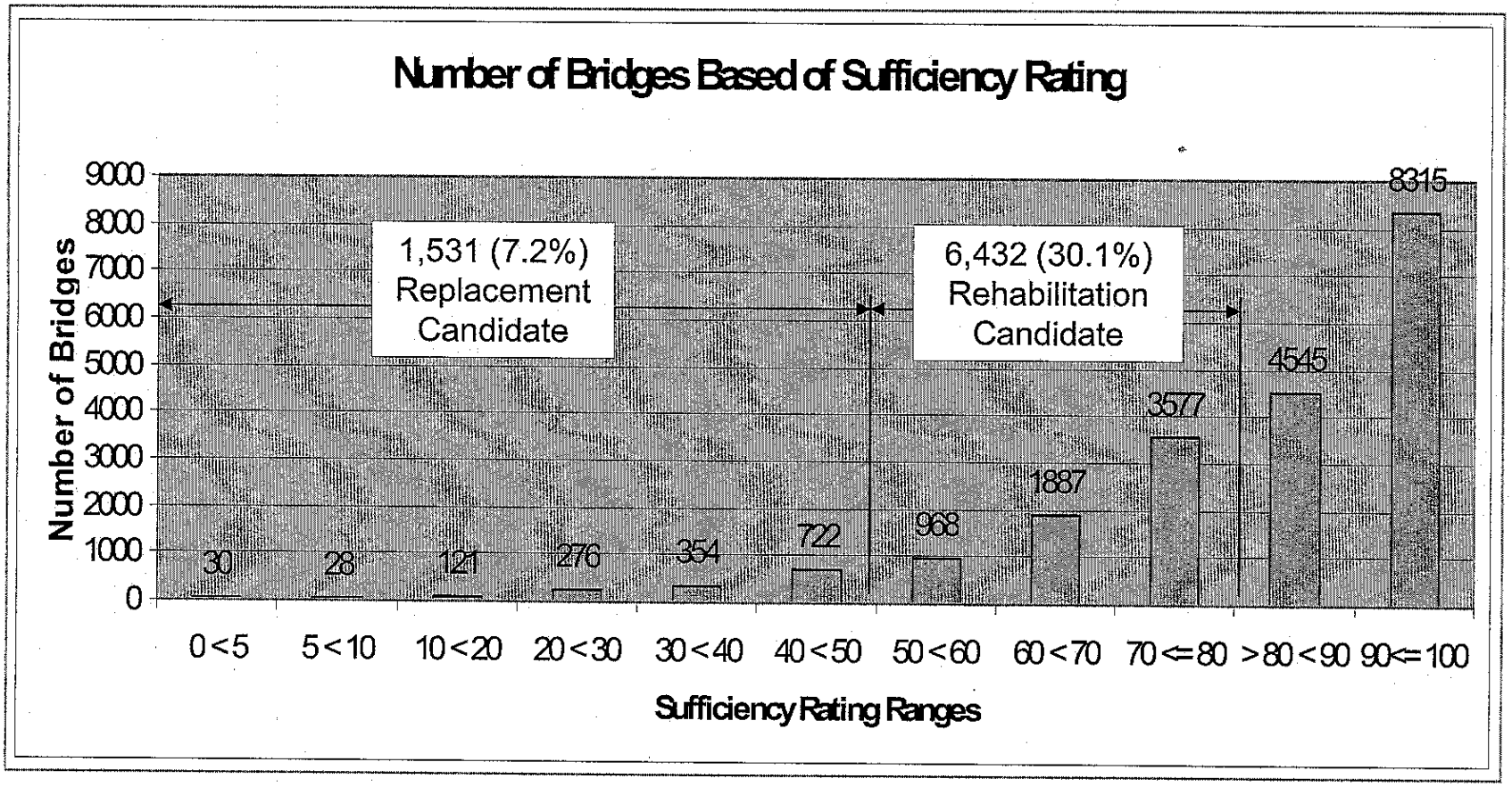
  - Structure Rehabilitation
    - Structure requires a Sufficiency Rating of less then or equal to 80

  - Ten Year Rule
    - Structures built or reconstructed within the last 10 years are not counted by FHWA as structurally deficient (SD) or functionally obsolete (FO).

Bridge Sufficiency Rating Formula

- **Elements included in the Formula (S1+S2+S3-S4)**
  - S1 = Structural Adequacy and Safety (55%)
    - Superstructure, Substructure, Culverts and Inventory Ratings
  - S2 = Serviceability and Functional Obsolescence (30%)
    - Rating Reductions, Roadway Insufficiency, Under Clearances
  - S3 = Essentiality for Public Use (15%)
    - Detour length, ADT, Highway Designation
  - S4 = Special Reductions (13% Max)
    - Detour Length
    - Traffic Safety Features
    - Structure Type

Sufficiency Ratings of Inventory



FHWA Deficient Structures

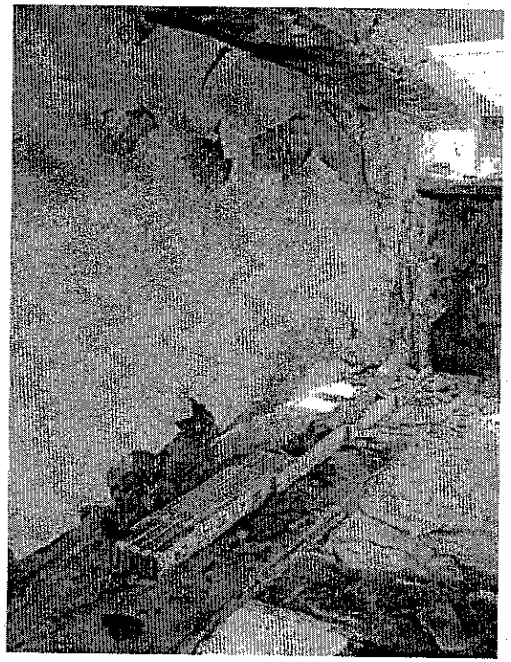
The Federal Highway Administration (FHWA) identifies a deficient structure as being either structurally deficient (SD) or functionally obsolete (FO).

	Structures in Inventory	Total # of SD	Total # of FO	Total # of SD and FO
NBI	13,118	1,197 (9%)	2,199 (17%)	3,396 (26%)
Non-NBI	7,705	542 (7%)	904 (12%)	1,446 (19%)
Total =	20,823	1,739 (8.4%)	3,103 (14.9%)	4,842 (23.3%)

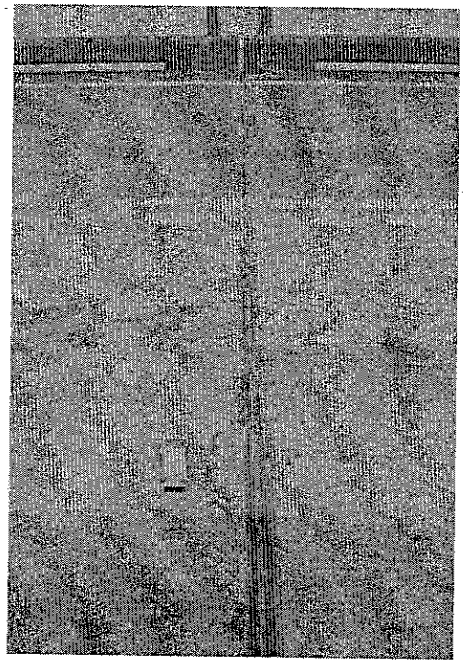
Structurally Deficient Structures

- **Structurally Deficient** means there are elements of the bridge that need to be monitored and/or repaired.
  - An element (deck, superstructure or substructure) receives a general condition rating of a 4 or less (poor or worse condition)
  - Structural Condition or Waterway Adequacy rated a 2 or less
    - Very low load rating and bridge needs replacement
    - Frequently floods causing traffic delays

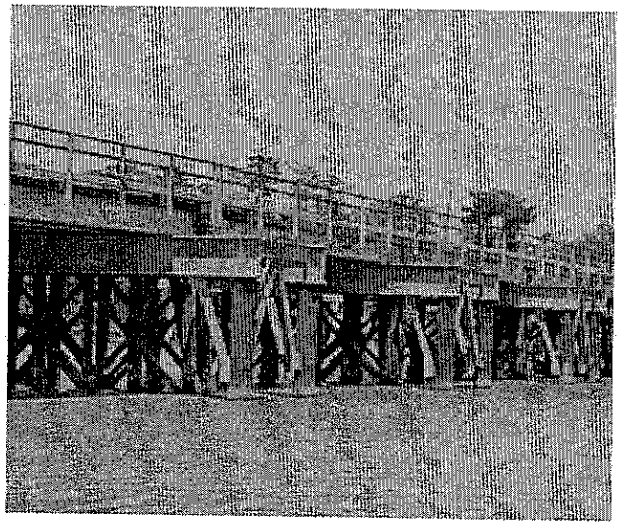
Structurally Deficient Structure Example



Superstructure



Deck



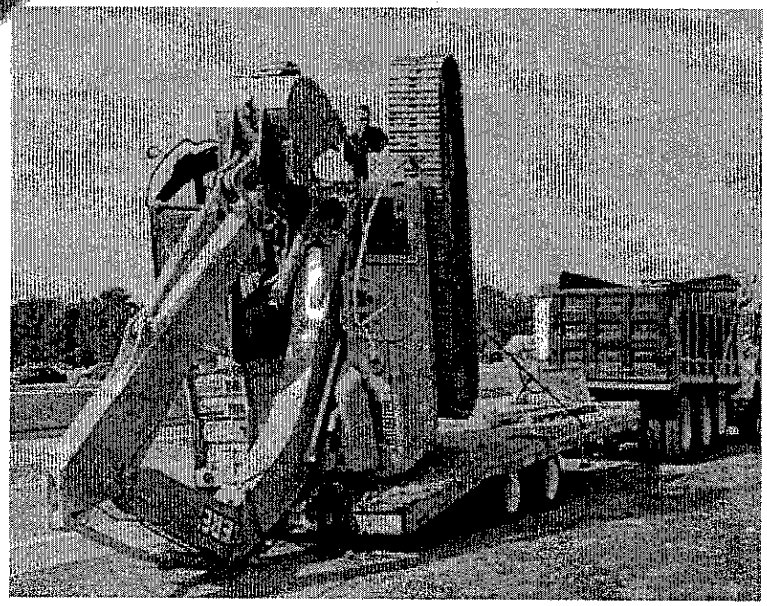
Substructure

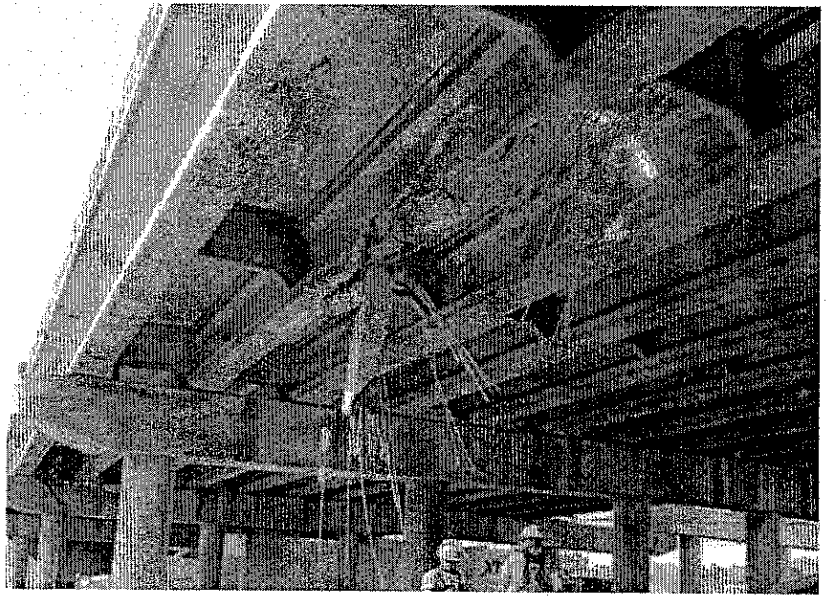
Functionally Obsolete Structures

- **Functionally Obsolete** means that the bridge was built to standards that are not used today.

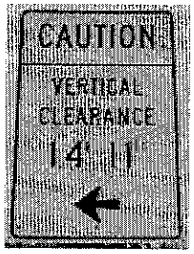
- **Examples:**
  - Deck Geometry (Shoulder requirements have increased)
  - Load Carrying Capacity
  - Horizontal and Vertical Clearances
  - Approach Roadway Alignment
  - Waterway Adequacy

Functionally Obsolete Structure Example

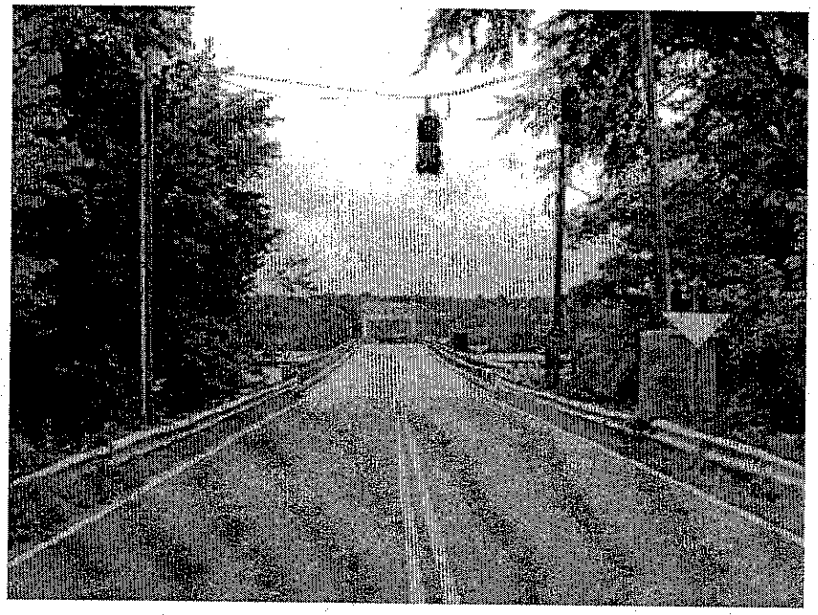


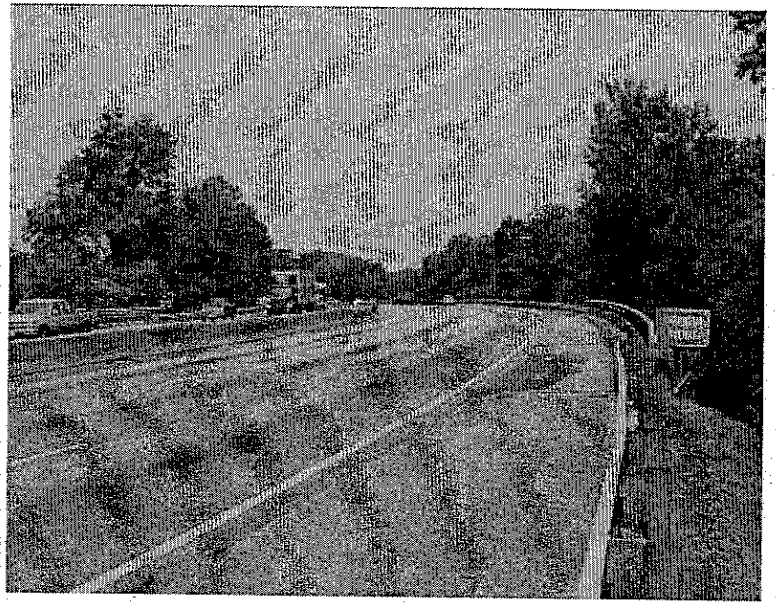


Vertical Clearance



Functionally Obsolete Structure Example





Shoulder Widths

- Do not meet current standards

Structural Inventory per VDOT Construction District

Inventory per District												
DISTRICT	No. of Structures			SD			FO			Total SD/FO		
	NBI	Non-NBI	Total	NBI	Non-NBI	Total	NBI	Non-NBI	Total	NBI	Non-NBI	Total
Bristol	1,846	1,430	3,276	283	160	443	252	158	410	535	318	853
Salem	1,802	1,246	3,048	214	100	314	391	238	629	605	338	943
Lynchburg	1,392	739	2,131	131	73	204	258	71	329	389	144	533
Richmond	1,964	681	2,645	165	29	194	253	43	296	418	72	490
Hampton Roads	1,390	321	1,711	62	2	64	293	9	302	355	11	366
Fredericksburg	519	286	805	52	15	67	70	12	82	122	27	149
Culpeper	1,023	670	1,693	93	21	114	172	80	252	265	101	366
Staunton	1,834	1,647	3,481	170	135	305	283	220	503	453	355	808
NOVA	1,348	685	2,033	27	7	34	227	73	300	254	80	334
Total =	13,118	7,705	20,823	1,197	542	1,739	2,199	904	3,103	3,396	1,446	4,842

Inventory per Roadway Classification

DISTRICT	No. of Structures					Structurally Deficient					Functionally Obsolete				
	I	P	S	U	O	I	P	S	U	O	I	P	S	U	O
Bristol	258	896	2,005	117	0	17	84	318	24	0	35	101	258	16	0
Salem	275	723	1,884	164	2	15	42	246	11	0	31	130	428	40	0
Lynchburg	0	603	1,410	118	0	0	28	162	14	0	0	95	201	33	0
Richmond	722	717	1,093	113	0	34	47	106	7	0	62	83	129	22	0
Hampton Roads	533	268	468	440	2	2	15	21	26	0	102	27	82	91	0
Fredericksburg	107	238	448	12	0	4	16	43	4	0	8	31	43	0	0
Culpeper	147	483	1,025	31	7	2	14	94	3	1	8	45	192	6	1
Staunton	527	757	2,061	136	0	7	44	245	9	0	35	108	334	26	0
NOVA	437	414	1,054	63	65	3	10	21	0	0	82	59	146	9	4
Total =	3,006	5,099	11,448	1,194	76	84	300	1,256	98	1	363	679	1,813	243	5

I = Interstate; P = Primary; S = Secondary; U = Urban; O = Other

Inventory on National Highway System

DISTRICT	Total Inventory	# on NHS	% of Total	# SD NHS	% of NHS	# FO NHS	% of NHS
Bristol	3,276	483	14.7%	24	5.0%	56	11.6%
Salem	3,048	493	16.2%	15	3.0%	72	14.6%
Lynchburg	2,131	300	14.1%	9	3.0%	43	14.3%
Richmond	2,645	916	34.6%	37	4.0%	55	6.0%
Hampton Roads	1,711	777	45.4%	13	1.7%	129	16.6%
Fredericksburg	805	161	20.0%	4	2.5%	15	9.3%
Culpeper	1,693	284	16.8%	5	1.8%	12	4.2%
Staunton	3,481	505	14.5%	2	0.4%	32	6.3%
NOVA	2,033	786	38.7%	11	1.4%	128	16.3%
Total =	20,823	4,705	22.6%	120	2.6%	542	11.5%

Bridge Inspections

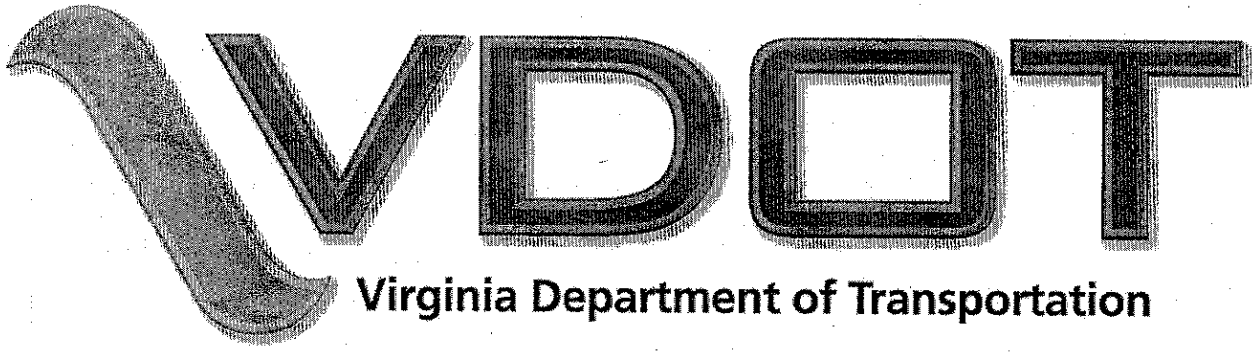
Number of Inspections (Aug 2006 thru Aug 2007)									
DISTRICT	No. Bridge Inspections	Percent of State	Bridge Area	Percent of State	No. Culvert Inspections	Percent of State	Culvert Area	Percent of State	Total Structures
Bristol	1,385	18%	6,758,096	7%	318	11%	1,725,872	10%	1,703
Salem	1,223	16%	7,832,415	8%	462	16%	1,831,723	11%	1,685
Lynchburg	791	11%	5,875,868	6%	314	11%	1,641,398	9%	1,105
Richmond	757	10%	17,828,242	19%	396	14%	3,014,498	17%	1,153
Hampton Roads	631	8%	27,812,360	30%	158	6%	1,123,396	6%	789
Fredericksburg	220	3%	3,453,960	4%	162	6%	738,867	4%	382
Culpeper	652	9%	3,400,276	4%	332	12%	1,287,943	7%	984
Staunton	1,321	18%	7,941,561	8%	340	12%	2,158,329	12%	1,661
NOVA	527	7%	12,914,580	14%	348	12%	3,865,423	22%	875
Total	7,507	100%	93,817,359	100%	2,830	100%	17,387,449	100%	10,337

In Summary

- **VDOT Inspection Practices**
  - **VDOT is in full compliance with the National Bridge Inspection Standards (NBIS) criteria**
    - Bridges and culverts measuring more than 20 feet (measured along the roadway Centerline) be inventoried and receive routine inspections at a frequency not to exceed 2 years
    - Bridges with Fracture Critical Members (FCM) to receive a "close-up" inspections at a frequency not to exceed two (2) years
    - Bridges crossing major waterways to receive underwater inspections at a frequency not to exceed five (5) years
  - **In addition:**
    - All bridges are inventoried and inspected at least once every two years regardless of length
    - All culverts having an opening of ≥36 SF are inventoried and inspected regularly
    - Bridges with Fracture Critical Members (FCM) receive "close up" inspections annually
    - Bridges having fatigue prone details receive "close up" inspections

- **Appropriation of Federal Bridge Funds**
  - Calculated based on percentage of the total NBI deficient structure deck area compared to the total deck area of all NBI structures

- **Structurally Deficient Structures**
  - 8.4% of the total structure inventory (1,739 bridges)
  - Holding consistently for the past five years at approximately 9%



Structure and Bridge Division
Status of the Commonwealth's Structures
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