

## Chapter 6

### A Workbook for the Noise Assessment Guidelines

#### Introduction

The following problems were prepared to give you the opportunity to practice the calculations and procedures described in the *Noise Assessment Guidelines*. Because it is so rarely used, we have not included any problems dealing with the aircraft noise procedure.

We have not reproduced the charts or tables from the *Guidelines* so you will need to have it at hand to do the problems.

## Noise Assessment Guidelines Workbook

### Problems

#### Problems 1 Through 7: Combining Sound Levels in Decibels

Calculate the Combined Sound Level for the Following Sets of Individual Levels:

1. 67 LDN  
61 LDN

\_\_\_\_\_ Combined  
Level

4. 62 LDN  
85 LDN

\_\_\_\_\_ Combined  
Level

7. 73 LDN  
72 LDN  
61 LDN  
67 LDN

\_\_\_\_\_ Combined  
Level

2. 63 LDN  
63 LDN

\_\_\_\_\_ Combined  
Level

5. 67 LDN  
72 LDN

\_\_\_\_\_ Combined  
Level

3. 51 LDN  
68 LDN

\_\_\_\_\_ Combined  
Level

6. 59 LDN  
63 LDN  
71 LDN

\_\_\_\_\_ Combined  
Level

#### Problems 8 and 9: Calculating Effective Distance

Calculate the Effective Distances for the Following Roads:

8. Distance in Feet from NAL to:  
Near Edge of Nearest Lane 22 Feet  
Far Edge of Farthest Lane 76 Feet  
Effective Distance \_\_\_\_\_

9. Distance in Feet from NAL to:  
Near Edge of Nearest Lane 60 Feet  
Far Edge of Farthest Lane 84 Feet  
Effective Distance \_\_\_\_\_

#### Problems 10 Through 15: Adjustment Factors

List The Adjustment Factors Necessary for Each of the Following Situations and the Numerical Value for Each Adjustment Factor.

10. A Roadway Where the Road Gradient is 1%, the Average Speed for Both Autos and Trucks is 30 MPH and the Fraction of Nighttime Traffic is 10%.

Adjustment Factors Needed: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Value of Adjustment Factors: \_\_\_\_\_

\_\_\_\_\_

11. A Roadway Where There Is A Stop Sign 400 Feet from the NAL. The Gradient is 1%, the Average Speed for Autos is 45 MPH (There Are No Trucks) and the Fraction of Nighttime Traffic is 15%.

Adjustment Factors Needed: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Value of Adjustment Factors: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

12. A Roadway Where the Road Gradient Is 2%, the Average Speed for Autos Is 50 MPH and for Trucks (Both Uphill and Downhill) Is 50 MPH and the Fraction of Nighttime Traffic Is 10%.

Adjustment Factors Needed: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Value of Adjustment Factors: \_\_\_\_\_

\_\_\_\_\_

13. A Railroad Where the Fraction of Operations Occurring at Night Is 30%, the Average Train Speed Is 40 MPH, the Track Is Bolted and There Are No Whistle Or Horns Required for Grade Crossings.

Adjustment Factors Needed: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Value of Adjustment Factors: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

14. A Railroad Where the Fraction of Operations Occurring at Night Is 5%, the Average Train Speed Is 10 MPH, the Tracks Are Welded and There Are No Whistles Or Horns Required for Grade Crossing.

Adjustment Factors Needed: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Value of Adjustment Factors: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

15. A Railroad Where the Fraction of Operations Occurring at Night Is 20%, the Average Train Speed Is 30 MPH, the Track Is Bolted and No Whistles or Horns Are Required for Grade Crossings.

Adjustment Factors Needed: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Value of Adjustment Factors: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**Problems 16 Through 21: Some Basic Problems**

Calculate the Combined Noise Levels for Each of the Following Situations:

16. A Roadway Where the distance in Feet from the NAL to the Near Edge of the Nearest Lane is 310 Feet, the Distance to the Far Edge of the Farthest Lane is 358 Feet. There is A Stop Sign 400 Feet from the NAL. The Gradient is 1%. The Average Number of Automobiles is 17,000, the 24 Hour Average Number of Medium Trucks is 1,500, the 24 Hour Average Number of Heavy Trucks is 400 Total. The Fraction of Nighttime Traffic is 20%.

The Combined Noise Level for This Roadway is \_\_\_\_\_.

17. A Site Exposed to Noise from Two Roads. For Roadway Number 1 the Distance in Feet from the NAL to the Near Edge of the Nearest Lane is 125 Feet, the Distance to the Far Edge of the Farthest Lane is 233 Feet. There is A Stop Sign 250 Feet from the NAL. The Gradient is 3%. The Average Speed for Both Autos and Trucks is 30 MPH.

The 24 Hour Average Number of Autos is 22,000, the 24 Hour Average Number of Medium Trucks is 2,000. The 24 Hour Average Number of Heavy Trucks is 950 Total. The Fraction of Nighttime Traffic is 10%.

For Roadway Number 2, the Distance to the Near Edge of the Nearest Lane is 45 Feet, the Distance to the Far Edge of the Farthest Lane is 93 Feet. There is A Stop Sign 100 Feet from the NAL and the Gradient is 1%. The Average Speed for Both Autos and Heavy Trucks is 30 MPH. The 24 Hour Average Number of Automobiles is 14,000, for Medium Trucks 700, and for Heavy Trucks 600 Total. The Fraction of Nighttime Traffic is 20%.

The Combined Noise Level for This Site is \_\_\_\_\_.

18. A Site Exposed to Noise from Two Railroads. For Railroad 1, the Distance in Feet from the NAL to the Railway Track is 150 Feet. There are 35 Diesel Trains Every 24 Hours, No Electrified Trains. The Fraction of Operations Occurring at Night is 25%. There are 3 Diesel Locomotives Per Train and 70 Cars Per Train. The Average Speed is 30 MPH and the Track is Bolted. No Whistles Or Horns are Used.

For Railroad 2, the Distance in Feet from the NAL to the Railway Track is 310 Feet. There are 20 Diesel and 2 Electrified Trains Each 24 Hours. The Fraction of Operations Occurring at Night is 15%. There are 2 Locomotives Per Diesel Train and 45 Cars for Each Diesel Train and 15 Cars Per Electrified Train. The Average Train Speed is 40 MPH and the Track is Bolted. No Horns Or Whistles are Used.

The Combined Noise Level for This Site is \_\_\_\_\_.

19. A Site Exposed to Noise from Two Railroads. For Railroad 1, the Distance in Feet from the NAL to the Railway Track is 75 Feet. There are 34 Diesel Trains Every 24 Hours, No Electrified Trains. Twenty Percent of the Operations Occur at Night. There are 5 Locomotives Per Train and 75 Cars Per Train. The Average Train Speed is 35 MPH and the Track is Welded. No Horns Or Whistles.

For Railway 2, the Distance in Feet from the NAL to the Railway Track is 120 Feet. There are 12 Diesel Trains in 24 Hours, No Electrified Trains. Twenty-Five Percent of the Operations Occur at Night. There are 4 Locomotives Per Train and 40 Cars Per Train. The Average Train Speed is 20 MPH and the Track is Bolted. No Horns Or Whistles are Used.

The Combined Noise Level for This Site is \_\_\_\_\_.

20. A Site Exposed to Noise from Three Roads. For Road 1, the Distance in Feet from the NAL to the Near Edge of the Nearest Lane is 100 Feet, to the Far Edge of the Farthest Lane, 208 Feet. There is No Stop Sign and the Gradient is 1%. The Average Speed for Autos is 55 MPH. (There are No Trucks Allowed On This Road.) The 24 Hour Average Number of Autos is 40,000. The Fraction of Nighttime Traffic is 15%.

For Road 2, the Distance from the NAL to the Near Edge of the Nearest Lane is 45 Feet, to the Far Edge of the Farthest Lane 75 Feet. There is A Stop Sign 175 Feet from the NAL and the Road Gradient is 4%. The average Speed for Both Autos and Trucks is 40 MPH. The 24 Hour Average Number of Autos is 15,000, for Medium Trucks 900 and for Heavy Trucks 320 Total. The Fraction of Nighttime Traffic is 20%.

For Road 3, the Distance from the NAL to the Near Edge of the Nearest Lane is 52 Feet, to the Far Edge of the Farthest Lane 92 Feet. There is A Stop Sign 400 Feet from the NAL and the Gradient is 1%. The Average Speed for Both Autos and Trucks is 25 MPH. The 24 Hour Average Number of Autos is 5,000, for Medium Trucks 1,050 and for Heavy Trucks 175 Total. The Fraction of Nighttime Traffic is 20%.

The Combined Noise Level for This Site is \_\_\_\_\_.

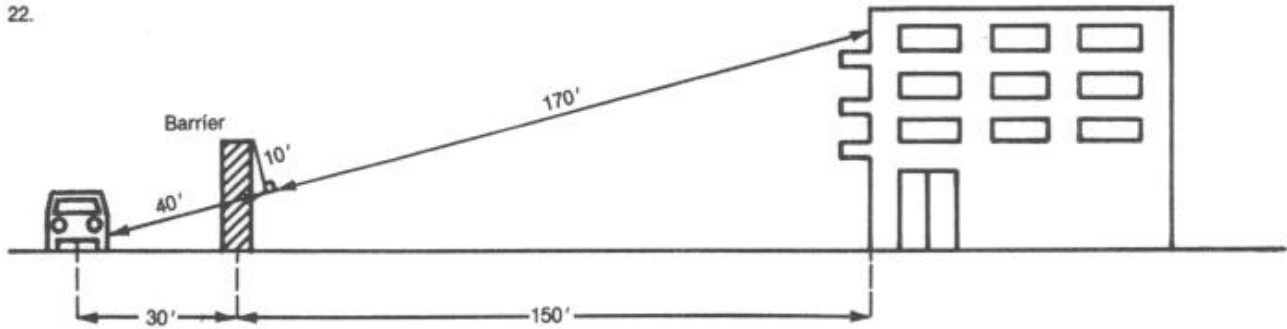
21. A Site Exposed to Noise from A Railroad. The Distance from the NAL to the Railroad Is 110 Feet. There Are 30 Diesel Trains Every 24 Hours, No Electrified Trains. Twenty Percent of the Operations Occur at Night. There Are 3 Locomotives Per Train and 50 Cars Per Train. The Average Train Speed Is 30 MPH, the Track Is Bolted and There Is A Grade Crossing Where Horns and Whistles Are Used 100 Feet from the NAL.

The Combined Noise Level at This Site Is \_\_\_\_\_

**Problems 22 Through 24: Barriers - Identifying the Values for H, R, R', D and D'**

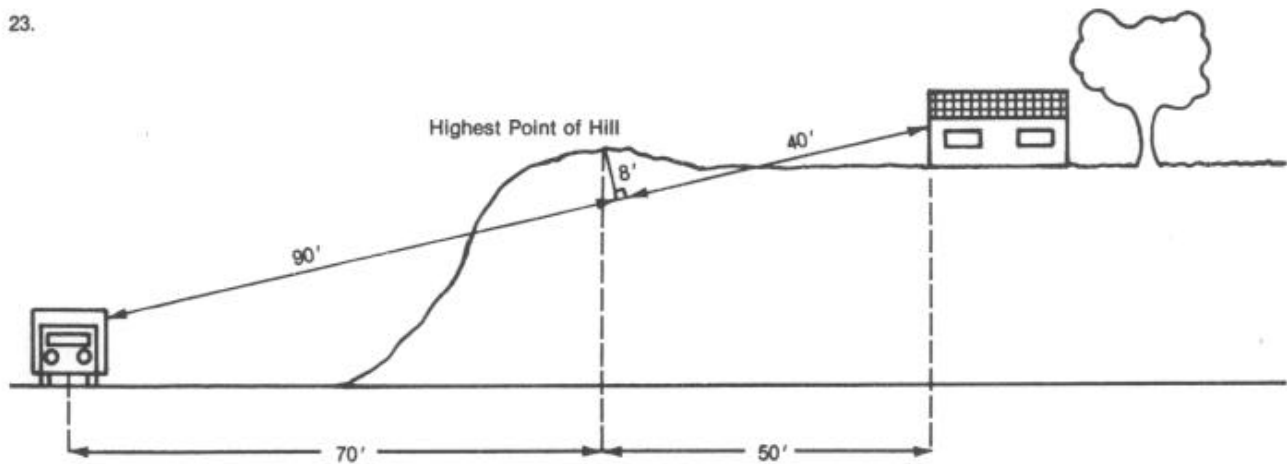
Identify the Values for H, R, R', D and D' for Each of the Following Barriers:

22.



H = \_\_\_\_\_, R = \_\_\_\_\_, R' = \_\_\_\_\_, D = \_\_\_\_\_ and D' = \_\_\_\_\_

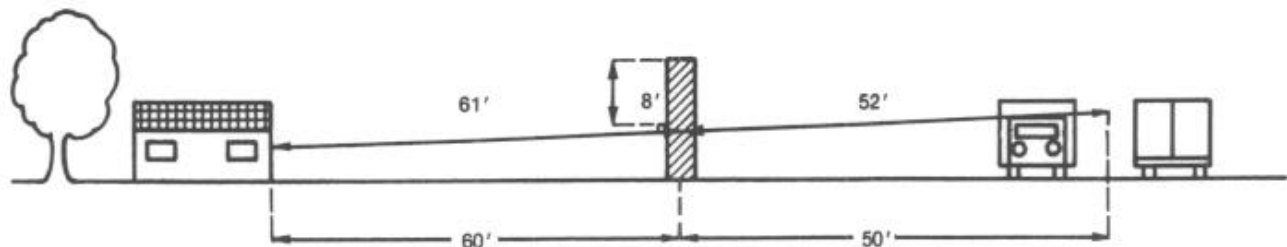
23.



H = \_\_\_\_\_, R = \_\_\_\_\_, R' = \_\_\_\_\_, D = \_\_\_\_\_ and D' = \_\_\_\_\_

Barrier	40'	10'	170'	90'	70'
Highest Point of Hill	30'	150'		8'	50'
				40'	

24.



H = \_\_\_\_\_, R = \_\_\_\_\_, R' = \_\_\_\_\_, D = \_\_\_\_\_ and D' = \_\_\_\_\_

**Problems 25 Through 27: Barrier Calculations Using Workcharts 6 and 7.**

Using Workcharts 6 and 7 Only, Calculate the Noise Attenuation Provided by the Barriers Illustrated in Problems 22 Through 24. Additional Data on the Angles Subtended by the Ends of the Barriers and the NAL for Each Location Is Provided.

25. Calculate the Noise Attenuation Provided by the Barrier Described in Problem 22. The Angle Subtended by the Ends of the Barrier and the NAL Is 150 Degrees.

The Noise Attenuation Provided Is \_\_\_\_\_ Decibels.

26. Calculate the Noise Attenuation Provided by the Barrier Described in Problem 23. The Angle Subtended by the Ends of the Barrier and the NAL Is 90 Degrees.

The Noise Attenuation Provided Is \_\_\_\_\_ Decibels.

27. Calculate the Noise Attenuation Provided by the Barrier Described in Problem 24. The Angle Subtended by the Ends of the Barrier and the NAL Is 130 Degrees.

The Noise Attenuation Provided Is \_\_\_\_\_ Decibels.

**Problems 28 Through 30: Barrier Calculations Using Workcharts 5, 6 and 7**

Calculate the Attenuation Provided by the Barriers in the Following Situations. Use Workcharts 5, 6 and 7.

28. A Two Story Building Is Exposed to Noise Levels of 68 LDN from Automobiles. The Barrier Is 15 Feet High and Is Located 40 Feet from the Source and 20 Feet from the Building. The Source, Barrier, and Building Are All On Level Ground. The Angle Subtended by the Ends of the Barrier and the Noise Assessment Location Is 110 Degrees.

The Noise Attenuation Provided by This Barrier Is \_\_\_\_\_ Decibels.

Is This Sufficient? \_\_\_\_\_

29. A Three Story Building Is Exposed to A Noise Level of 72 LDN from Diesel Locomotives and 60 LDN from Railroad Cars. The Barrier Is 12 Feet High and Is Located 40 Feet from the Source and 85 Feet from the Building. The Barrier and the Building Are on the Same Level, But the Track Is Depressed 25 Feet. The Angle Subtended by the Ends Of the Barrier and the NAL Is 120 Degrees.

The Noise Attenuation Provided by This Barrier Is \_\_\_\_\_ Decibels.

Is This Sufficient? \_\_\_\_\_

30. A Three Story Building Is Exposed to Noise Levels of 67 LDN from Automobiles and 71 LDN from Trucks. The Barrier Is 16 Feet High and Is Located 36 Feet from the Source and 56 Feet from the Building. The Source, the Barrier and the Building Are All At the Same Level. The Angle Subtended by the Barrier Ends and the NAL Is 130 Degrees.

The Noise Attenuation Provided by This Barrier Is \_\_\_\_\_ Decibels.

Is This Sufficient? \_\_\_\_\_

## Noise Assessment Guidelines Workbook

### Answers

#### Problem

1. 68 LDN (67-61 = 6, Add 1dB (From Table) to 67 = 68 LDN)
2. 66 LDN (63-63 = 0, Add 3dB (From Table) to 63 = 66 LDN)
3. 69 LDN (69-51 = 0, Add 0dB to 69 = 69 LDN)
4. 67 LDN (65-62 = 3, Add 1.8dB to 65, Round Off to Nearest Whole Number, 66.8 = 67 LDN)
5. 73 LDN (72-65 = 5, Add 1.2 = 73.2 = 73 LDN)
6. 72 LDN (63-59 = 4, Add 1.5 = 64.5, 71-64.5 = 6.5 Interpolate From Table: 6 = 1.0, 7 = .8 6.5 = .9) 71 + .9 = 71.9 = 72 LDN)
7. 76 LDN (67-61 = 6, Add 1.0 = 68, 72-68 = 4, Add 1.5 = 73.5, 73.5-73 = .5, Interpolate From Table, Add 2.75 = 76.25 = 76 LDN)
8. 49 Feet (76 + 22 = 98 - 2 = 49)
9. 72 Feet (84 + 60 = 144 - 2 = 72)

#### 10. Adjustment Factors Needed: Speed and Night-Time Percentage

Value of Factors: Speed = Autos .30  
Trucks .81  
Nighttime  
Percentage .81

*Note*—You Must Have Different Speed Adjustments for Autos and Trucks.

#### 11. Adjustment Factors Needed: Speed and Stop and Go Traffic

Value of Factors: Speed .67  
Stop and Go .70

#### 12. Adjustment Factors Needed: Gradient, Speed and Nighttime Percentage

Value of Factors: Gradient 1.4  
Speed = Autos .30  
Trucks .81  
Nighttime  
Percentage .81

#### 13. Adjustment Factors Needed: Nighttime Percentage, Speed, Bolted Track

Value of Factors: Nighttime  
Percentage 1.57  
Speed = Engines .75  
Cars 1.78  
Bolted Track 4

*Note*—You Must Have Different Speed Adjustments for Engines and Cars.

#### 14. Adjustment Factors Needed: Nighttime Percentage and Speed

Value of Factors: Nighttime  
Percentage .62  
Speed = Engines 3.0  
Cars .11

#### 15. Adjustment Factors Needed: Nighttime Percentage and Bolted Track

Value of Factors: Nighttime  
Percentage 1.19  
Bolted Track 4

16. Combined Noise Level = 62 LDN (If Your Answer Is Plus or Minus 1dB Its OK - Between Rounding Off and the Large Scale on the Nomographs, That's Close Enough)

**Worksheet C**  
Roadway Noise

Page 1

Notes Assessment Guidelines

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List all major roads within 1000 ft of the site:

1. \_\_\_\_\_  
2. \_\_\_\_\_  
3. \_\_\_\_\_  
4. \_\_\_\_\_

Necessary Information

	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane	310			
b. farthest lane	358			
c. average (effective) distance	334			
2. Distance to stop sign	400			
3. Road gradient in percent	1%			
4. Average speed in mph				
a. Automobiles	40			
b. heavy trucks - uphill	40			
c. heavy trucks - downhill	40			
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	17000			
b. medium trucks	1500			
c. effective ADT (a + (10b))	32000			
6. 24 hour average number of heavy trucks				
a. uphill	200			
b. downhill	200			
c. total	400			
7. Fraction of nighttime traffic (10:00 p.m. to 7: a.m.)	20%			
8. Traffic projected for what year?	---			

**Worksheet C**  
Roadway Noise

Page 2

Notes Assessment Guidelines

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Adjustments for Automobile Traffic

	9 Stop and-go Table 3	10 Average Speed Table 4	11 Right- Turn Table 5	12 Auto ADT (5% Sc) Table 6	13 Adjusted Auto ADT Table 6	14 DNL (Worksheet 1)	15 Barrier Attenuation	16 Partial DNL
Road No. 1	.70	x .53	x 1.19	x 32000	.14128	67	0	67
Road No. 2		X	X	X				
Road No. 3		X	X	X				
Road No. 4		X	X	X				

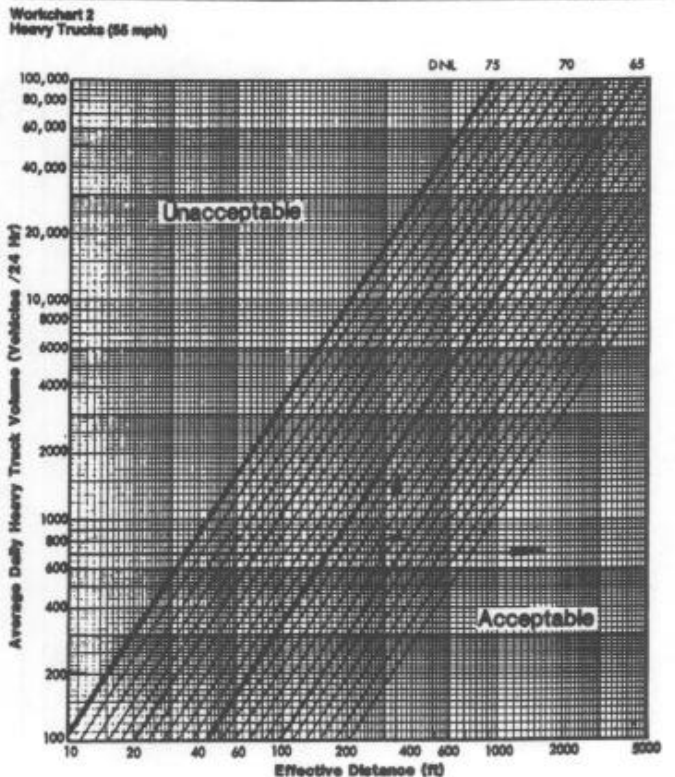
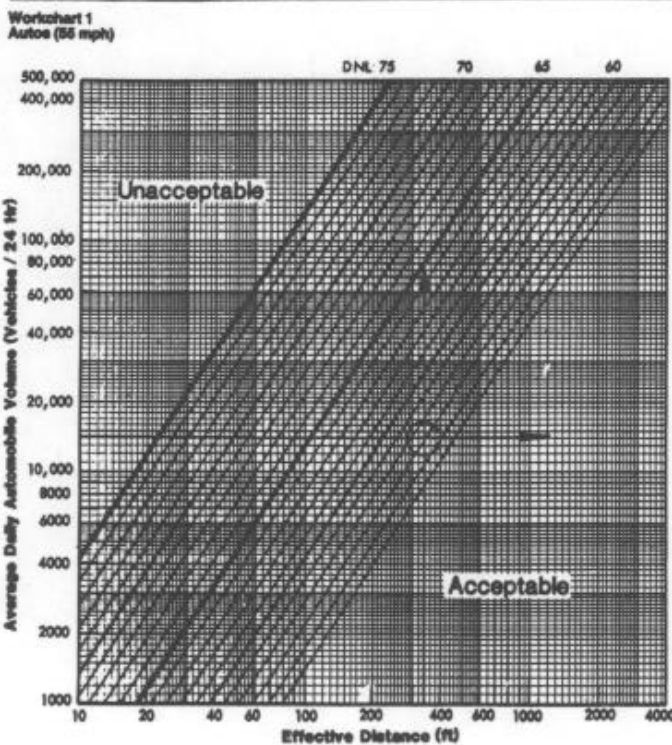
Adjustments for Heavy Truck Traffic

	17 Gradient Table 8	18 Average Speed Table 7	19 Truck ADT Table 9	20	21	22 Stop and-go Table 8	23 Right- Turn Table 9	24 Adjusted Truck ADT Table 9	25 DNL (Work- sheet 2)	26 Barrier Attn.	27 Partial DNL
Uphill		x .81	x 200					.162			
Road No. 1				Adj	.824	x 1.8	x 1.19	.694	60	0	60
Downhill		x .81	x 200					.162			
Uphill		X	X								
Road No. 2				Adj	X	X					
Downhill		X									
Uphill		X	X								
Road No. 3				Adj	X	X					
Downhill		X									
Uphill		X	X								
Road No. 4				Adj	X	X					
Downhill		X									

Combined Automobile & Heavy Truck DNL

Road No.	DNL	Total DNL for All Roads
Road No. 1	67	62
Road No. 2		
Road No. 3		
Road No. 4		

Signature \_\_\_\_\_ Date \_\_\_\_\_





17. Combined Noise Level = 74 LDN (+ OR - 1 dB)

**Worksheet C**  
Roadway Noise

Page 1

Noise Assessment Guidelines

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List all major roads within 1000 ft of the site:

1. \_\_\_\_\_  
2. \_\_\_\_\_  
3. \_\_\_\_\_  
4. \_\_\_\_\_

Necessary Information

	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane	125	45		
b. farthest lane	233	93		
c. average (effective distance)	179	69		
2. Distance to stop sign	250	100		
3. Road gradient in percent	3%	1%		
4. Average speed in mph				
a. Automobiles	30	30		
b. heavy trucks - uphill	30	30		
c. heavy trucks - downhill	30	30		
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	22000	14000		
b. medium trucks	2000	700		
c. effective ADT (a + (10b))	42000	21000		
6. 24 hour average number of heavy trucks				
a. uphill	475	300		
b. downhill	475	300		
c. total	950	600		
7. Fraction of nighttime traffic (10:00 p.m. to 7: a.m.)	10%	20%		
8. Traffic projected for what year?	-	-		

**Worksheet C**  
Roadway Noise

Page 2

Noise Assessment Guidelines

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Adjustments for Automobile Traffic

	9	10	11	12	13	14	15	16
	Stop and-go Table 3	Average Speed Table 4	Highway Time Table 5	Auto ADT (line 5c)	Adjusted Auto ADT	DNL (Worksheet 1)	Barrier Attenuation	Partial DNL
Road No. 1	x 48	x 30	x .81	x 42000	- 4899	57	0	57
Road No. 2	x 25	x 30	x 1.19	x 21000	- 1874	59	0	59
Road No. 3								
Road No. 4								

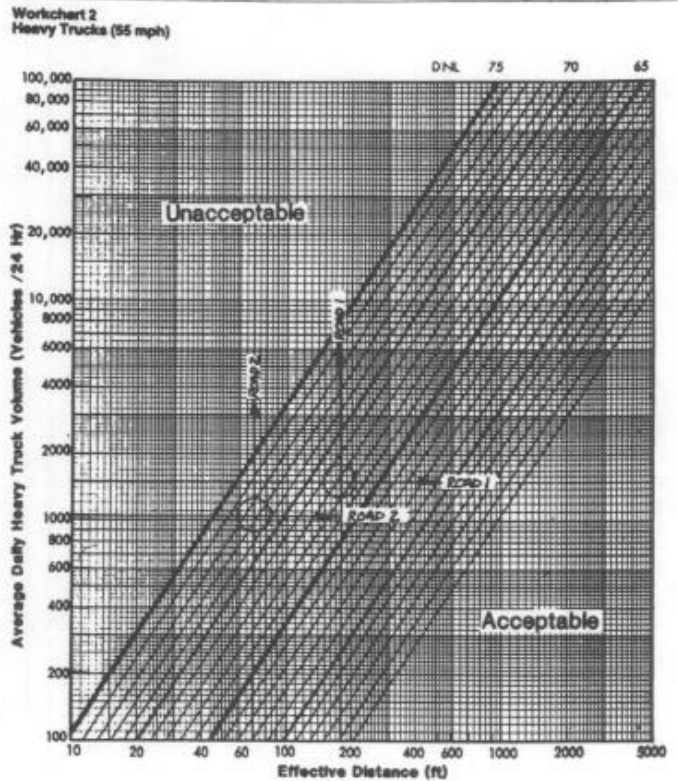
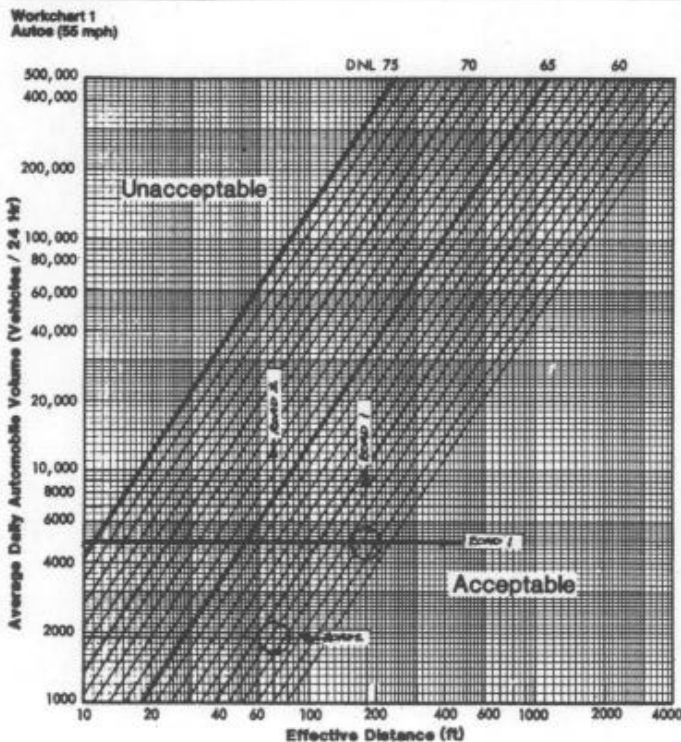
Adjustments for Heavy Truck Traffic

	17	18	19	20	21	22	23	24	25	26	27
	Gradient Table 6	Average Speed Table 7	Truck ADT			Stop and-go Table 8	Highway Time Table 5	Adjusted Truck ADT	DNL (Worksheet 1)	Barrier Attn.	Partial DNL
Uphill	1.7	x .81	x 475	- 654							
Road No. 1					Adj 1039	x 1.8	x .81	- 1515	68	0	68
Downhill											
Uphill											
Road No. 2					Adj 486	x 1.8	x 1.19	- 1044	72	0	72
Downhill											
Road No. 3											
Road No. 4											

Combined Automobile & Heavy Truck DNL

Road No.	1	2	3	4	Total DNL for All Roads
	68	72			74

Signature \_\_\_\_\_ Date \_\_\_\_\_





18. Combined Noise Level = 71 LDN

Note—In Order to Complete Column 18 for Railway #2 You Must Find the Average Number of Cars Per Train. Multiply the Number of Diesel Trains Times the Number of Cars Per Train (20 x 45 = 900). Multiply the Number of Electrified Trains Times the Number of Cars Per Train (2 x 15 = 30). Add the Two Totals Together and Divide By the Total Number of Trains (900 + 30 = 930 ÷ 22 = 42).

Worksheet D Railway Noise		Page 2		Noise Assessment Guidelines						
Adjustments for Diesel Locomotives										
8 No. of Locomotives Z	10 Average Speed Table 8	11 Home (enter 10)	12 High- Speed Table 5	13 No. of Trains (line 24)	14 Adj. No. of Ops.	15 DNL Worksheet 3	16 Barrier Adj.	17 Partial DNL		
Railway No. 1	1.5	1.0	-	1.38	35	72	70	0	72	
Railway No. 2	1	.75	-	1.0	20	15	58	0	58	
Railway No. 3		X	X	X	X					
Adjustments for Railway Cars or Rapid Transit Trains										
18 Number of cars SO	19 Average Speed Table 10	20 Subst. Rate (enter 4)	21 High- Speed Table 5	22 No. of Trains (Line 24 or 25)	23 Adj. No. of Ops.	24 DNL Worksheet 4	25 Barrier Adj.	26 Partial DNL		
Railway No. 1	1.4	1.0	4	1.38	35	270	64	0	64	
Railway No. 2	.84	1.78	4	1.38	22	182	57	0	67	
Railway No. 3		X	X	X	X					
Combined Locomotive and Railway Car DNL										
Railway No. 1	71	Railway No. 2	61	Railway No. 3	71	Total DNL for all Railways				

Signature \_\_\_\_\_ Date \_\_\_\_\_

19. Combined Noise Level = 76 LDN

Worksheet D Railway Noise		Page 2		Noise Assessment Guidelines						
Adjustments for Diesel Locomotives										
8 No. of Locomotives Z	10 Average Speed Table 8	11 Home (enter 10)	12 High- Speed Table 5	13 No. of Trains (line 24)	14 Adj. No. of Ops.	15 DNL Worksheet 3	16 Barrier Adj.	17 Partial DNL		
Railway No. 1	2.5	.88	-	1.19	34	89	75	0	75	
Railway No. 2	2	1.50	-	1.38	12	50	70	0	70	
Railway No. 3		X	X	X	X					
Adjustments for Railway Cars or Rapid Transit Trains										
18 Number of cars SO	19 Average Speed Table 10	20 Subst. Rate (enter 4)	21 High- Speed Table 5	22 No. of Trains (Line 24 or 25)	23 Adj. No. of Ops.	24 DNL Worksheet 4	25 Barrier Adj.	26 Partial DNL		
Railway No. 1	1.5	1.39	-	1.19	34	84	63	0	63	
Railway No. 2	.80	.44	4	1.38	12	23	55	0	55	
Railway No. 3		X	X	X	X					
Combined Locomotive and Railway Car DNL										
Railway No. 1	75	Railway No. 2	70	Railway No. 3		Total DNL for all Railways 76				

Signature \_\_\_\_\_ Date \_\_\_\_\_

20. Combined Noise Level = 75 LDN

Worksheet C  
Roadway Noise

Page 1

Noise Assessment Guidelines

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List all major roads within 1000 ft of the site:

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

Necessary Information

	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane	100	45	52	
b. farthest lane	308	75	92	
c. average (effective distance)	154	60	72	
2. Distance to stop sign	-	175	400	
3. Road gradient in percent	1%	4.9%	1.9%	
4. Average speed in mph				
a. Automobiles	55	40	25	
b. heavy trucks - uphill	55	40	25	
c. heavy trucks - downhill	55	40	25	
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	40000	15000	5000	
b. medium trucks	-	900	1050	
c. effective ADT (a + 10b)	40000	23400	15500	
6. 24 hour average number of heavy trucks				
a. uphill	-	160	87	
b. downhill	-	160	87	
c. total	-	320	175	
7. Fraction of nighttime traffic (10:00 p.m. to 7: a.m.)	15%	20%	20%	
8. Traffic projected for what year?	-	-	-	

Worksheet C  
Roadway Noise

Page 2

Noise Assessment Guidelines

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Adjustments for Automobile Traffic

	8	10	11	12	13	14	15	16
	Stop and-go Table 3	Average Speed Table 4	High-Time Table 5	Auto ADT (One Way)	Adjusted Auto ADT	DAL (Worksheet 1)	Barrier Attenuation	Partial DAL
Road No. 1	0	1.0	1.0	40000	40000	67	0	67
Road No. 2	30	58	1.19	24000	5450	65	0	65
Road No. 3	70	21	1.19	15500	2711	60	0	60
Road No. 4								

Adjustments for Heavy Truck Traffic

	17	18	19	20	21	22	23	24	25	26	27
	Gradient Table 6	Average Speed Table 7	Truck ADT			Stop and-go Table 8	High-Time Table 9	Adjusted Truck ADT	DAL (Sheet 2)	Barrier Att.	Partial DAL
Uphill	-	X	-	-	-	-	-	-	-	-	-
Downhill	-	X	-	-	-	-	-	-	-	-	-
Road No. 1											
Uphill			2.0	81	160	259					
Downhill											
Road No. 2											
Uphill											
Downhill											
Road No. 3											
Uphill											
Downhill											
Road No. 4											
Uphill											
Downhill											

Combined Automobile & Heavy Truck DAL

Road No.	1	2	3	4	Total DAL for All Roads
1	67				
2		73			
3			68		
4					
Total					75

Signature \_\_\_\_\_ Date \_\_\_\_\_

21. Combined Noise Level = 81 LDN

To Solve This Problem You Must Add Some More Lines to the Workchart for Engines Because the Workchart as Set up Does Not Go High Enough. There Are A Variety of Ways to Do This But One of the Easiest Is to Take A Piece of Blank Paper (A 3 x 5 Card Does Very Well) Place the Edge of the Paper Along Either the Top Or Bottom Edge of the Workchart and Mark Where the LDN Lines Fall Along the Edge of the Blank Paper. Then Once You Have Drawn Your Distance and Operations Lines on the Work Chart, You Take Your Paper with the Line Markings and Lay It along the Line for Adjusted Operations with the Mark Farthest to the Right Lined up with the 75 LDN Line. Now Just Count over until You Reach the Intersection of the Operations and Distance Lines.

Worksheet D  
Railway Noise

Page 2

Noise Assessment Guidelines

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Adjustments for Diesel Locomotives

	9 No. of Locomotives	10 Average Speed Table 9	11 Home (enter 10)	12 Night-Site Table 9	13 No. of Trains (See 3a)	14 Adj. No. of Ops.	15 DNL Worksheet 3	16 Barrier Adj.	17 Partial DNL
Railway No. 1	1.5	1.0	10	1.19	30	535	81	0	81
Railway No. 2		X	X	X	X				
Railway No. 3		X	X	X	X				

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Adjustments for Railway Cars or Rapid Transit Trains

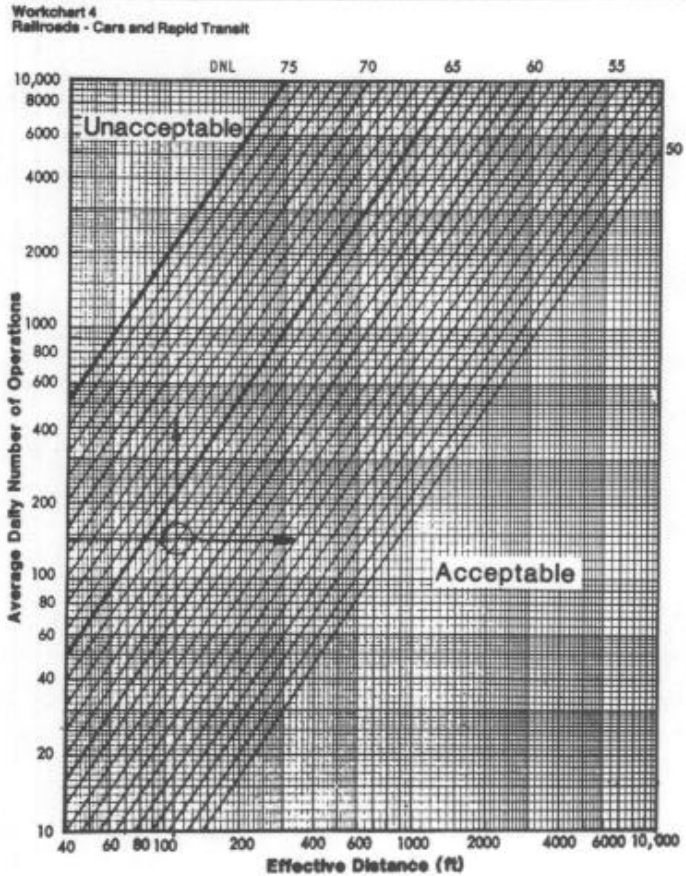
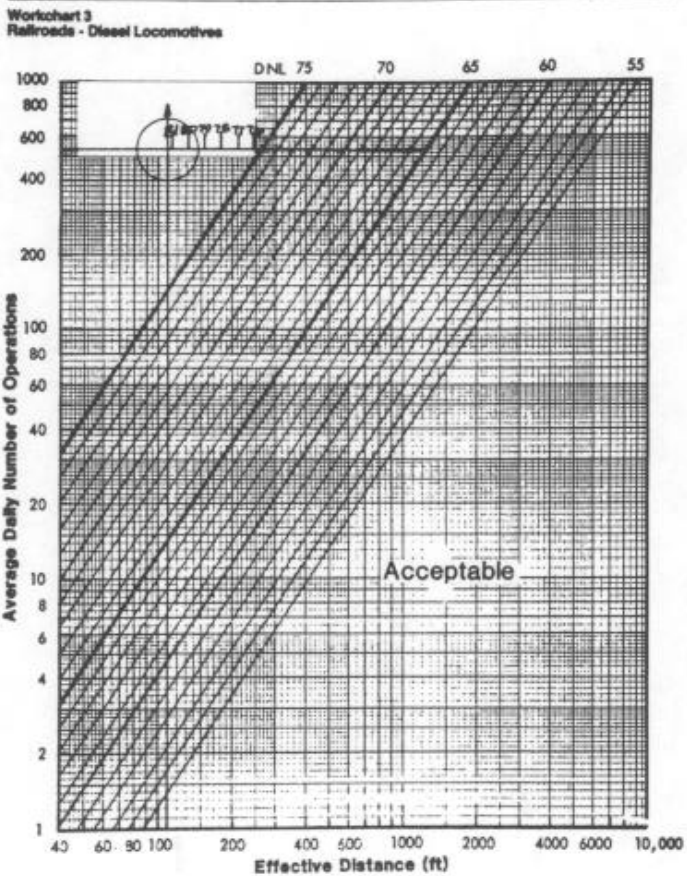
	18 Number of cars	19 Average Speed Table 10	20 Baked Pads (enter 4)	21 Night-Site Table 9	22 No. of Trains (Line 2a or 2b)	23 Adj. No. of Ops.	24 DNL Worksheet 4	25 Barrier Adj.	26 Partial DNL
Railway No. 1	1.0	1.0	4	1.19	30	143	63	0	63
Railway No. 2		X	X	X	X				
Railway No. 3		X	X	X	X				

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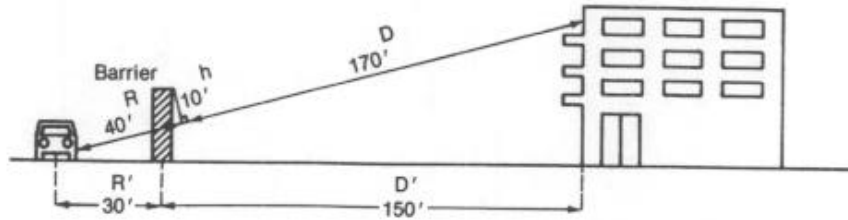
Combined Locomotive and Railway Car DNL

Railway No. 1 81 Railway No. 2 \_\_\_\_\_ Railway No. 3 \_\_\_\_\_ Total DNL for all Railways 81

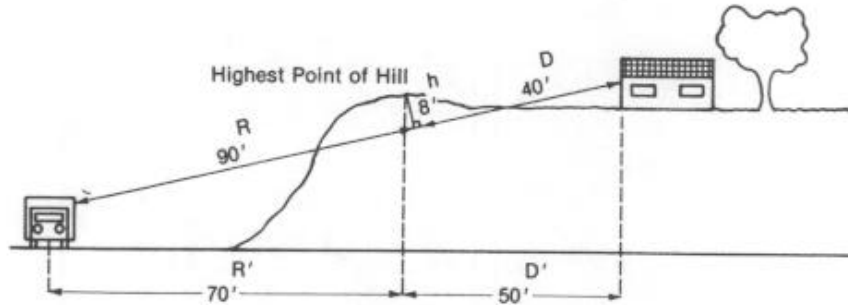
Signature \_\_\_\_\_ Date \_\_\_\_\_



22.  $H = 10$  Feet,  $R = 40$  Feet,  $R' = 30$  Feet,  $D = 170$  Feet,  $D' = 150$  Feet

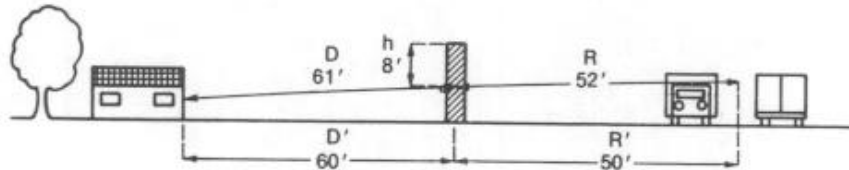


23.  $H = 8$  Feet,  $R = 90$  Feet,  $R' = 70$  Feet,  $D = 40$  Feet,  $D' = 50$  Feet



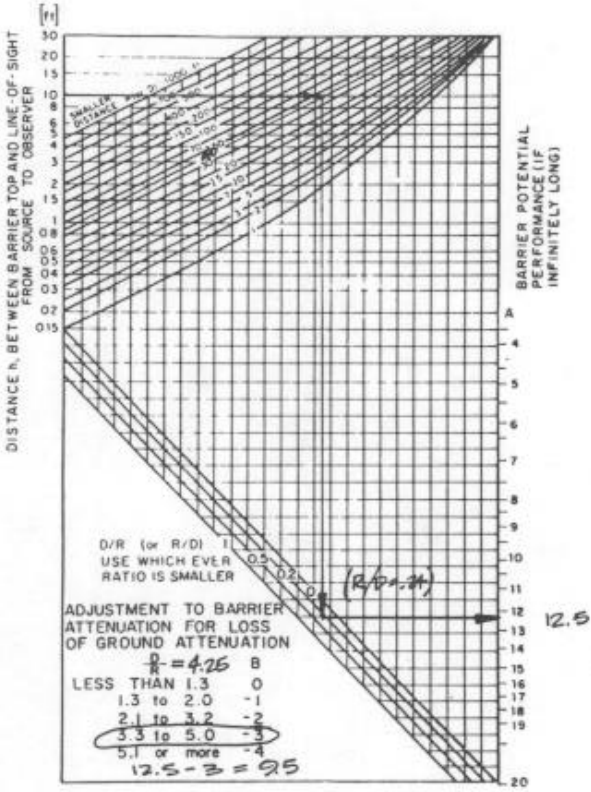
*Note*—The Line of Sight Line Starts Above the Road Level Because of the Trucks.

24.  $H = 8$  Feet,  $R = 52$  Feet,  $R' = 50$  Feet,  $D = 61$  Feet,  $D' = 60$  Feet

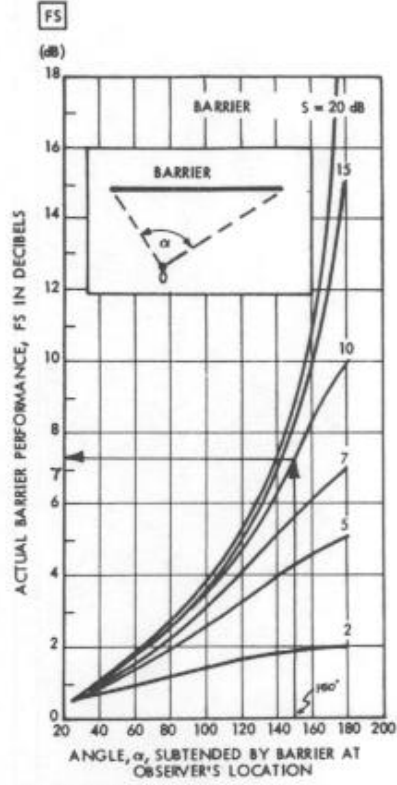


25. The Noise Attenuation Provided Is 7 Decibels

Workchart 6  
Noise Barrier



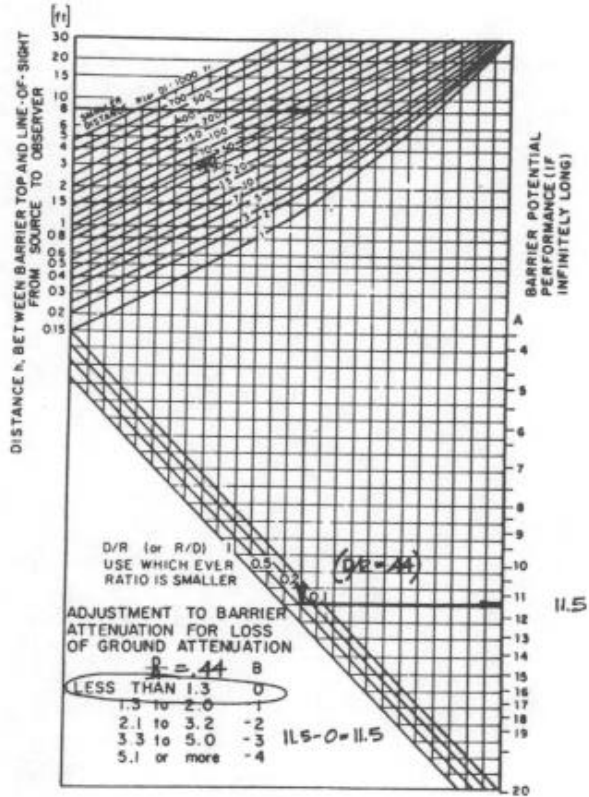
Workchart 7



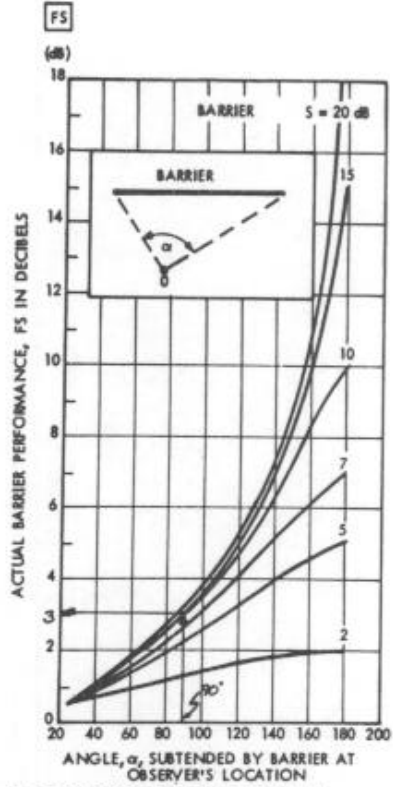
26. The Noise Attenuation Provided Is 3 Decibels

Note—When the Curves Are So Close Together Don't Worry About Extrapolating. In This Case You Couldn't Anyway, the 15 dB and 10 dB Curves Have Merged.

Workchart 6  
Noise Barrier



Workchart 7

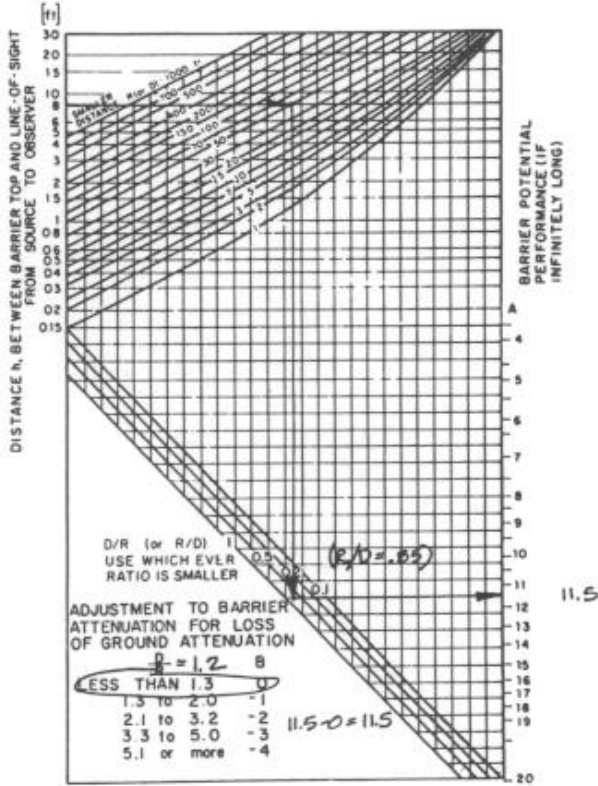


Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

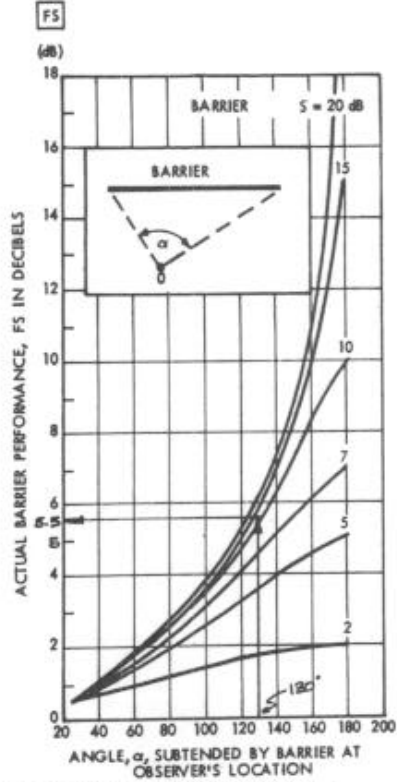
27. The Noise Attenuation Provided Is 8 Decibels (5.5 Rounded Up)

Note—Again You Have Problems With Extrapolating—Don't Worry About Being Too Precise.

Workchart 6  
Noise Barrier



Workchart 7



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.



28. The Noise Attenuation Provided by This Barrier Is 4 dB. This Is Sufficient

Note—Don't Forget That the Height of the observer is 5' Less Than the Total Height of the Building and the Height of the Building Is 10 Feet Times the Number of Stories. And Did You Remember to Make the Adjustment for Ground Attenuation Loss.

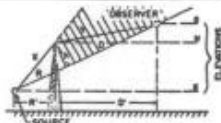
**Workchart 5  
Noise Barrier**

To find R, D and h from Site Elevations and Distances

Fill out the following worksheet (all quantities are in feet):

Enter the values for:

H = 15 R = 40  
S = 0 D = 20  
O = 15



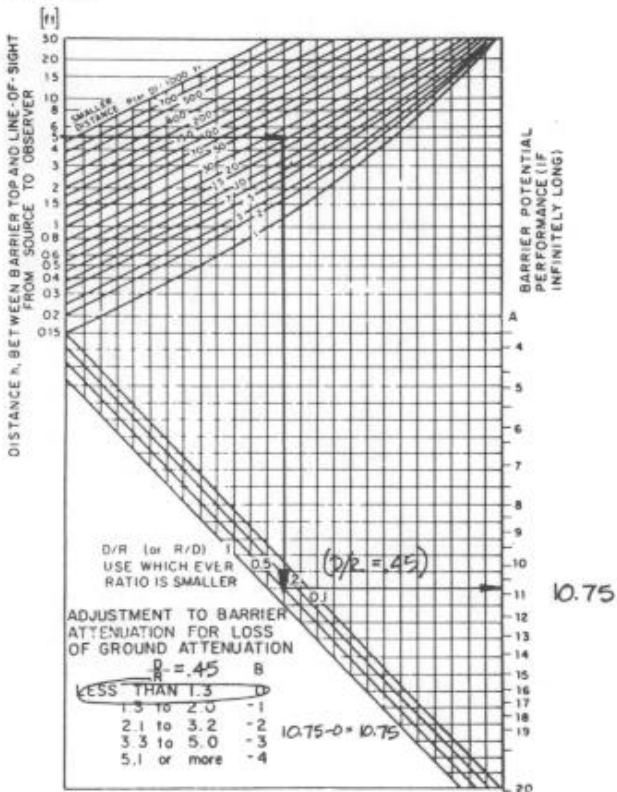
1. Elevation of barrier top minus elevation of source [ 15 ] - [ 0 ] = [ 15 ]
2. Elevation of observer minus elevation of source [ 15 ] - [ 0 ] = [ 15 ]
3. Map distance between source and observer (R + D) [ 60 ]
4. Map distance between barrier and source (R) [ 40 ]
5. Line 2 divided by line 3 [ 15 ] ÷ [ 60 ] = [ .25 ]
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive [ .25 ] × [ .25 ] = [ .0625 ]
7. 40% of line 6 [ .4 ] × [ .0625 ] = [ .025 ]
8. One minus line 7 [ 1.0 ] - [ .025 ] = [ .975 ]
9. Line 5 times line 4 (will be negative if line 2 is negative) [ .25 ] × [ 40 ] = [ 10 ]
10. Line 1 minus line 9 [ 15 ] - [ 10 ] = [ 5 ]
11. Line 10 times line 8 [ 5 ] × [ .975 ] = [ 4.9 ] = 5
12. Line 5 times line 10 [ .25 ] × [ 5 ] = [ 1.25 ]
13. Line 4 divided by line 8 [ 40 ] ÷ [ .975 ] = [ 41 ]
14. Line 13 plus line 12 [ 41 ] + [ 1.25 ] = [ 42 ] = 41
15. Line 3 minus line 4 [ 60 ] - [ 40 ] = [ 20 ]
16. Line 15 divided by line 8 [ 20 ] ÷ [ .975 ] = [ 20.5 ]
17. Line 16 minus line 12 [ 20.5 ] - [ 1.25 ] = [ 19 ] = 19

(Note: The value on line 2 may be negative in which case so will the values on lines 5, 9, and 12. Line 1 may also be negative. Remember, then, in

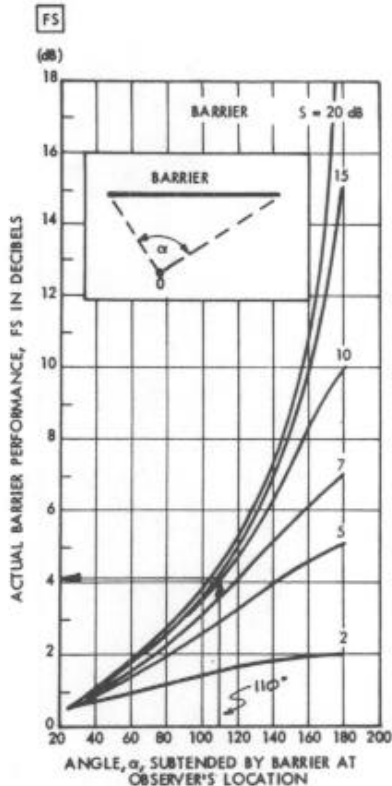
lines 10, 14, and 17, that adding a negative number is the same as subtracting. And subtracting a negative number is the adding.  $X + (-Y) = X - Y$

Round off R and D to nearest integer, h to one decimal place.

**Workchart 6  
Noise Barrier**



**Workchart 7**



29. The Noise Attenuation Provided by This Barrier Is Approximately 5 dB for Both the Engines and the Railroad Cars.

This Is Not Sufficient.

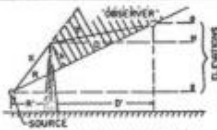
Note—You Were Supposed to Calculate Attenuation for Diesel Engines and Cars Separately Because the Source Heights Are Different. The Value of S for the Engines Should Have Been -10 and the Value of S for the Railroad Cars Should Have Been -25.

**Workchart 5  
Noise Barrier**

To find R, D and h from Site Elevations and Distances

Enter the values for:

H = 12 R = 40  
S = -10 D = 85  
O = 25



Fill out the following worksheet (all quantities are in feet):

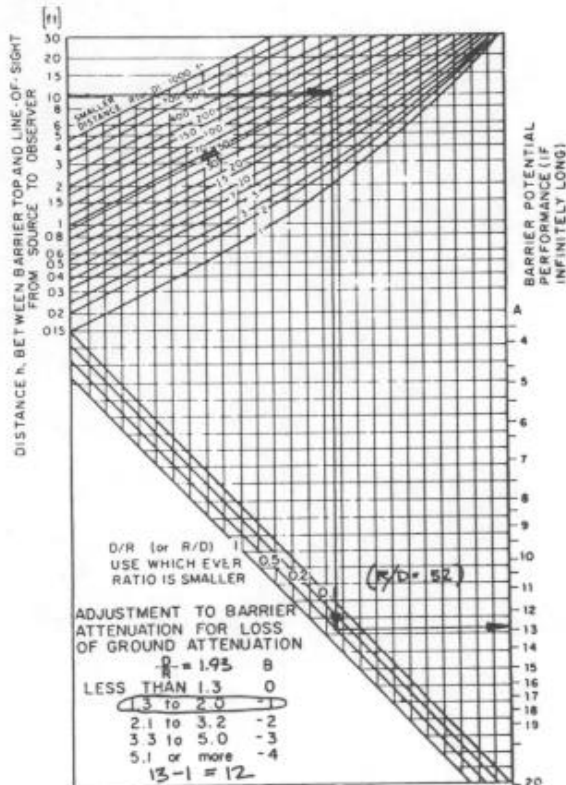
1. Elevation of barrier top minus elevation of source [4 12 ] - [0 -10 ] = [1 22 ]
2. Elevation of observer minus elevation of source [0 25 ] - [0 -10 ] = [0 35 ]
3. Map distance between source and observer (R + D) [0 125 ]
4. Map distance between barrier and source (R) [0 40 ]
5. Line 2 divided by line 3 [0 35 ] ÷ [0 125 ] = [0 .28 ]
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive [0 .28 ] × [0 .28 ] = [0 .08 ]
7. 40% of line 6 [0 .4 ] × [0 .08 ] = [0 .03 ]
8. One minus line 7 [1 0 ] - [0 .03 ] = [0 .97 ]
9. Line 5 times line 4 (will be negative if line 2 is negative) [0 .28 ] × [0 40 ] = [0 11.2 ]
10. Line 1 minus line 9 [1 22 ] - [0 11.2 ] = [10 10.8 ]
11. Line 10 times line 8 [10 10.8 ] × [0 .97 ] = [11 10.5 ] = h
12. Line 5 times line 10 [0 .28 ] × [11 10.8 ] = [12 3 ]
13. Line 4 divided by line 8 [0 40 ] ÷ [0 .97 ] = [13 41 ]
14. Line 13 plus line 12 [13 41 ] + [12 3 ] = [14 44 ] = R
15. Line 3 minus line 4 [0 125 ] - [0 40 ] = [15 85 ]
16. Line 15 divided by line 8 [15 85 ] ÷ [0 .97 ] = [16 88 ]
17. Line 16 minus line 12 [16 88 ] - [12 3 ] = [17 85 ] = D

(Note: the value on line 2 may be negative, in which case so will the values on lines 5, 9, and 12; line 1 may also be negative. Remember, then, in

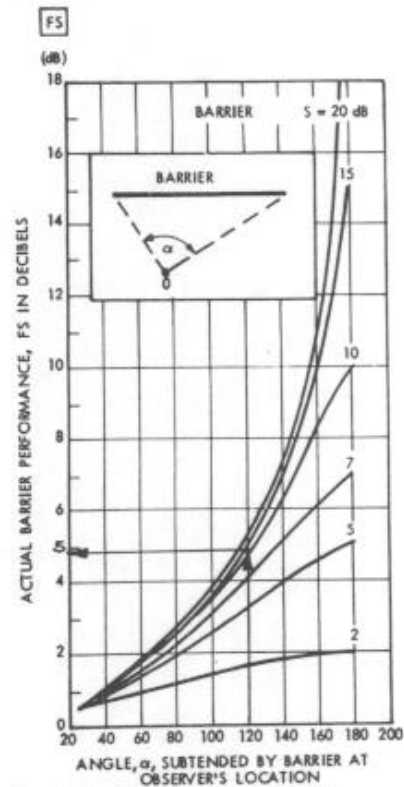
lines 10, 14, and 17, that adding a negative number is the same as subtracting:  $-1 + 2 = 1$ . And subtracting a negative number is the same as adding:  $2 - (-1) = 3$ .)

Round off R and D to nearest integer, h to one decimal place.

**Workchart 6  
Noise Barrier**



**Workchart 7**



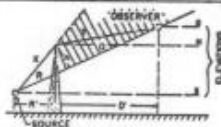
Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

**Workchart 5  
Noise Barrier**

To find R, D and h from Site Elevations and Distances

Enter the values for:

H = 12 R = 40  
S = -25 D = 85  
O = 25



Fill out the following worksheet (all quantities are in feet):

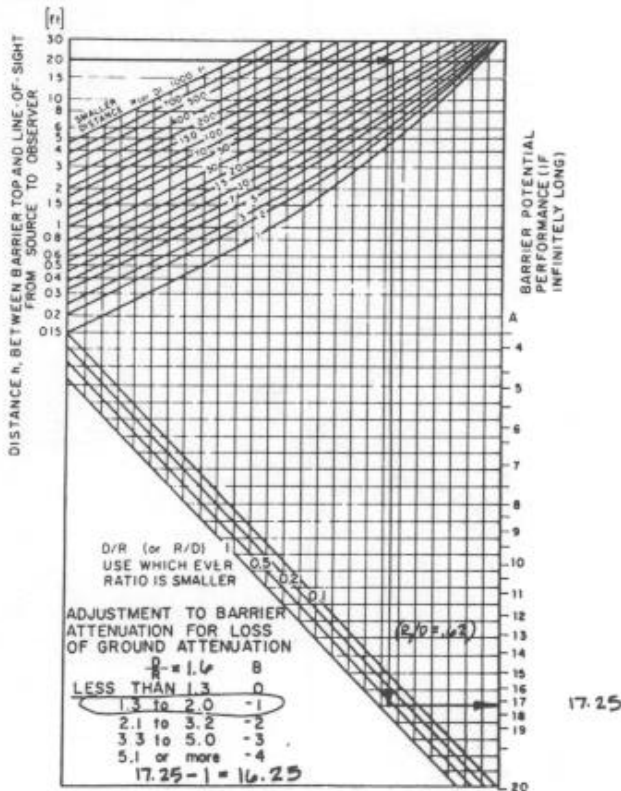
1. Elevation of barrier top minus elevation of source [12] - [-25] = [137]
2. Elevation of observer minus elevation of source [25] - [-25] = [50]
3. Map distance between source and observer (R + D) [125]
4. Map distance between barrier and source (R) [40]
5. Line 2 divided by line 3 [50] ÷ [125] = [.4]
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive [.4] × [.4] = [.16]
7. 40% of line 6 [.16] × [.4] = [.064]
8. One minus line 7 [.16] - [.064] = [.096]
9. Line 5 times line 4 (.4 × 40) will be negative if line 2 is negative [.4] × [40] = [16]
10. Line 1 minus line 9 [137] - [16] = [121]
11. Line 10 times line 8 [121] × [.096] = [11.616] = 11.6
12. Line 5 times line 10 [.4] × [121] = [48.4]
13. Line 4 divided by line 12 [40] ÷ [48.4] = [.8266] = .83
14. Line 13 plus line 12 [.8266] + [48.4] = [49.2266] = 49.2
15. Line 3 minus line 4 [125] - [40] = [85]
16. Line 15 divided by line 8 [85] ÷ [.096] = [885.416] = 885.4
17. Line 16 minus line 12 [885.4] - [48.4] = [837] = 837

(Note: the value on line 2 may be negative, in which case so will the values on lines 5, 9, and 12. Line 1 may also be negative. Remember, then, in

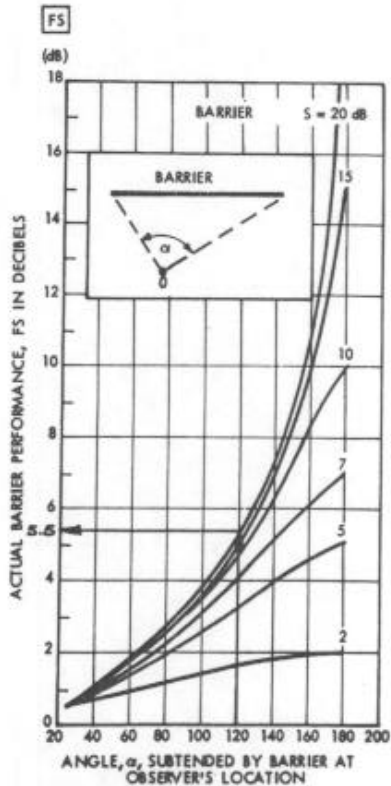
lines 10, 14, and 17, that adding a negative number is the same as subtracting. + +) = +. And subtracting a negative number is like adding. - (-) = + +.)

Round off R and D to nearest integer. h to one decimal place.

**Workchart 6  
Noise Barrier**



**Workchart 7**



30. The Noise Attenuation Provided by This Barrier is 3 dB for Trucks and 5 dB for Autos. The Combined Level Resulting is 69 LDN.

This is Not Sufficient

Note—You Must Calculate the Barrier Effect Separately for Autos and Trucks Because the Source Height is Different. Then Recombine levels.

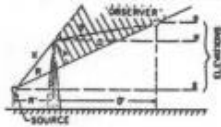
**Workchart 5  
Noise Barrier**

To find R, D and h from Site Elevations and Distances

Fill out the following workchart (all quantities are in feet):

Enter the values for:

H = 16    h = 36  
S = 0    D = 56  
O = 25



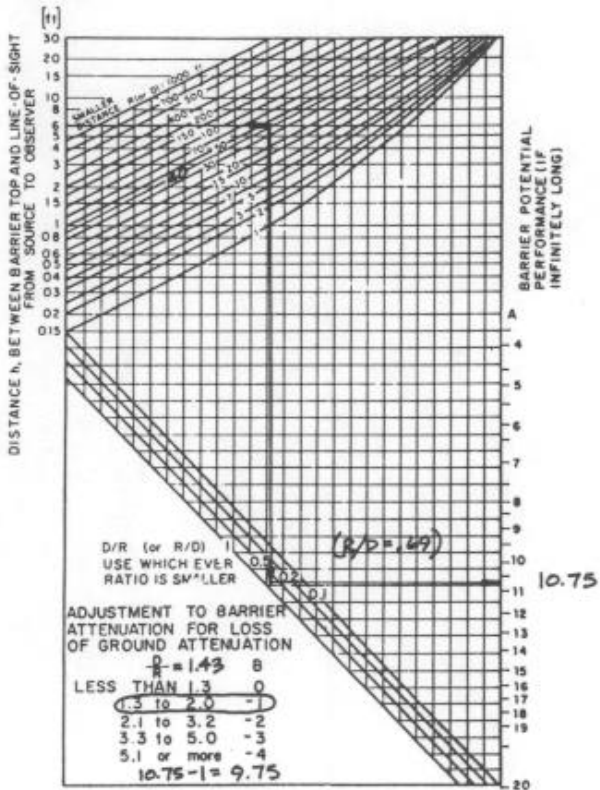
1. Elevation of barrier top minus elevation of source [1] 16 ] - [2] 0 ] = [1] 16 ]
2. Elevation of observer minus elevation of source [2] 25 ] - [3] 0 ] = [2] 25 ]
3. Map distance between source and observer (R + D) [3] 92 ]
4. Map distance between barrier and source (R) [4] 36 ]
5. Line 2 divided by line 3 [2] 25 ] ÷ [3] 92 ] = [5] .27 ]
6. Square the quantity on line 5 (i.e., multiply it by itself): always positive [5] .27 ] × [5] .27 ] = [6] .07 ]
7. 40% of line 6 [6] .07 ] × [7] .4 ] = [7] .03 ]
8. One minus line 7 [8] 1 ] - [7] .03 ] = [8] .97 ]
9. Line 5 times line 4 (will be negative if line 2 is negative) [5] .27 ] × [4] 36 ] = [9] 9.7 ]
10. Line 1 minus line 9 [1] 16 ] - [9] 9.7 ] = [10] 6.3 ]
11. Line 10 times line 8 [10] 6.3 ] × [8] .97 ] = [11] 6.1 ] =
12. Line 5 times line 10 [5] .27 ] × [10] 6.1 ] = [12] 1.7 ]
13. Line 4 divided by line 8 [4] 36 ] ÷ [8] .97 ] = [13] 37 ]
14. Line 13 plus line 12 [13] 37 ] + [12] 1.7 ] = [14] 39 ] =
15. Line 3 minus line 4 [3] 92 ] - [4] 36 ] = [15] 56 ]
16. Line 15 divided by line 8 [15] 56 ] ÷ [8] .97 ] = [16] 58 ]
17. Line 16 minus line 12 [16] 58 ] - [12] 1.7 ] = [17] 56 ] =

Note: the value on line 2 may be negative, in which case so will the values on lines 5, 8, and 12. Line 1 may also be negative. Remember, then, in

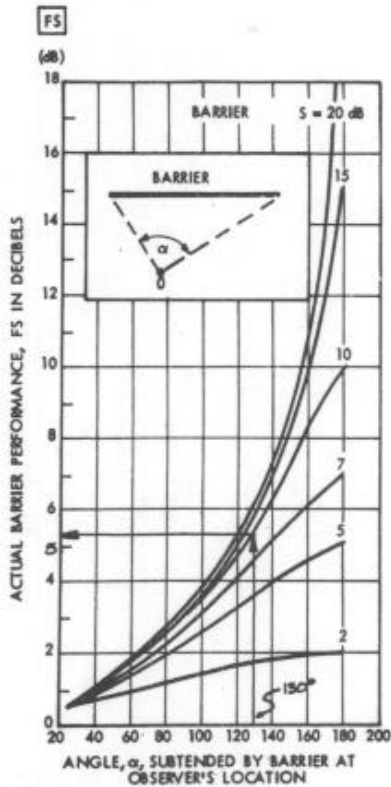
lines 10, 14, and 17, that adding a negative number is the same as subtracting.  $x + (-y) = x - y$ . And subtracting a negative number is the same as adding.  $x - (-y) = x + y$ .

Round off R and D to nearest integer, h to one decimal place.

**Workchart 6  
Noise Barrier**



**Workchart 7**



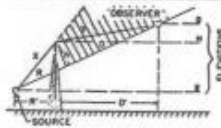
Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

**Workchart 5  
Noise Barrier**

To find R, D and h from Site Elevations and Distances

Enter the values for:

H = 16 R = 36  
S = 8 D = 56  
O = 25



Fill out the following worksheet (all quantities are in feet)

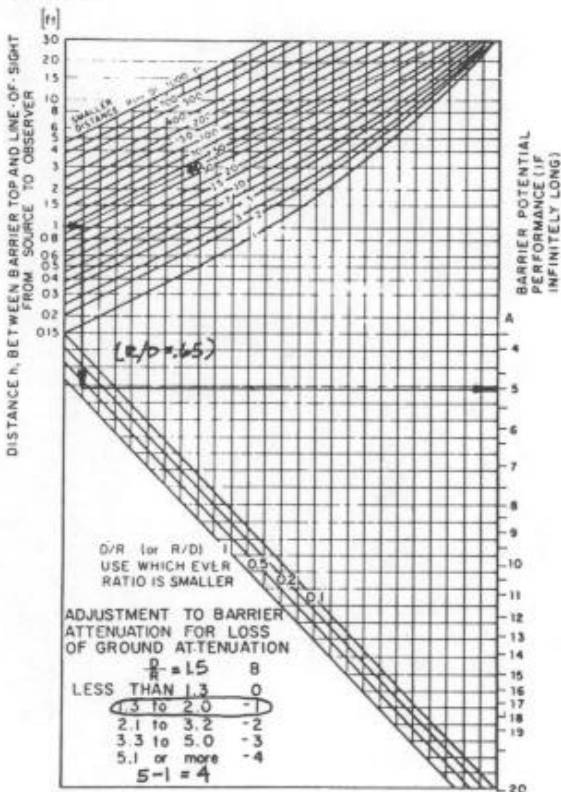
1. Elevation of barrier top minus elevation of source  $[^1 16] - [^2 8] = [^3 8]$
2. Elevation of observer minus elevation of source  $[^4 25] - [^5 8] = [^6 17]$
3. Map distance between source and observer (R + D)  $[^7 92]$
4. Map distance between barrier and source (R)  $[^8 36]$
5. Line 2 divided by line 3  $[^9 17] \div [^8 92] = [^{10} .2]$
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive  $[^{11} .2] \times [^{10} .2] = [^{12} .04]$
7. 40% of line 6  $[^{13} .44] \times [^{12} .04] = [^{14} .02]$
8. One minus line 7  $[^{15} 1] - [^{14} .02] = [^{16} .98]$
9. Line 5 times line 4 (will be negative if line 2 is negative)  $[^{17} .2] \times [^8 36] = [^{18} 7]$
10. Line 1 minus line 9  $[^3 8] - [^{18} 7] = [^{19} 1]$
11. Line 10 times line 8  $[^{20} 1] \times [^{16} .98] = [^{21} .98] = A$
12. Line 5 times line 10  $[^{10} .2] \times [^{20} 1] = [^{22} .2]$
13. Line 4 divided by line 8  $[^8 36] \div [^{16} .98] = [^{23} 37]$
14. Line 13 plus line 12  $[^{24} 37] + [^{22} .2] = [^{25} 37] = H$
15. Line 3 minus line 4  $[^7 92] - [^8 36] = [^{26} 56]$
16. Line 15 divided by line 8  $[^{26} 56] \div [^8 36] = [^{27} 57]$
17. Line 16 minus line 12  $[^{27} 57] - [^{22} .2] = [^{28} 57] = D$

(Note: the value on line 2 may be negative, in which case so will the value on lines 5, 9, and 12; line 1 may also be negative. Remember, then, in

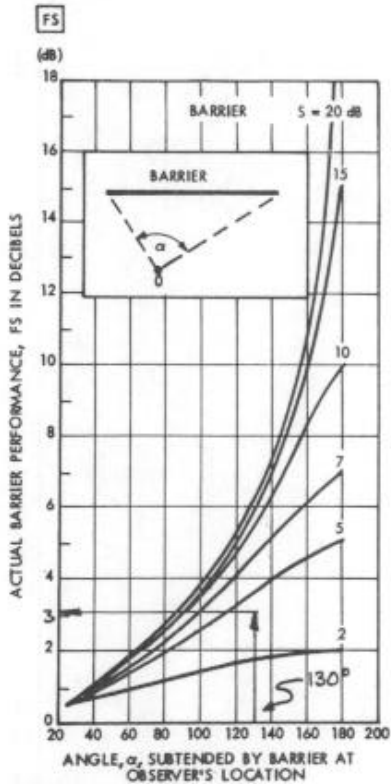
lines 10, 14, and 17, that adding a negative number is the same as subtracting. And subtracting a negative number is like adding:  $X - (-y) = X + y$ .)

Round off R and D to nearest integer, h to one decimal place.

**Workchart 6  
Noise Barrier**



**Workchart 7**



Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.