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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

2. 63 LDN
   63 LDN
   _____ Combined Level

3. 51 LDN
   68 LDN
   _____ Combined Level

4. 62 LDN
   65 LDN
   _____ Combined Level

5. 67 LDN
   72 LDN
   _____ Combined Level

6. 59 LDN
   63 LDN
   71 LDN
   _____ Combined Level

7. 73 LDN
   72 LDN
   61 LDN
   67 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 _____.

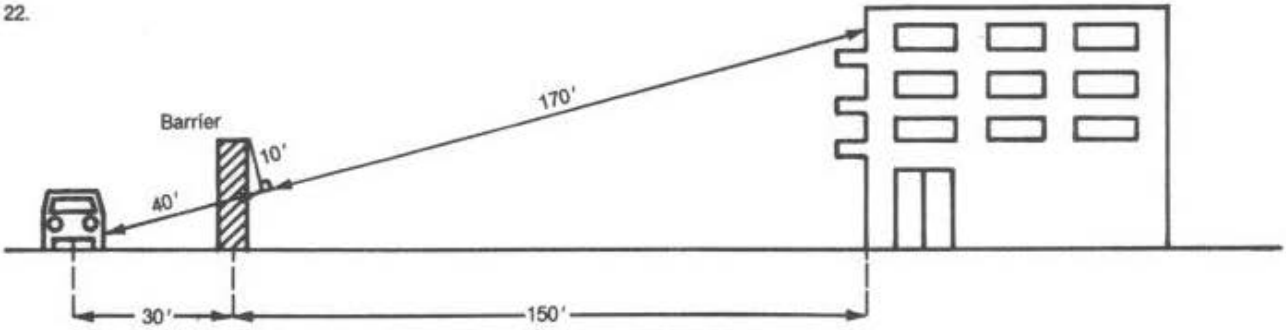
21. A Site Exposed to Noise from A Railroad. The Distance from the NAL to the Railroad Is 110 Feet. There Are 30 Diesel Trains Every 24 Hours, No Electrified Trains. Twenty Percent of the Operations Occur at Night. There Are 3 Locomotives Per Train and 50 Cars Per Train. The Average Train Speed Is 30 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'

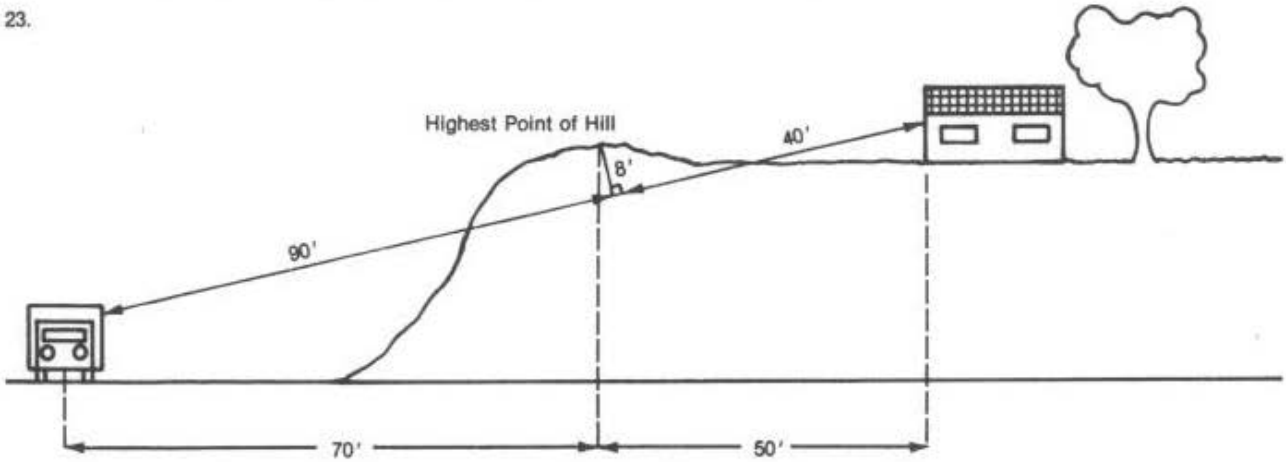
Identify the Values for H, R, R', D and D' for Each of the Following Barriers:

22.



H = _____, R = _____, R' = _____ D = _____ and D' = _____

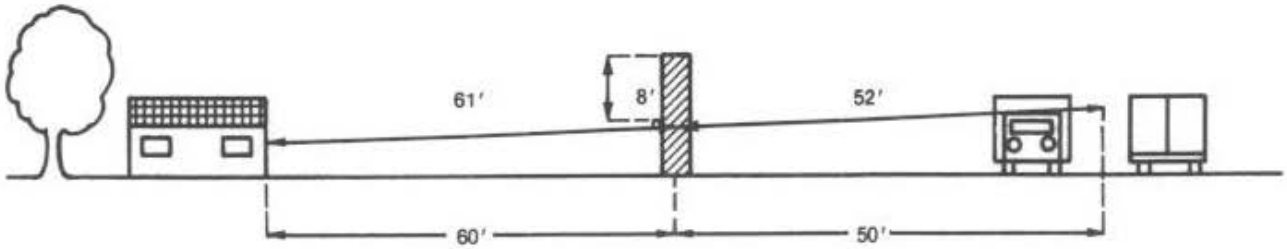
23.



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

Noise Assessment Guidelines

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 + (10xb))	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

Noise Assessment Guidelines

Adjustments for Automobile Traffic

	9 Stop and-go Table 3	10 Average Speed Table 4	11 Night-Time Table 5	12 Auto ADT (line 5c)	13 Adjusted Auto ADT	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

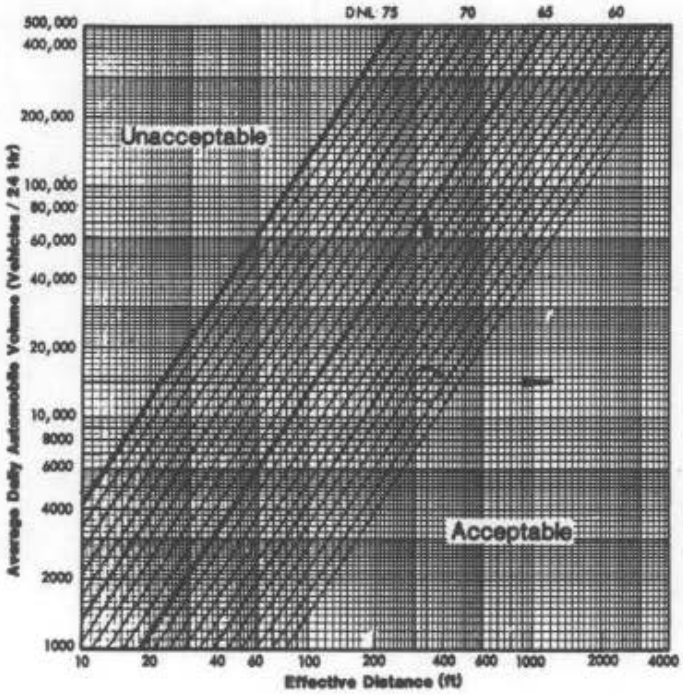
	17 Gradient Table 6	18 Average Speed Table 7	19 Truck ADT 5	20	21	22 Stop and-go Table 9	23 Night-Time Table 5	24 Adjusted Truck ADT	25 DNL (Work chart 2)	26 Barrier Atn.	27 Partial DNL
Uphill	— x	.81 x	200 =	162							
Road No. 1						Add 324	x 1.8	x 1.19 =	694	60 -	0 = 60
Downhill		.81 x	200 =	162							
Uphill	x	x	=								
Road No. 2						Add	x	x =		-	=
Downhill		x	=								
Uphill	x	x	=								
Road No. 3						Add	x	x =		-	=
Downhill		x	=								
Uphill	x	x	=								
Road No. 4						Add	x	x =		-	=
Downhill		x	=								

Combined Automobile & Heavy Truck DNL

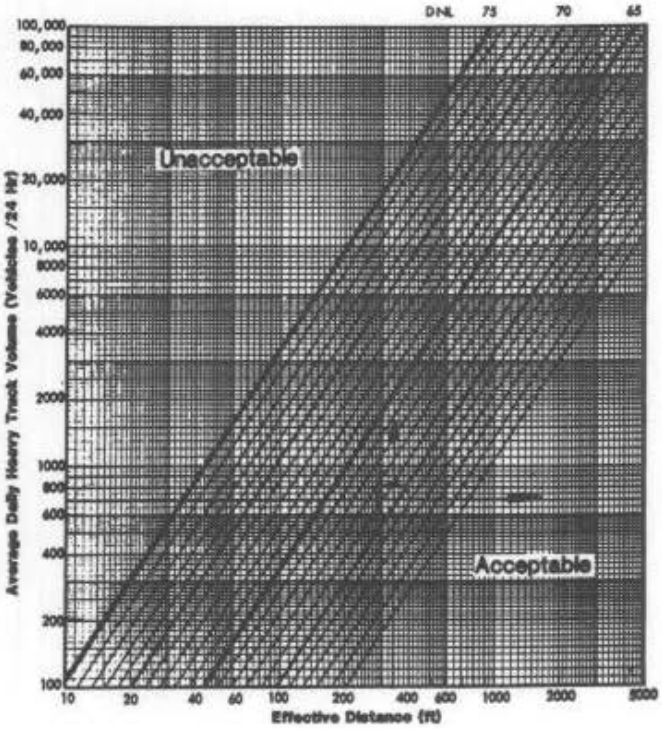
Road No. 1 62 Road No. 2 _____ Road No. 3 _____ Road No. 4 _____ Total DNL for All Roads 62

Signature _____ Date _____

Worksheet 1
Autos (55 mph)



Worksheet 2
Heavy Trucks (55 mph)



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

Worksheet C
Roadway Noise

Page 1

Noise Assessment Guidelines

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 + (10xb))	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

Adjustments for Automobile Traffic

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

Adjustments for Heavy Truck Traffic

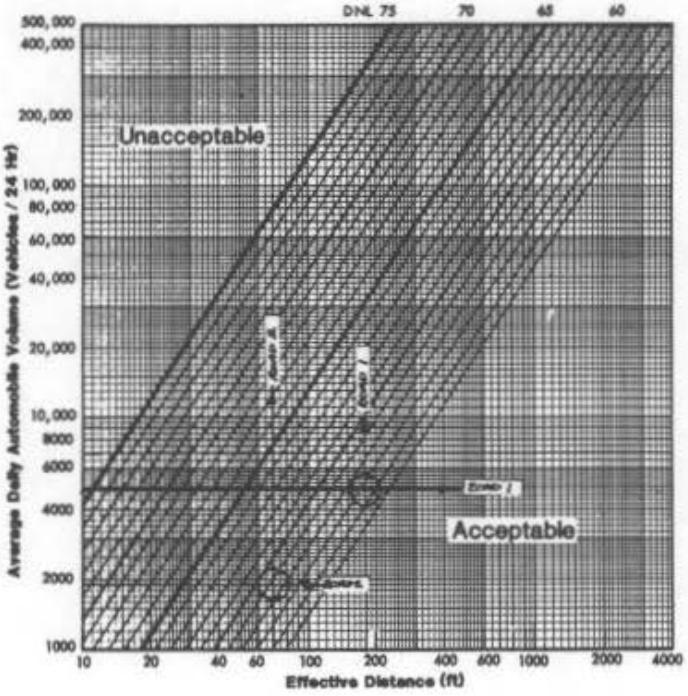
	17 Gradient Table 6	18 Average Speed Table 7	19 Truck ADT 6	20	21	22 Stop and go Table 8	23 Night Time Table 9	24 Adjusted Truck ADT	25 DNL (Work sheet 2)	26 Barrier Atn.	27 Partial DNL
Road No. 1 Uphill	1.7	.81	475	654							
Road No. 1					Add	1089	1.8	.81	1515	68	0	68
Road No. 1 Downhill	.81	475	385								
Road No. 2 Uphill	–	.81	300	243							
Road No. 2					Add	486	1.8	1.19	1041	72	0	72
Road No. 2 Downhill	.81	300	243								
Road No. 3 Uphill											
Road No. 3					Add						
Road No. 3 Downhill											
Road No. 4 Uphill											
Road No. 4					Add						
Road No. 4 Downhill											

Combined Automobile & Heavy Truck DNL

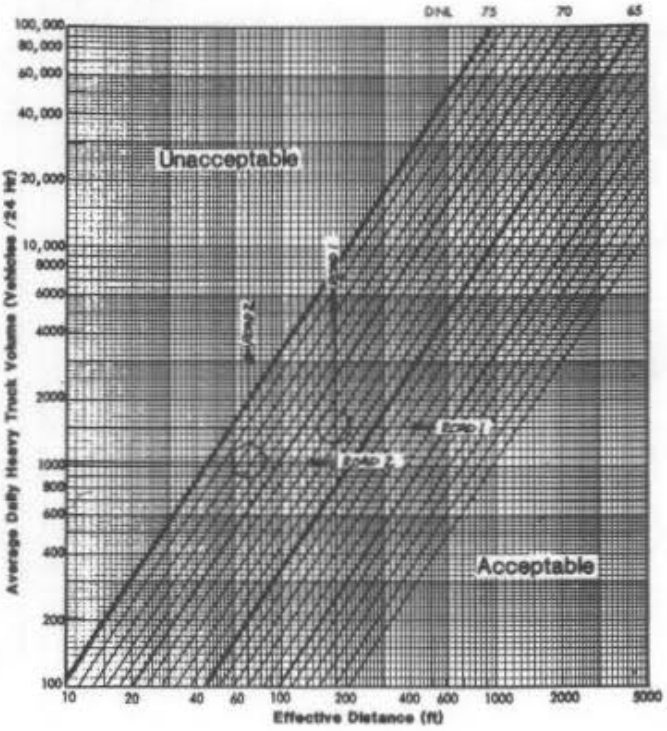
Road No. 1 68 Road No. 2 72 Road No. 3 _____ Road No. 4 _____ Total DNL for All Roads 74

Signature _____ Date _____

Worksheet 1
Autos (55 mph)



Worksheet 2
Heavy Trucks (55 mph)



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 × 45 = 900). Multiply the Number of Electrified Trains Times the Number of Cars Per Train (2 × 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 (2)	10 Average Speed Table 9	11 Horns (enter 10)	12 Night time Table 5	13 No. of Trains (line 2a)	14 Adj. No. of Opns.	15 DNL Worksheet 3	16 Barrier Atn.	17 Partial DNL
Railway No. 1	1.6	1.0	–	1.38	35	.72	70	0	72
Railway No. 2	1	.75	–	1.0	20	.15	58	0	58
Railway No. 3									

Adjustments for Railway Cars or Rapid Transit Trains

	18 Number of Cars (50)	19 Average Speed Table 10	20 Bolted Rails (enter 4)	21 Night time Table 5	22 No. of Trains (Line 2b or 2b)	23 Adj. No. of Opns.	24 DNL Worksheet 4	25 Barrier Atn.	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	132	57	0	57
Railway No. 3									

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 (2)	10 Average Speed Table 9	11 Horns (enter 10)	12 Night time Table 5	13 No. of Trains (line 2a)	14 Adj. No. of Opns.	15 DNL Worksheet 3	16 Barrier Atn.	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									

Adjustments for Railway Cars or Rapid Transit Trains

	18 Number of cars (50)	19 Average Speed Table 10	20 Bolted Rails (enter 4)	21 Night time Table 5	22 No. of Trains (Line 2b or 2b)	23 Adj. No. of Opns.	24 DNL Worksheet 4	25 Barrier Atn.	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									

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

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	208	75	92	
c. average (effective distance)	154	60	72	
2. Distance to stop sign	–	175	400	
3. Road gradient in percent	1%	4%	1%	
4. Average speed in mph				
a. Automobiles	65	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 + (10xb))	40000	24000	15500	
6. 24 hour average number of heavy trucks				
a. uphill	–	160	87	
b. downhill	–	160	88	
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

Adjustments for Automobile Traffic

	8 Stop and-go Table 3	10 Average Speed Table 4	11 Night-Time Table 5	12 Auto ADT (line 5c)	13 Adjusted Auto ADT	14 DNL (Worksheet 1)	15 Barrier Attenuation	16 Partial DNL
Road No. 1	0	1.0	1.0	40000	40000	67	0	67
Road No. 2	.36	.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 Gradient Table 8	18 Average Speed Table 7	19 Truck ADT 9	20	21	22 Stop and-go Table 6	23 Night-Time Table 5	24 Adjusted Truck ADT	25 DNL (Work chart 2)	26 Barrier Atn.	27 Partial DNL
Road No. 1 Uphill	–	–	–								
Road No. 1 Downhill	–	–	–								
Road No. 1 Adj						–	–	–	–	–	–
Road No. 2 Uphill	2.0	.81	160	259							
Road No. 2 Downhill	.81	160	130								
Road No. 2 Adj					389	1.8	1.19	833	72	0	72
Road No. 3 Uphill	1.0	.81	87	70							
Road No. 3 Downhill	.81	88	71								
Road No. 3 Adj					141	1.8	1.19	303	67	0	67
Road No. 4 Uphill											
Road No. 4 Downhill											
Road No. 4 Adj											

Combined Automobile & Heavy Truck DNL

Road No. 1 67 Road No. 2 73 Road No. 3 68 Road No. 4 _____ Total DNL for All Roads 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

Adjustments for Diesel Locomotives

	9 No. of Locomotives 2	10 Average Speed Table 9	11 Horns (enter 10)	12 Night-time Table 3	13 No. of Trains (line 2a)	14 Adj. No. of Ops.	15 DNL Workchart 3	16 Barrier Attn.	17 Partial DNL
Railway No. 1	1.5	1.0	10	1.19	30	535	81	0	81
Railway No. 2									
Railway No. 3									

Adjustments for Railway Cars or Rapid Transit Trains

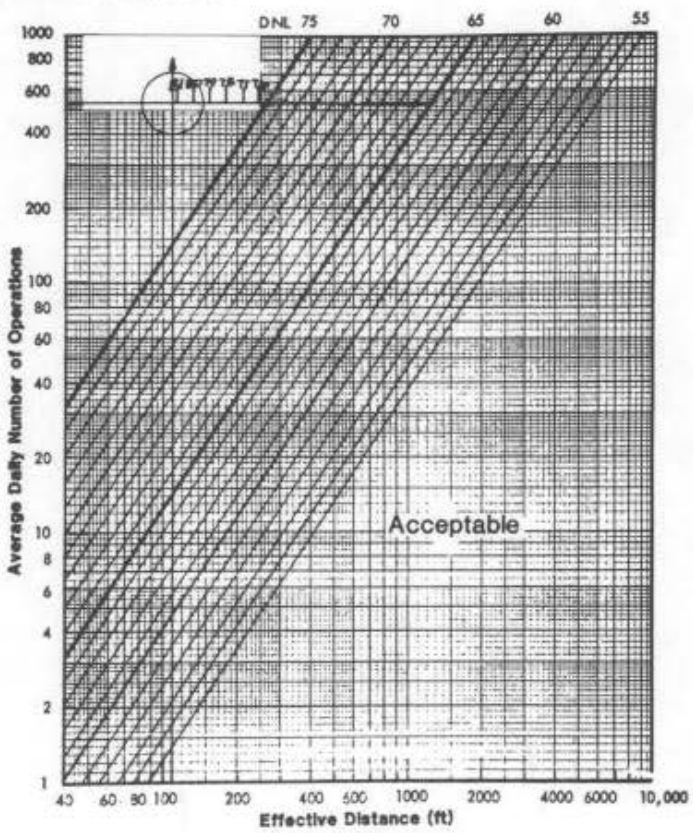
	18 Number of cars 50	19 Average Speed Table 10	20 Bolted Rails (enter 4)	21 Night-time Table 3	22 No. of Trains (Line 2b or 2c)	23 Adj. No. of Ops.	24 DNL Work-chart 4	25 Barrier Attn.	26 Partial DNL
Railway No. 1	1.0	1.0	4	1.19	30	143	63	0	63
Railway No. 2									
Railway No. 3									

Combined Locomotive and Railway Car DNL

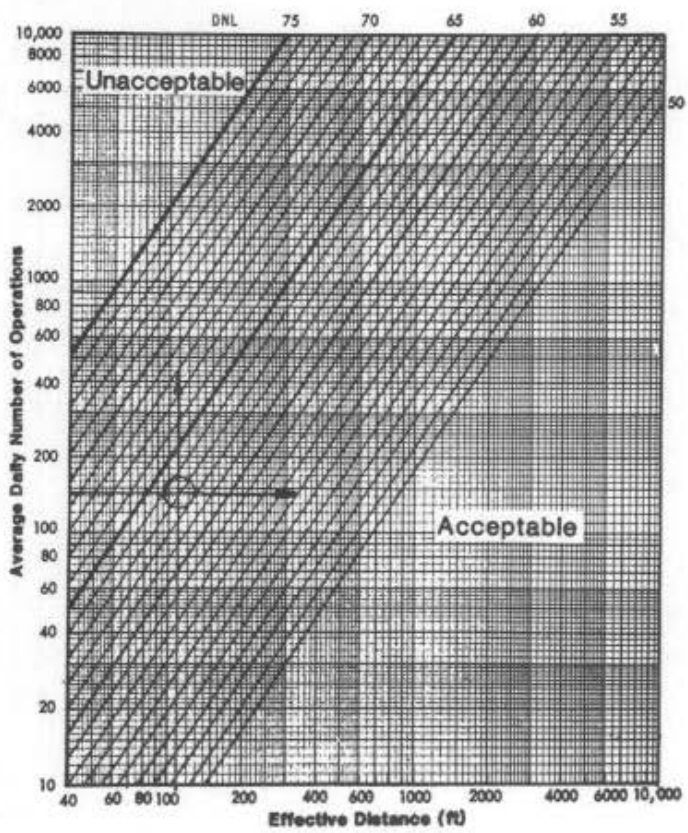
Railway No. 1 81 Railway No. 2 _____ Railway No. 3 _____ Total DNL for all Railways 81

Signature _____ Date _____

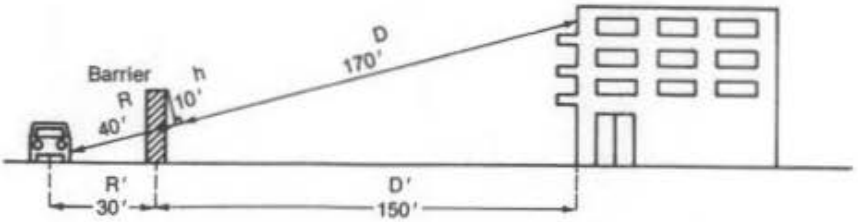
Workchart 3
Railroads - Diesel Locomotives



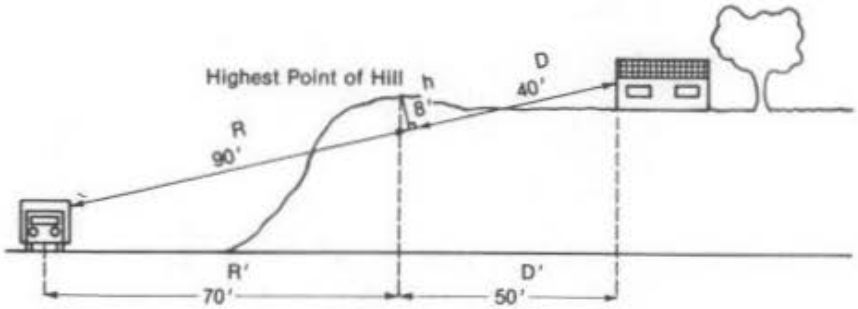
Workchart 4
Railroads - Cars and Rapid Transit



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

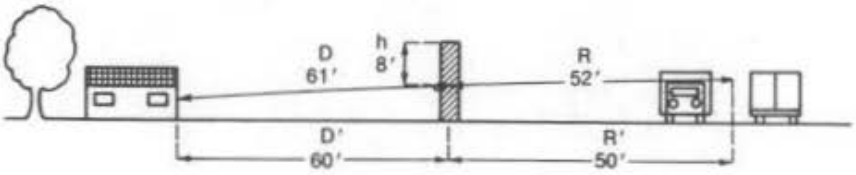


23. H = 8 Feet, R = 90 Feet, R′ = 70 Feet, D = 40 Feet, D′ = 50 Feet



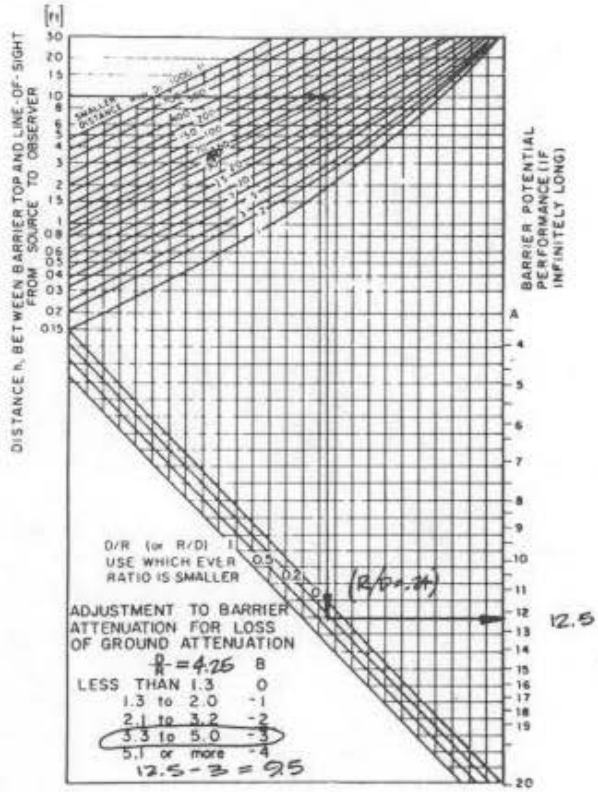
Note—The Line of Sight Line Starts Above the Road Level Because of the Trucks.

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

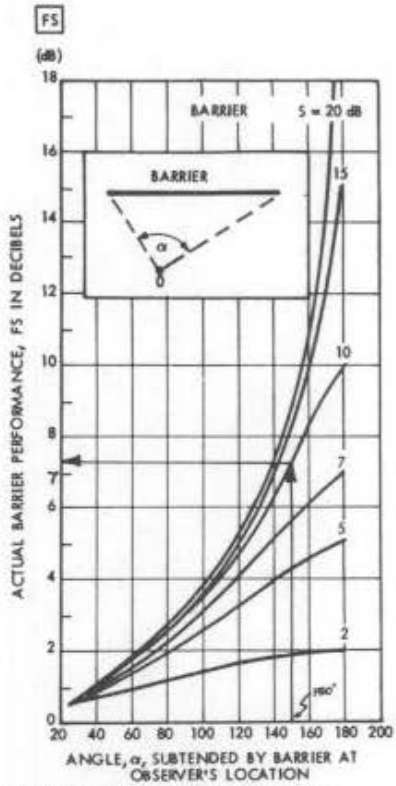


25. The Noise Attenuation Provided Is 7 Decibels

Workchart 6
Noise Barrier



Workchart 7

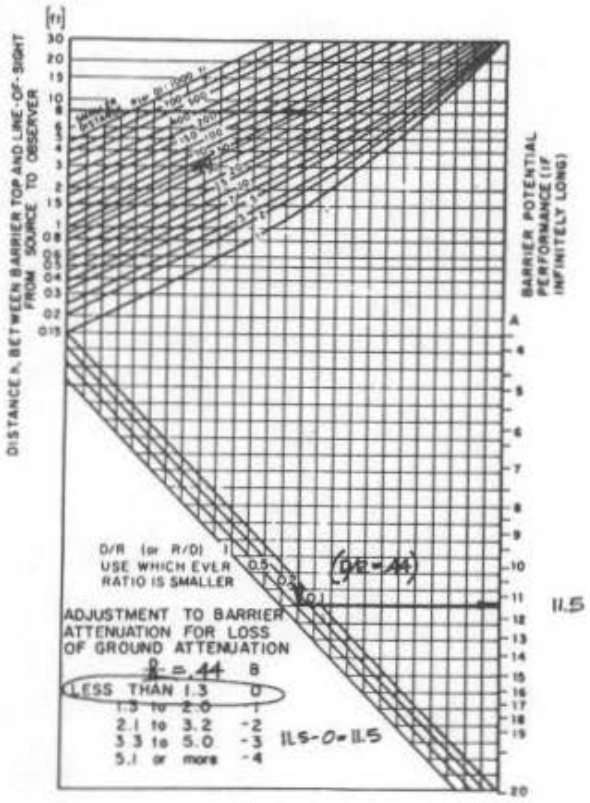


Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

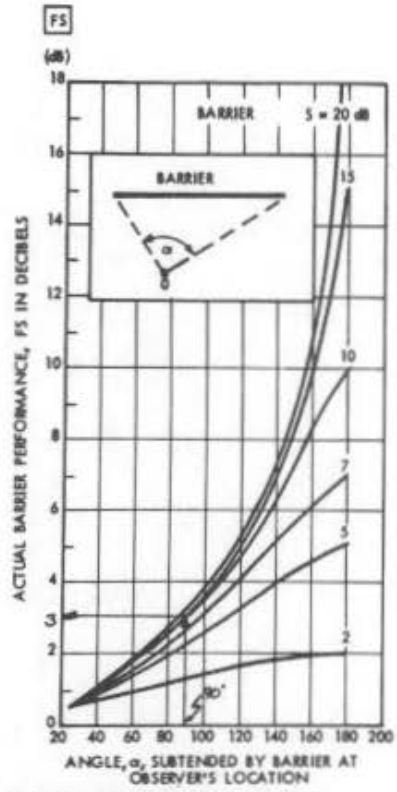
26. The Noise Attenuation Provided Is 3 Decibels

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 8
Noise Barrier



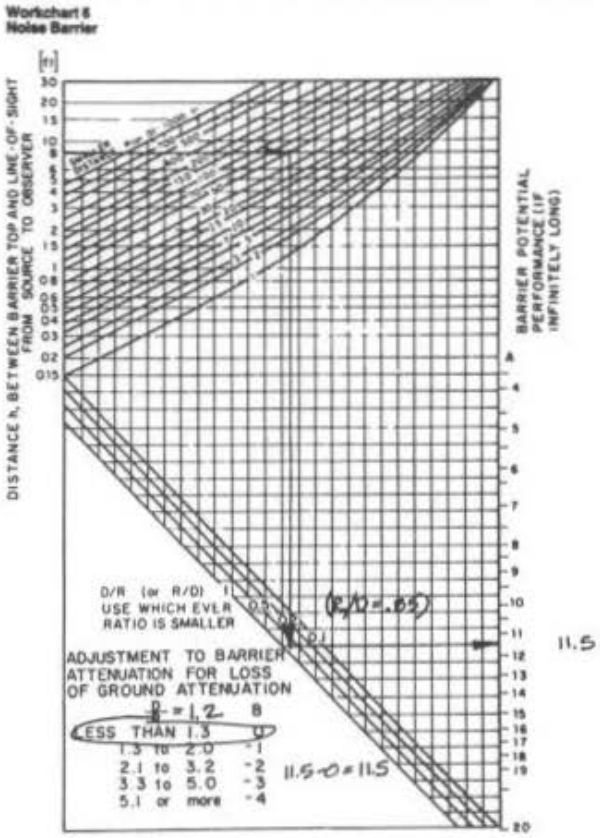
Workchart 7

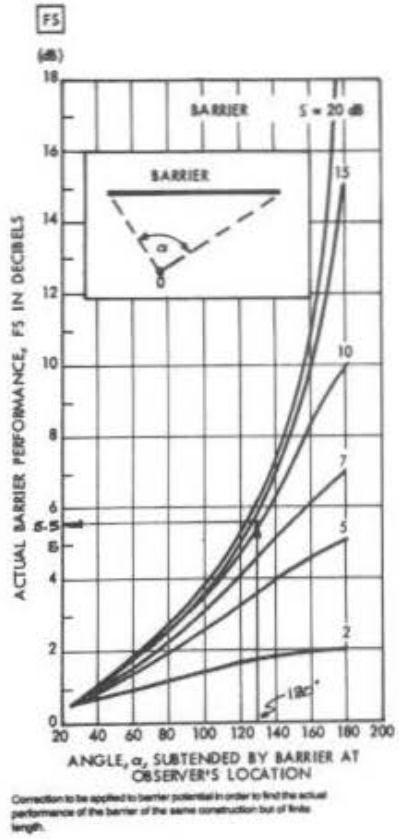


Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

27. The Noise Attenuation Provided Is 6 Decibels (5.5 Rounded Up)

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





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

Note—Don't Forget That the Height of the observor 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

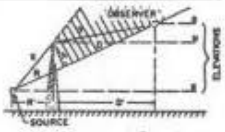
Enter the values for:

H= 15 R′= 40

S= 0 D′= 20

D= 15

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

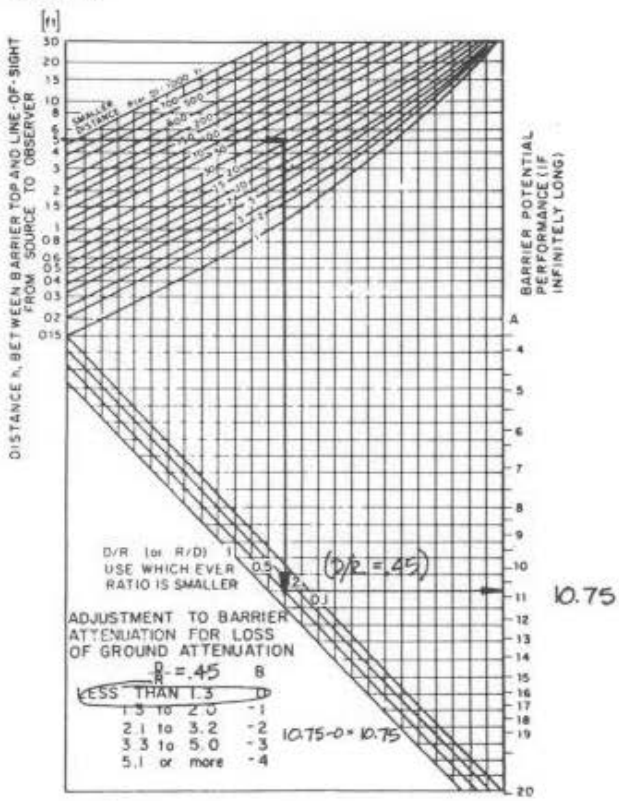


1. Elevation of barrier top minus elevation of source	[H 15] − [S 0]	= [1 15]	
2. Elevation of observer minus elevation of source	[O 15] − [S 0]	= [2 15]	
3. Map distance between source and observer (R′ + D′)		[3 60]	
4. Map distance between barrier and source (R′)		[4 40]	
5. Line 2 divided by line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

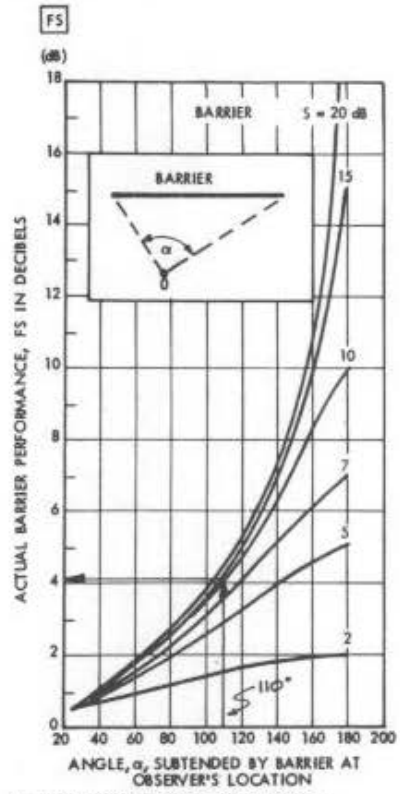
[Note: the value on line 2 may be negative, in which case so will the values on lines 5,9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: x + (−y) = x − y. And subtracting a negative number is like adding: X−(−y) = 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.

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

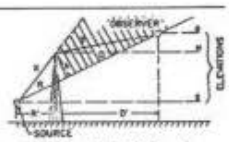
This Is Not Sufficient.

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

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

Enter the values for:
H= 12 R= 40
S= −10 D= 85
O= 25

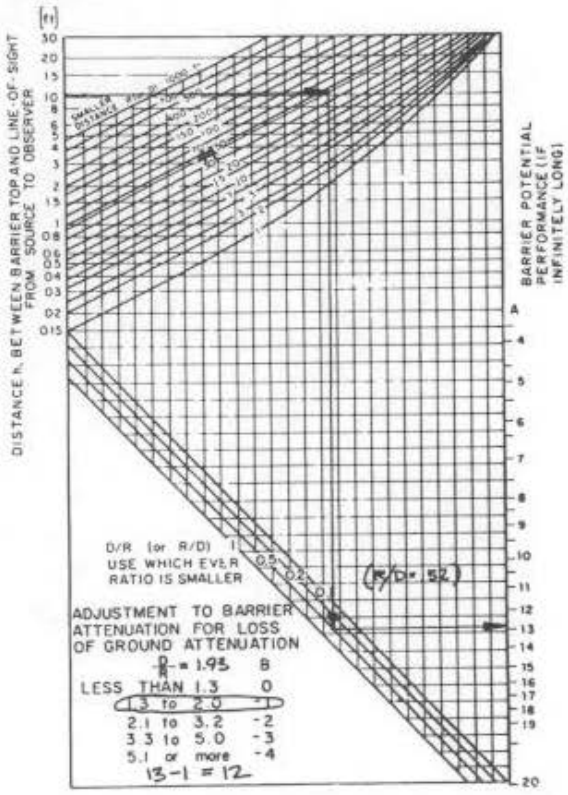


1. Elevation of barrier top minus elevation of source	[H 12] − [S −10]	= [1 22]	
2. Elevation of observer minus elevation of source	[O 25] − [S −10]	= [2 35]	
3. Map distance between source and observer (R + D)		[3 125]	
4. Map distance between barrier and source (R)		[4 40]	
5. Line 2 divided by line 3	[2 35] ÷ [3 125]	= [5 .28]	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[5 .28] × [5 .28]	= [6 .08]	
7. 40% of line 6	[.04] × [6 .08]	= [7 .03]	
8. One minus line 7	[1.0] − [7 .03]	= [8 .97]	
9. Line 5 times line 4 (will be negative if line 2 is negative)	[5 .28] × [4 40]	= [9 11.2]	
10. Line 1 minus line 9	[1 22] − [9 11.2]	= [10 10.8]	
11. Line 10 times line 8	[10 10.8] × [8 .97]	= [11 10.5]	= h
12. Line 5 times line 10	[5 .28] × [10 10.8]	= [12 3]	
13. Line 4 divided by line 8	[4 40] ÷ [8 .97]	= [13 41]	
14. Line 13 plus line 12	[13 41] + [12 3]	= [14 44]	= R
15. Line 3 minus line 4	[3 125] − [4 40]	= [15 85]	
16. Line 15 divided by line 8	[15 85] ÷ [8 .97]	= [16 88]	
17. Line 16 minus line 12	[16 88] − [12 3]	= [17 85]	= D

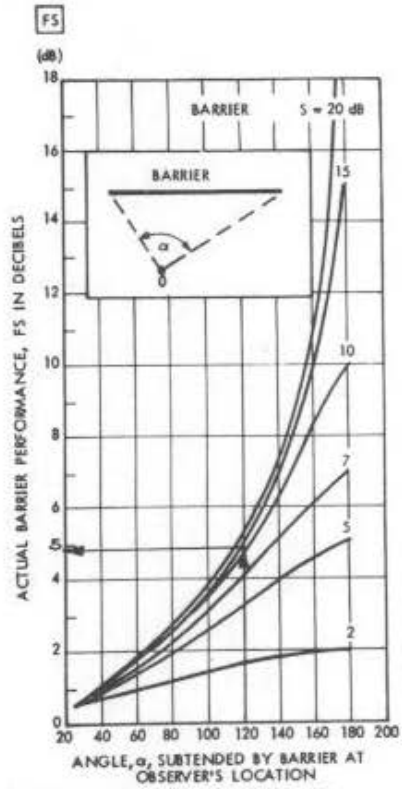
(Note: the value on line 2 may be negative, in which case so will the values on lines 5,9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: x + (−y) = x−y. And subtracting a negative number is like adding: X−(−y) = 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.

Workchart 5
Noise Barrier

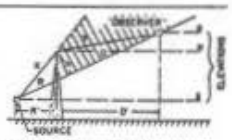
To find R, D and h from Site Elevations and Distances

Enter the values for:

H= 12 R= 40

S= -25 D= 85

O= 25



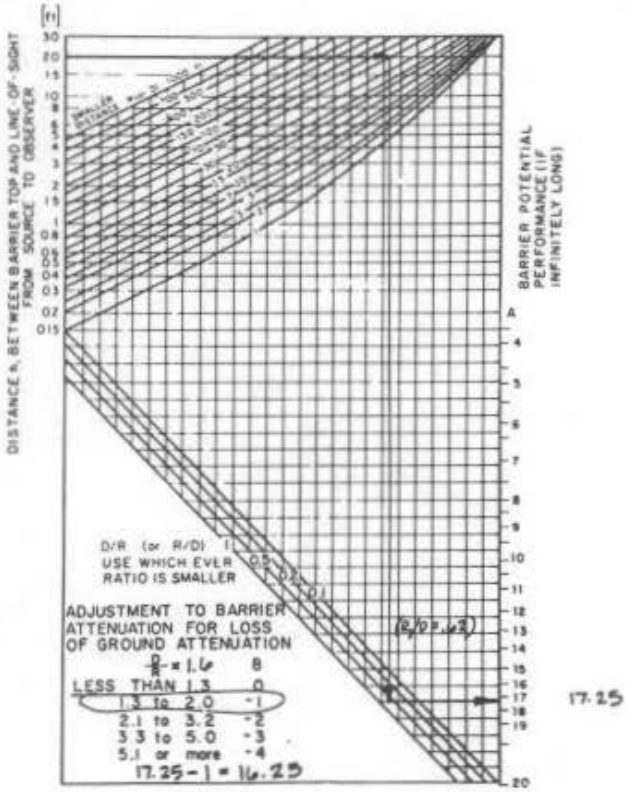
Fill out the following worksheet (all quantities are in feet):

1. Elevation of barrier top minus elevation of source	[H 12]	− [S −25]	= [1 37]	
2. Elevation of observer minus elevation of source	[O 25]	− [S −25]	= [2 50]	
3. Map distance between source and observer (R + D)			[3 125]	
4. Map distance between barrier and source (R)			[4 40]	
5. Line 2 divided by line 3	[2 50]	÷ [3 125]	= [5 .4]	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[5 .4]	× [5 .4]	= [6 .16]	
7. 40% of line 6	[ ]	× [6 .16]	= [7 .06]	
8. One minus line 7	[ ]	− [7 .06]	= [8 .94]	
9. Line 5 times line 4 (will be negative if line 2 is negative)	[5 .4]	× [4 40]	= [9 16]	
10. Line 1 minus line 9	[1 37]	− [9 16]	= [10 21]	
11. Line 10 times line 8	[10 21]	× [8 .94]	= [11 19.7]	= h
12. Line 5 times line 10	[5 .4]	× [10 21]	= [12 8.4]	
13. Line 4 divided by line 8	[4 40]	÷ [8 .94]	= [13 42.6]	
14. Line 13 plus line 12	[13 42.6]	+ [12 8.4]	= [14 51]	= R
15. Line 3 minus line 4	[3 125]	− [4 40]	= [15 85]	
16. Line 15 divided by line 8	[15 85]	÷ [8 .94]	= [16 90.4]	
17. Line 16 minus line 12	[16 90.4]	− [12 8.4]	= [17 82]	= D

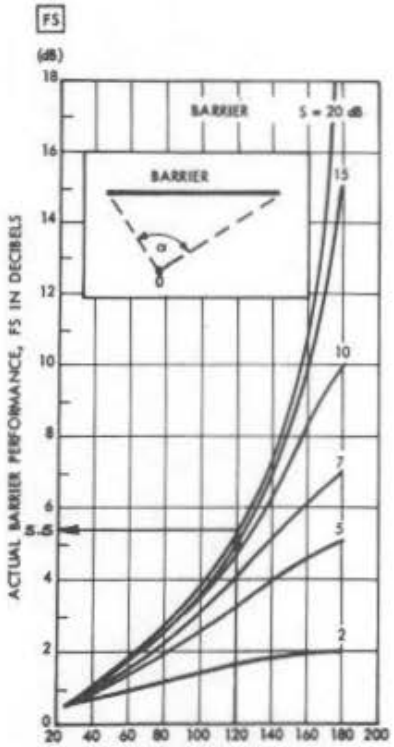
[Note: the value on line 2 may be negative, in which case so will the values on lines 5, 9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting. x + (−y) = x − y. And subtracting a negative number is like adding: x − (−y) = 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.

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.

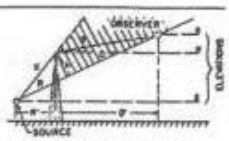
Workchart 5
Noise Barrier

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

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

Enter the values for:

H- 16 R- 36
S- 0 D- 56
O- 25

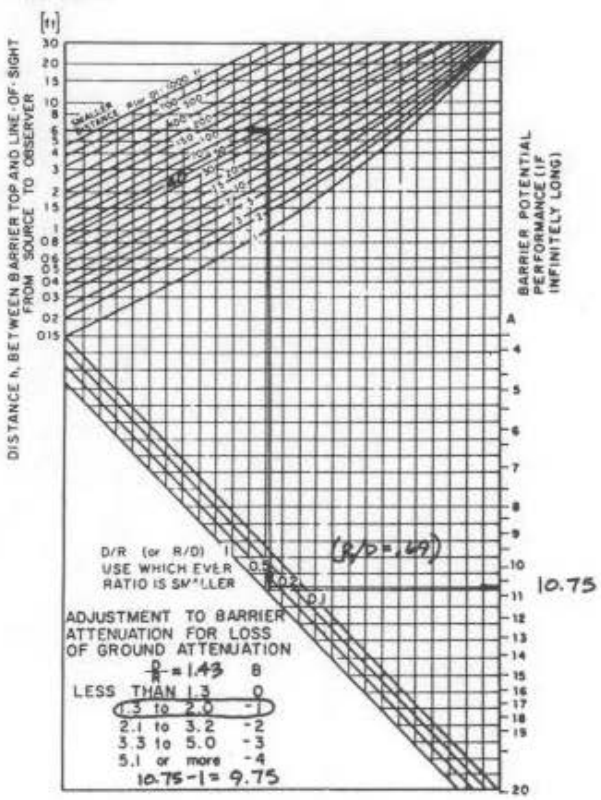


1. Elevation of barrier top minus elevation of source	[H 16] − [S 0] = [1 16]
2. Elevation of observer minus elevation of source	[O 25] − [S 0] = [2 25]
3. Map distance between source and observer (R + D)	[3 92]
4. Map distance between barrier and source (R)	[4 36]
5. Line 2 divided by line 3	[2 25] ÷ [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	[.4] × [6 .07] = [7 .03]
8. One minus line 7	[1.0] − [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] = h
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] = R
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] = D

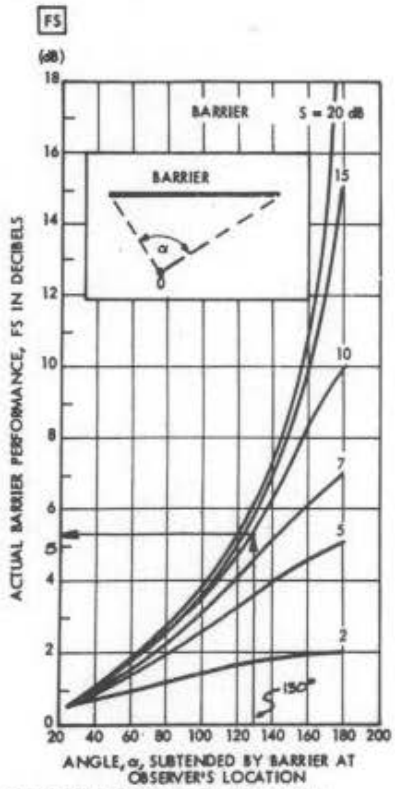
[Note: the value on line 2 may be negative, in which case so will the values on lines 5,9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: x + (−y) = x − y. And subtracting a negative number is like adding: X−(−y)=x+y.]

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

Workchart 6
Noise Barrier



Workchart 7



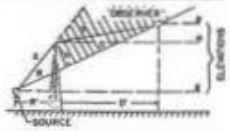
Correction to be applied to barrier potential in order to find the actual performance of the barrier of the same construction but of finite length.

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



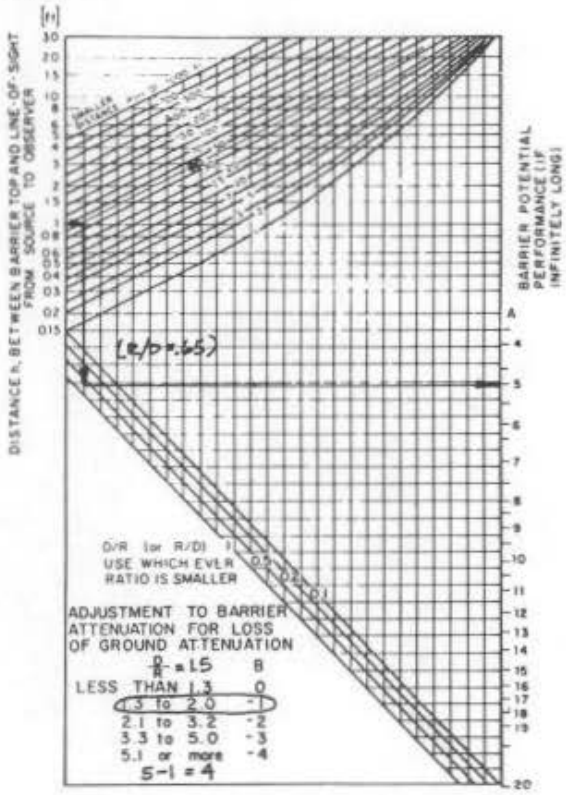
FIll out the following worksheet (All quantities are in feet)

1. Elevation of barrier top minus elevation of source	[H 16] −	[S 8] =	[1 8]	
2. Elevation of observer minus elevation of source	[O 25] −	[S 8] =	[2 17]	
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 17] +	[3 92] =	[5 .2]	
6. Square the quantity on line 5 (i.e., multiply it by itself); always positive	[5 .2] ×	[5 .2] =	[6 .04]	
7. 40% of line 6	[.4] ×	[6 .04] =	[7 .02]	
8. One minus line 7	[1.0] −	[7 .02] =	[8 .98]	
9. Line 5 times line 4 (will be negative if line 2 is negative)	[5 .2] ×	[4 36] =	[9 7]	
10. Line 1 minus line 9	[1 8] −	[9 7] =	[10 1]	
11. Line 10 times line 8	[10 1] ×	[8 .98] =	[11 .98]	= h
12. Line 5 times line 10	[5 .2] ×	[10 1] =	[12 .2]	
13. Line 4 divided by line 8	[4 36] ÷	[8 .98] =	[13 37]	
14. Line 13 plus line 12	[13 37] +	[12 .2] =	[14 37]	= R
15. Line 3 minus line 4	[3 92] −	[4 36] =	[15 56]	
16. Line 15 divided by line 8	[15 56] ÷	[8 .98] =	[16 57]	
17. Line 16 minus line 12	[16 57] −	[12 .2] =	[17 57]	= D

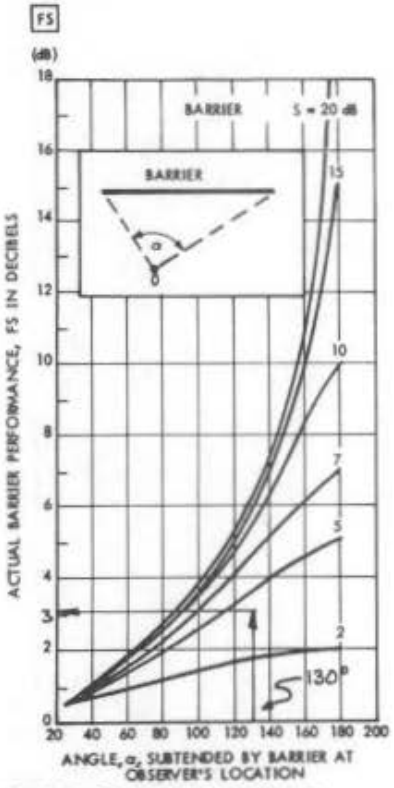
(Note: the value on line 2 may be negative, in which case so will the values on lines 5,9, and 12; line 1 may also be negative. Remember, then, in lines 10, 14, and 17, that adding a negative number is the same as subtracting: x + (−y) = x − y. And subtracting a negative number is like adding: x − (−y) = 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.