CHAPTER 8
SOLUTIONS

8-1 Wavelength

Given: Building 6.92 m high; f = 50.0 Hz; C = 346.12

Solution:

a. Compute wavelength

$$\lambda = \frac{346.12\text{m/s}}{50.0\text{s}^{-1}} = 6.92\text{m}$$

b. Building height in wavelengths

$$\text{h} = \frac{6.92\text{m}}{6.92\text{m}} = 1.00$$

Building is one wavelength high @ 50 Hz

8-2 Wavelength

Given: Problem 8-1 and 500 Hz and temp. = 25 °C

Solution:

a. Calculate speed of sound (Eqn. 8-6) with T = 25 + 273 = 298

$$C = 20.05\ (298)^{1/2} = 346.12\ \text{m/s}$$

b. Wavelength

$$\lambda = \frac{346.12\text{m/s}}{500.0\text{s}^{-1}} = 0.692\text{m}$$

c. Building height in wavelengths

$$\text{h} = \frac{6.92\text{m}}{0.692\text{m}} = 10$$

Building is 10 wavelengths high @ 500 Hz

8-3 Sum of sound levels

Given: Sound levels of 68, 68, 74, 76, 81, 82

Solution:

a. Using Figure 8-4

First difference

68 - 68 = 0 Thus add 3 to 68 = 71

Second difference

74 - 71 = 3 add 1.75 to 74 = 75.75

Third

76 - 75.75 = 0.22 add 2.8 to 76 = 78.8

Fourth

81 - 78.8 = 2.20 add 2.05 to 81 = 83.05

Fifth

83.05 - 82 = 1.05 add 2.45 to 83.05 = 85.50

Total = 85.5 or 86 dB

8-4 Sixteen motorcycles

Given: 16 motorcycles at 200 m. One motorcycle = 56 dBA

Solution:

a. Using Figure 8-4

For first difference

56 - 56 = 0 add 3 dB to 59 = 65

Now take advantage of symmetry and combine two pair

59 - 59 = 0 add 3 dB to 59 = 62

Again using two groups of 4

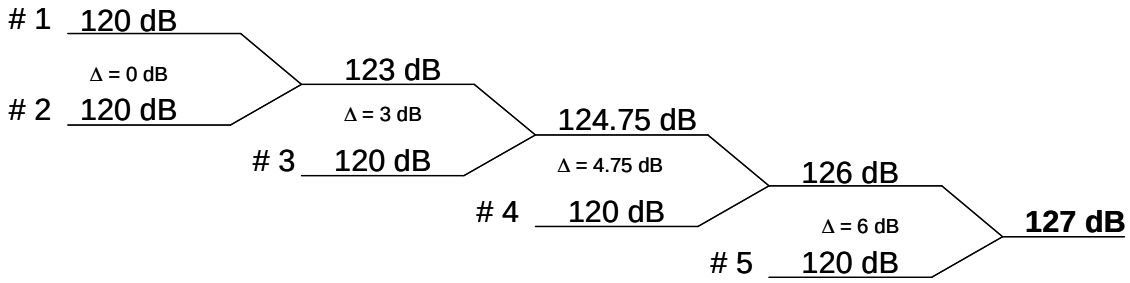
62 - 62 = 0 add 3 dB to 62 = 65

And finally two groups of 8

65 - 65 = 0 add 3 dB to 65 = 68 dBA

8-5 Given SPL when all chippers are working: 127 dB
And SPL when only one chipper is working: 120 dB

a. Solution by decibel addition:



Total number of Chippers is 5.

b. Alternate solution by sound level:

$$127 = 10Log\sum[(10^{(120/10)})(X)]$$

$$12.7 = \log[(10^{(120/10)})(X)] = \log[(10^{12})(X)]$$

Raise both sides to the power of 10

$$10^{12.7} = 10^{12}X$$

$$X = \frac{10^{12.7}}{10^{12}} = 5.012$$

8-6 Low or mid frequency

Given: 80 dBA; 84 dBB and 90 dBC

Solution:

a. Since A, B and C scale readings are spread out this indicates a low frequency source. Looking at Figure 8-5 one can see that the spread occurs because the weighting factors for the A scale is greater than that for the B scale and much greater than that for the C scale (which is nil).

8-7 Bass or soprano

Given: 109 dBA; 110 dBB; 111 dBC

Solution:

a. Since A, B and C scale readings are close together the source is mid- to high frequency. Thus, the singer is a soprano. Looking at Figure 8-5, one can see that the weighting factors from 500 to 10,000 differ little for each scale. Thus, when readings are close together they will have frequencies in this range.

8-8 Equivalent A weighted level

Given: Octave band readings

Solution:

a. Using Table 8-1

Band Center Frequency (Hz)	Band Level dB	Weighting Value	Weighted dB
31.5	78	-39.4	38.6
63	76	-26.2	49.8
125	78	-16.1	61.9
250	82	- 8.6	73.4
500	81	- 3.2	77.8
1000	80	0.0	80.0
2000	80	1.2	81.2
4000	73	1.0	74.0
8000	65	- 1.1	63.9

b. By decibel addition (Figure 8-4) reading = 85.5 or 86 dBA

8-9 Equivalent A-weighted sound level for Jet aircraft

Given: Aircraft Noise spectrum

Band Center Frequency	Band Level [dB]	Weighting Value	Weighted Value	SPL
125	85	-16.1	68.9	7762471.17
250	88	-8.6	79.4	87096359.00
500	96	-3.2	92.8	1905460717.96
1000	100	0	100	10000000000.00
2000	104	1.2	105.2	33113112148.26
4000	101	1	102	15848931924.61
			Sum =	60962363621
			Log Sum =	10.79
			dB(A) =	107.85
			or	108 dBA

Weighted value = Band Level + Weighting Value

$SPL = 10^{(\text{Weighted value}/10)}$

$dB(A) = 10(\text{Log}_{10}(\text{Sum}))$

8-10 Equivalent A-weighted Sound level for automobile

Given: Automobile noise spectrum (see previous)

Band Center Frequency	Band Level [dB]	Weighting Value	Weighted Value	SPL
63	67	-26.2	40.8	12022.64435
125	64	-16.1	47.9	61659.50019
250	58	-8.6	49.4	87096.359
500	59	-3.2	55.8	380189.3963
1000	59	0	59	794328.2347
2000	55	1.2	56.2	416869.3835
4000	51	1	52	158489.3192
8000	45	-1.1	43.9	24547.08916
			Sum =	1935201.926
			Log Sum =	6.29
			dB(A) =	62.87
			or	63 dBA

8-11 Lawn Mower noise reduction

Given: lawn mower noise spectrum

Uncontrolled

Band Center Frequency	Band Level [dB]	Weighting Value	Weighted Value	SPL
63	78	-26.2	51.8	151356.1248
125	76	-16.1	59.9	977237.221
250	76	-8.6	67.4	5495408.739
500	77	-3.2	73.8	23988329.19
1000	79	0	79	79432823.47
2000	80	1.2	81.2	131825673.9
4000	78	1	79	79432823.47
8000	70	-1.1	68.9	7762471.166

Sum = 329066123.2

Log Sum = 8.52

dB(A) = 85.17

or 85 dBA

Improved muffler - 3 dB reduction in each frequency band

Band Center Frequency	Band Level [dB]	3 dB reduction	Weighting Value	Weighted Value	SPL
63	78	75	-26.2	48.8	75857.7575
125	76	73	-16.1	56.9	489778.8194
250	76	73	-8.6	64.4	2754228.703
500	77	74	-3.2	70.8	12022644.35
1000	79	76	0	76	39810717.06
2000	80	77	1.2	78.2	66069344.8
4000	78	75	1	76	39810717.06
8000	70	67	-1.1	65.9	3890451.45

Sum = 164923740

Log Sum = 8.22

dB(A) = 82.17

or 82 dBA

Speed reduction resulting in 5 dB reduction in each frequency band

Band Center Frequency	Band Level [dB]	5 dB reduction	Weighting Value	Weighted Value	SPL
63	78	73	-26.2	46.8	47863.00923
125	76	71	-16.1	54.9	309029.5433
250	76	71	-8.6	62.4	1737800.829
500	77	72	-3.2	68.8	7585775.75
1000	79	74	0	74	25118864.32
2000	80	75	1.2	76.2	41686938.35
4000	78	73	1	74	25118864.32
8000	70	65	-1.1	63.9	2454708.916

Sum = 104059845

Log Sum = 8.02

dB(A) = 80.17

or 80 dBA

Muffler reduction of 3 dB plus Speed reduction resulting in 5 dB reduction in each frequency band

Decibel addition of 3 dB plus 5dB = 7.124426

Band Center Frequency	Band Level [dB]	3+5 dB reduction	Weighting Value	Weighted Value	SPL
63	78	70.875574	-26.2	44.675574	29346.57328
125	76	68.875574	-16.1	52.775574	189477.3915
250	76	68.875574	-8.6	60.275574	1065509.674
500	77	69.875574	-3.2	66.675574	4651118.422
1000	79	71.875574	0	71.875574	15401300.59
2000	80	72.875574	1.2	74.075574	25559796.82
4000	78	70.875574	1	71.875574	15401300.59
8000	70	62.875574	-1.1	61.775574	1505072.419

Sum = 63802922.48

Log Sum = 7.80

dB(A) = 78.05

or 78 dBA

Engine redesign to reduce sound level 15 dB in five frequency bands

Band Center Frequency	Band Level [dB]	15 dB reduction	Weighting Value	Weighted Value	SPL
63	78		-26.2	51.8	151356.1248
125	76		-16.1	59.9	977237.221
250	76		-8.6	67.4	5495408.739
500	77	62	-3.2	58.8	758577.575
1000	79	64	0	64	2511886.432
2000	80	65	1.2	66.2	4168693.835
4000	78	63	1	64	2511886.432
8000	70	55	-1.1	53.9	245470.8916
				Sum =	16820517.25
				Log Sum =	7.23
				dB(A) =	72.26
				or	72 dBA

8-12 Comparing X and L_p

Given: Readings of 42, 50, 65, 71 and 47 dB

Solution:

a. Arithmetic average

$$X = \frac{42+50+65+71+47}{5} = 55dB$$

b. Logarithmic average (Eqn. 8-13)

$$L_p = 20\log\frac{1}{5}\left(10^{42/20}+10^{50/20}+10^{65/20}+10^{71/20}+10^{47/20}\right)$$

$L_p = 20 \log (0.2)(125.89 + 316.23 + 3548.13 + 223.87)$

$L_p = 20 \log (1198.48) = 61.57$ or 62 dB

c. Arithmetic averaging underestimates

8-13 Comparing X and L_p

Given: Readings of 76, 59, 35, 69, 72
Solution:

a. Arithmetic average

$$X = \frac{76 + 59 + 35 + 69 + 72}{5} = 62.dB$$ b. Logarithmic average (Eqn. 8-13)

$$L_p = 20 \log \frac{1}{5}\left(10^{76/20} + 10^{59/20} + 10^{355/20} + 10^{69/20} + 10^{72/20}\right)$$

$L_p = 20 \log(0.2)(6309.57 + 891.25 + 56.23 + 2818.38 + 3981.07)$

$L_p = 20 \log (2811.3) = 68.97$ or 69 dB

c. Arithmetic average underestimates.

8-14 Computing L_{eq}

Given: Hourly average noise levels

Solution:

a. Using Eqn. 8-15

$$L_{eq} = 10 \log\left[\left(10^{42/10}\right)\left(\frac{6}{24}\right) + \left(10^{45/10}\right)\left(\frac{8}{24}\right) + \left(10^{47/10}\right)\left(\frac{7}{24}\right) + \left(10^{50/10}\right)\left(\frac{3}{24}\right)\right]$$

$L_{eq} = 10 \log [3{,}962.23 + 10{,}540.92 + 14{,}617.96 + 12{,}500]$

$L_{eq} = 10 \log [41\ 621.12] = 46.19$ or 46 dBA

b. It is a quiet neighborhood.

8-15 Computing L_{eq}

Given: Hourly average noise levels

Solution:

a. Using Eqn. 8-15

$$L_{eq} = 10\log\left[\left(10^{42/10}\right)\left(\frac{6}{24}\right)+\left(10^{55/10}\right)\left(\frac{2}{24}\right)+\left(10^{65/10}\right)\left(\frac{2}{24}\right)+\left(10^{70/10}\right)\left(\frac{10}{24}\right)+\left(10^{68/10}\right)\left(\frac{2}{24}\right)+\left(10^{57/10}\right)\left(\frac{2}{24}\right)\right]$$

L_{eq} = 10 log [3,962.23 + 26,352.31 + 263,523.12 + 4,166,666.67 + 525,797.78 + 41,765.60]

L_{eq} = 10 log [5,028,067.74] = 67.01 or 67 dBA

8-16 Computing L_{dn}

Given: hourly Noise

Highlighted time period is to note the 10 dBA "penalty" period

Time interval [h]	Time interval [s]	Sound Level [dBA]	Exp	Exp x t(i)
0000-0500	18000	52	1584893.192	2.85E+10
0500-0700	7200	78	630957344.5	4.54E+12
0700-1130	16200	90	1000000000	1.62E+13
1130-1200	1800	70	10000000	1.80E+10
1200-1530	12600	90	1000000000	1.26E+13
1530-1800	9000	52	158489.3192	1.43E+09
1800-2200	14400	60	1000000	1.44E+10
2200-0000	7200	52	1584893.192	1.14E+10
			Sum =	3.34167E+13
			log Sum =	13.52
			10 log Sum =	135.24
			L(dn) =	85.84
			or	85 dBA

8-17 Computing L_{dn}

Given: hourly Noise

Highlighted time period is to note the 10 dBA "penalty" period

Time interval [h]	Time interval [s]	Sound Level [dBA]	Exp	Exp x t(i)
0000-0700	25200	52	1584893.192	39939308450
0700-0900	7200	82	158489319.2	1.14112E+12
0900-1200	10800	60	1000000	10800000000
1200-1300	3600	65	3162277.66	11384199577
1300-1500	7200	60	1000000	7200000000
1500-1700	7200	75	31622776.6	2.27684E+11
1700-1800	3600	90	1000000000	3.6E+12
1800-2200	14400	60	1000000	14400000000
2200-0000	7200	52	1584893.192	11411230986
			Sum =	5.06394E+12
			log Sum =	12.70448871
			10 log Sum =	127.0448871
			L(dn) =	77.64488708
			or	78 dBA

8-18 Power Plant Noise Level

Given: 139 dB 4000 Hz at power plant clear winter night, wind speed of 4.5 m/s, temperature of 0.0º C, Relative humidity of 30%, and barometric pressure of 101.3 kPa. Boiler at 12 m and height of the receiver is 1.5m.

a. Calculate the air attenuation from Eq 8-26 using table 8-8 at 0.0º C and 30% humidity we find a α = 69dB/km.

$$A_e = \frac{(69dB/km)(408m)}{1000m/km} = 28.15dB$$

b. Calculate the ground elevations at the source zone

   a. Calculate length of the source zone

      30 h_r = 30 (12m) = 360m

   b. From the sketch, note that 50m of the source zone is hard and 310m are soft. So that

$$G = \frac{310}{360}(1) = 0.86$$

   c. Using Table 8.9 the equation for 4,000 Hz is

$A_s = (1\text{-}G) - 1.5$

$A_s = (1\text{-}0.86)\text{-}1.5 = -1.36$

c. Calculate the ground attenuation at the receiver zone

   a. Calculate the length of the receiver zone

      $30\ h_r = 30\ (1.5m) = 45\ m$

   b. Note from the sketch that the entire receiver zone is soft so that G=1.

   c. Using Table 8-9the equation for 4,000 hz is

      $A_r = (1\text{-}G) - 1.5$

      $A_r = (1\text{-}1)\text{-}1.5 = -1.5$

d. Note that $h_s + h_r = 408 + 45 = 453$ m. Thus the source and receiver zones overlay and there is no middle zone.

e. The total attenuation is

   $A_{e1}\text{-}A_{e2} = 28.15 \text{ -}1.36 \text{ -}1.5 = 25.29$

f. Using the basic point source Model (Equation 8-25) the SPL at the receiver is

   $L_{p2}= 139 - 20 \log(408)- 11\text{-}25.29 = 50.5$ or 50 dB

8-19 Jet Engine Test Cell

Given: 149 dB at 125 Hz, clear summer morning, wind speed = 1.5 m/s, temperature 25ºC, relative humidity of 70% and Barometric pressure of 101.3 kPa. Test cell and receiver are at 1.5 m and the receiver is 1,200 m downwind.

a. Calculate air attenuation (Eq 8-26)

   Using Table 8-8 at 125 Hz, for 25ºC, we need to interpolate between 20 and 30ºC

$$0.34 - \left(\frac{0.34 - 0.26}{2} \right) = 0.30 dB / km$$

   Then

$$A_{e1} = \frac{(0.30 dB)(1{,}200 m)}{1{,}000 m / km} = 0.36 dB$$

b. Calculate the ground attenuation of the source zone

a. Calculate length of the source zone

$30h_s = 30(1.5) = 45$ m

b. From the sketch note that 100% f the source zone is hard and that G = 0.0

c. Using Table 8-9 the equation for 125 Hz is

$A_s = [(a)(G)]-1.5$

From the table a = 6.6

$A_s = [6.6(0)]-1.5 = -1.5$

c. Calculate the ground attenuation at the receiver

a. Calculate length of the receiver zone

$30h_s = 30(1.5) = 45$ m

b. From the sketch note that 45-10 = 35 m f the receiver zone is soft

$G = (35/45)(1) = 0.78$

c. Using Table 8-9 the equation for 125 Hz is

$A_s = [(a)(G)]-1.5$

From the table a = 6.6

$A_s = [6.6(0.78)]-1.5 = 5.15-1.5 = 3.65$

d. Calculate the ground attenuation in the middle zone

a. The middle zone composition is

Grass: 300 m +300 m + (400 m-35 m) = 965 m

Where 35 m is the receiver zone, which is grass

Asphalt: (100 m -45 m)+ 50 m + 40 m = 145 m

Where 45 m is the source zone

The fraction which is grass is then

$$\frac{965m}{965m+145m} = 0.87$$

The value of G is then

$G = (0.87)(1.0) = 0.87$

b. The equation for the middle zone is

$A_m = -3e(1-G)$

c. Using Equation 8-27

$$e = 1 - \left[\frac{30(1.5 + 1.5)}{1{,}200} \right] = 1 - \left[\frac{90}{1{,}200} \right] = 0.93$$

d. The attenuation in the middle zone is

$A_m = -3(0.93)(1-0.87) = -0.36$

e. The total ground attenuation is

$A_{e2} = -1.5 + 3.65 - 0.36 = 1.79$

f. The Sound Pressure Level at the receiver (Eqn 8-25)

$$L_{p2} = 149 - 20\log(1{,}200) - 11 - 0.36 - 1.79 = 74.27 dB$$ or 74 db @ 125 Hz

8-20 Jet Air Plane

Given: Band level table, jet is 2,000 m from receiver, clear summer morning, wind speed of 250 m/s, temperature of 20ºC and relative humidity of 70% and barometric pressure of 101.3 kPa. Source and receiver are 1.5 m above ground.

Solution:

a. Calculate the G values for the source, receiver and middle zones

Source zone attenuation

$30\ h_s = 30\ (1.5\ m) = 45\ m$

From the sketch note that 25 m of this length is grass so the fraction that is soft is

$$\frac{25m}{45m} = 0.56$$

The value of G is

$G = (0.56)(1.0) = 0.56$

b. Calculate the ground attenuation at the receiver

$30\ hr = 30\ (1.5m) = 45\ m$

Using the sketch note that 100% of the zone is grass. Therefore G = 1.0

c. Calculate the ground attenuation in the middle zone

Note that 80% of this zone is grass, therefore

$$G = (0.80)(1.0) = 0.80$$

The value for e is

$$e = 1 - \left[\frac{30(1.5+1.5)}{2{,}000}\right] = 1 - 0.045 = 0.955 \text{ or } 0.96$$

d. Use a computer spreadsheet to complete the solution

Distance = 2000 m G = 0.56 1.00 0.80

Band Frequency [Hz]	Band Level [dB]	Divergence [dB]	Alpha [dB/km]	Air Attenuation [dB]	Ground Atten. A(s) [dB]	Ground Atten. Ar [dB]	Grnd Atten. A(m) [dB]	L_p [dB]	A Weighting [dB]	Exponent	Exponetial
125	144	77.0	0.34	0.68	2.196	5.1	-0.576	59.6	-16.1	4.34794	22281.27
250	148	77.0	1.10	2.2	3.204	6.9	-0.576	59.3	-8.6	5.06514	116182.3
500	155	77.0	2.80	5.6	2.14	5	-0.576	65.8	-3.2	6.26154	1826165
1000	160	77.0	5.00	10	-0.324	0.6	-0.576	73.3	0.0	7.32794	21278451
2000	165	77.0	9.00	18	-1.06	-1.50	-0.576	73.1	1.2	7.43154	27010959
4000	168	77.0	23.00	46	-1.06	-1.50	-0.576	48.1	1.0	4.91154	81571.79
										Sum =	50335611
										Log =	7.70
										dBA =	77

8-21 Vehicle spacing and noise level (ideal)

Given: 1200 VPH; speed = 40 km/h; autos emit 71 dBA at 8 m

Solution:

a. Center to center spacing

$$\frac{40 km/h}{1200 vph} = 0.0333 km \text{ or } 33.3 \text{ m}$$

b. Number of vehicles in 1.0 km length

$$\frac{1200 vph}{40 km/h} = 30 vehicles$$

c. Sound level at edge of 8 m wide, i.e. 4 m to centerline

$$L_{p2} = 71 - 20\log\left(\frac{60}{4}\right)$$

L_{p2} = 71 - 23.52 = 47.48 or 48 dBA

8-22 Noise level at 80.0 km/h

Given: Problem 8-21

Solution:

a. Center to center spacing

$$\frac{80 km/h}{1200 vph} = 0.06667 km \text{ or } 66.67 \text{ m}$$

b. Number of vehicles in 1.0 km length

$$\frac{1200 vph}{80 km/h} = 15 vehicles$$

c. Sound level at edge of 8 m wide, i.e. 4 m to centerline

Some intuition and insight are called for here. From Figure 8-4 (and/or Problem 8-4) we note that twice the number of sources at the same SPL causes an increase in SPL of 3 dB. We may deduce that likewise, a reduction in sources by a factor of two reduces the SPL by 3 dB. Thus, the SPL at roadside would be:

L_{p1} = 71 - 3 = 68.

$$L_{p2} = 68 - 20\log\left(\frac{60}{4}\right)$$

L_{p2} = 68 - 23.52 = 44.48 or 44 dBA

8-23 L_{10} Noise Level

Given: Highway traffic situation

Solution:

a. Use noise prediction worksheet on the next page. Note that
   i. Autos and medium trucks may be combined using the equation:

$$V_C = V_A + 10\ V_{TM}$$

$$V_C = 1{,}500 + 10\ (150) = 3{,}000$$

ii. There are no heavy trucks

b. Use the L_{10} nomograph (see next page) to compute the unshielded L_{10}

c. Use the barrier nomograph (see next page) to determine the shielding. Because the medium trucks have been combined with the autos, there is no value in the unshielded L10 box for T_M and no heavy trucks; yielding no value for unshielded L10 for T_H.

8-24 L10 Noise level

Given: Highway traffic situation

Solution:

a. Use noise prediction worksheet on the next page. Note that

i. Autos and medium trucks may be combined using the equation:

$$V_C = V_A + 10\ V_{TM}$$

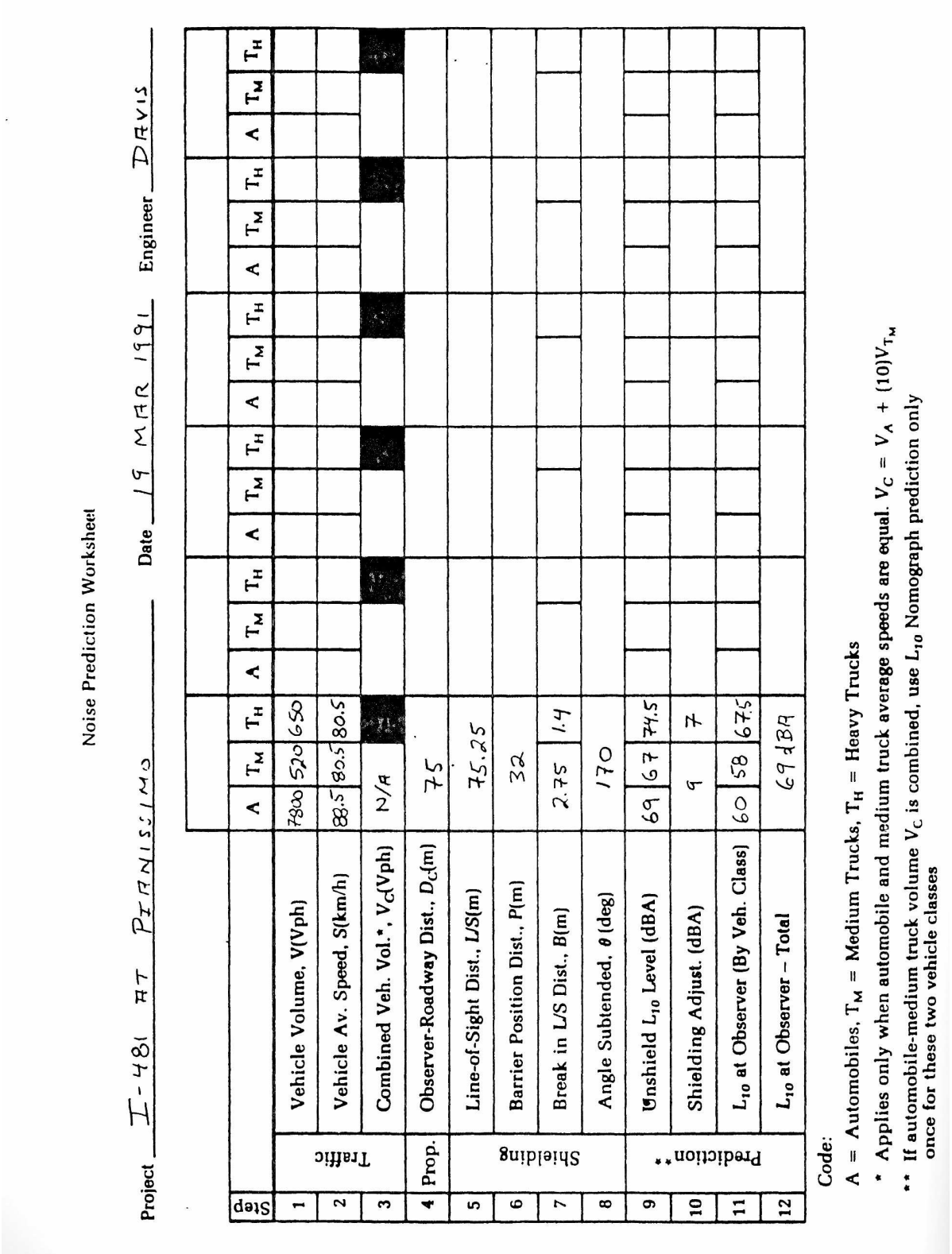
$$V_C = 2{,}000 + 10\ (200) = 4{,}000$$

ii. There are no heavy trucks

b. Use the L_{10} nomograph (see next page) to compute the unshielded L_{10}

c. Use the barrier nomograph (see next page) to determine the shielding. Because the medium trucks have been combined with the autos, there is no value in the unshielded L10 box for T_M and no heavy trucks; yielding no value for unshielded L10 for T_H.

8-25



Noise Prediction Worksheet

Project I-481 AT PENNSYLVANIA Date 19 MAR 1991 Engineer DAVIS

Step			A	T_M	T_H	A	T_M	T_H	A	T_M	T_H	A	T_M	T_H	A	T_M	T_H
1	Traffic	Vehicle Volume, V(Vph)	7800	520	650												
2		Vehicle Av. Speed, S(km/h)	88.5	80.5	80.5												
3		Combined Veh. Vol.*, V_C(Vph)	N/A														
4	Prop.	Observer-Roadway Dist., D_C(m)	75														
5	Shielding	Line-of-Sight Dist., L/S(m)	75.25														
6		Barrier Position Dist., P(m)	32														
7		Break in L/S Dist., B(m)	2.75		1.4												
8		Angle Subtended, θ (deg)	170														
9	Prediction**	Unshield L_{10} Level (dBA)	69	67	74.5												
10		Shielding Adjust. (dBA)	9		7												
11		L_{10} at Observer (By Veh. Class)	60	58	67.5												
12		L_{10} at Observer – Total	69 dBA														

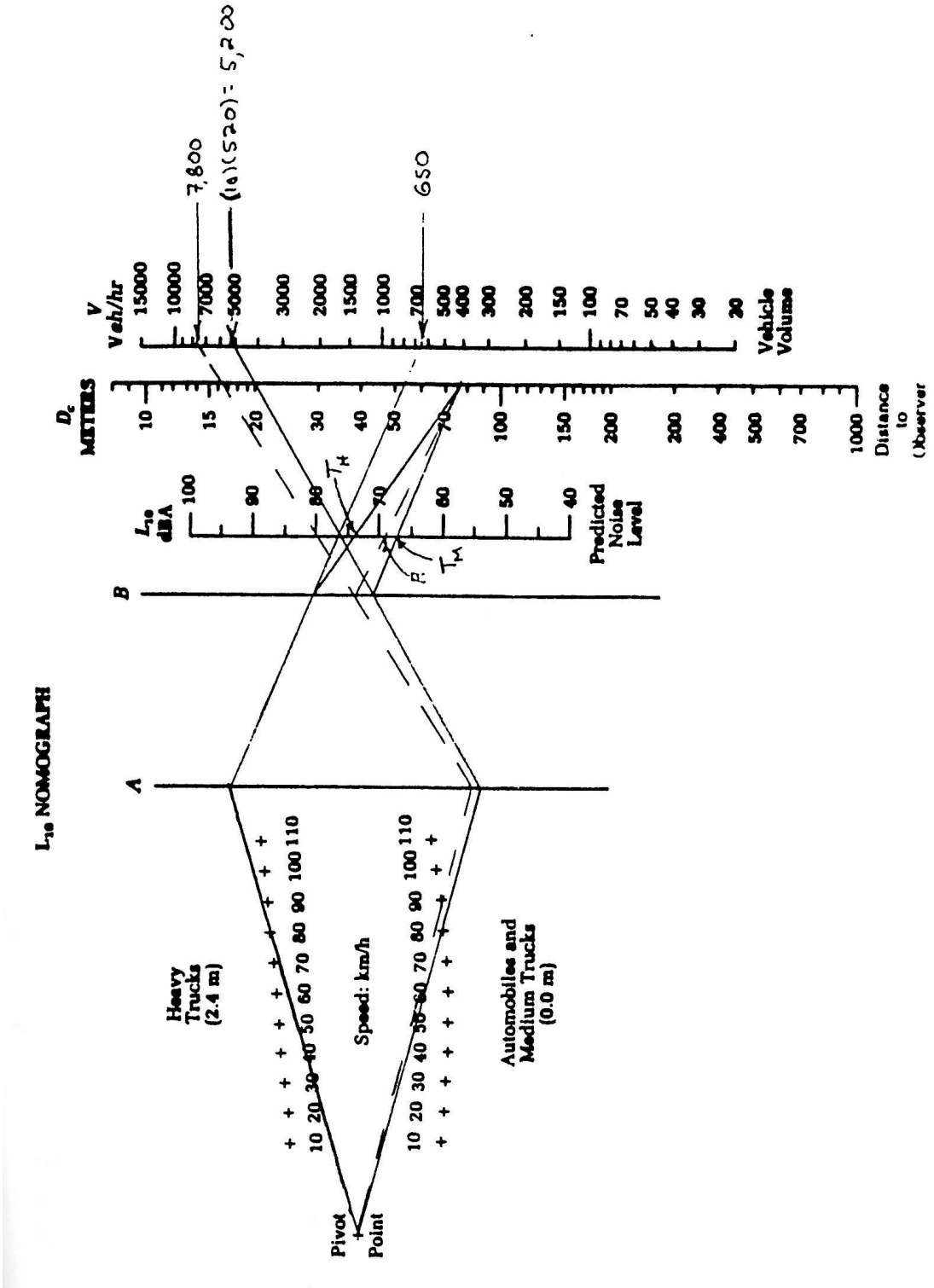
Code:

A = Automobiles, T_M = Medium Trucks, T_H = Heavy Trucks

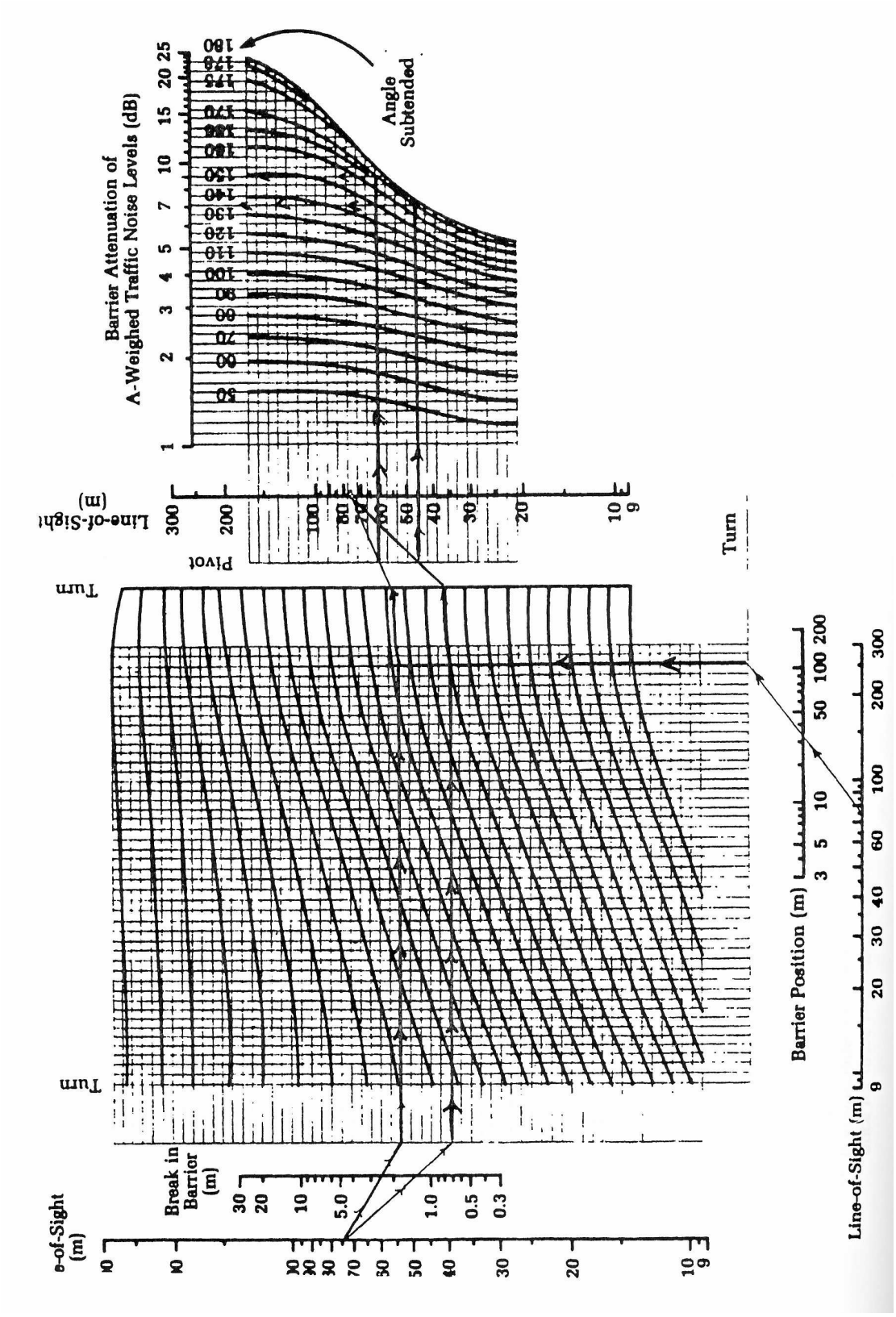
* Applies only when automobile and medium truck average speeds are equal. $V_C = V_A + (10)V_{T_M}$

** If automobile-medium truck volume V_C is combined, use L_{10} Nomograph prediction only once for these two vehicle classes

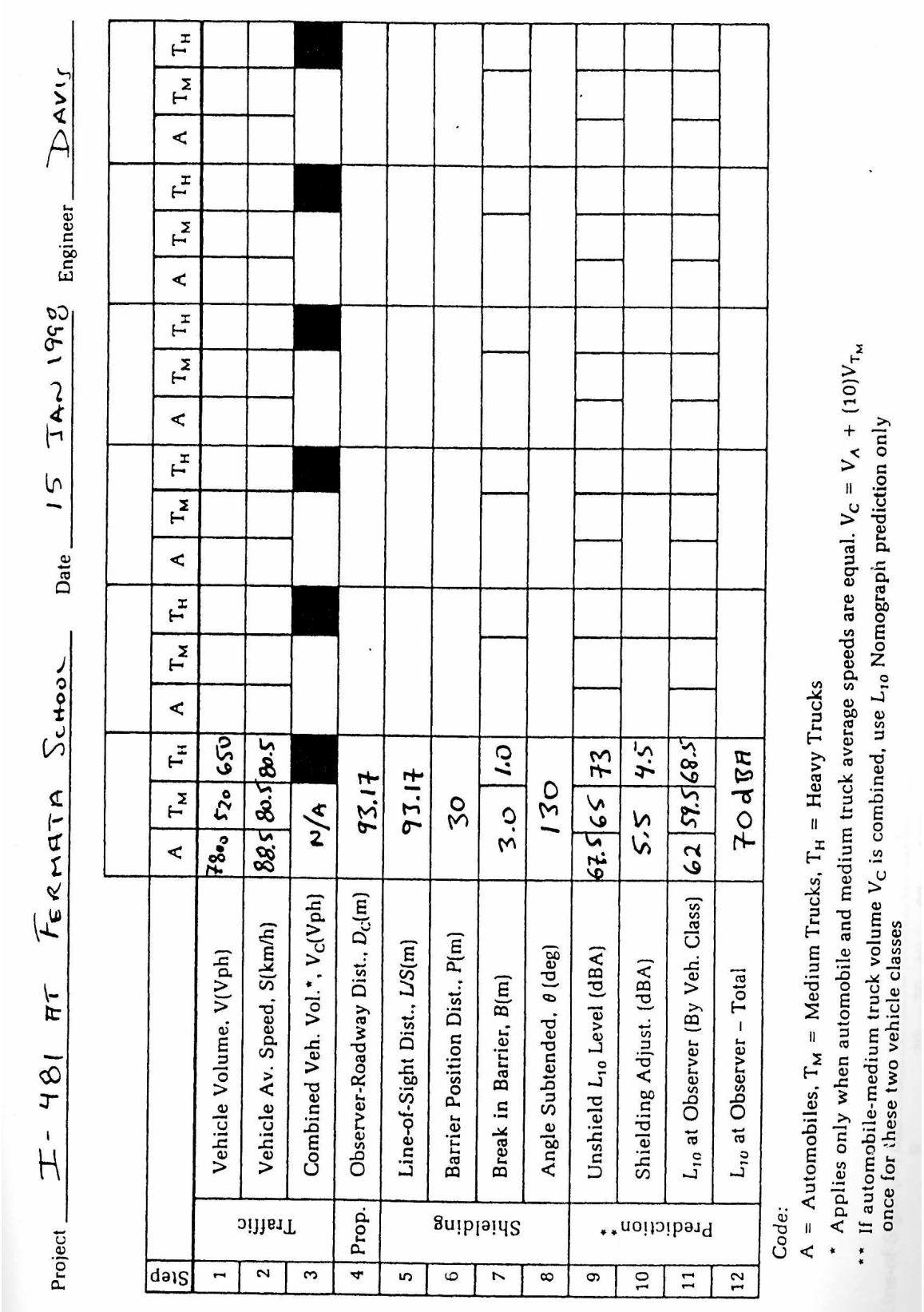
8-25



8-25



8-26



Project I-481 AT FERMATA SCHOOL Date 15 JAN 1998 Engineer DAVIS

Step		A	T_M	T_H	A	T_M	T_H	A	T_M	T_H	A	T_M	T_H	A	T_M	T_H	A	T_M	T_H
1	Traffic: Vehicle Volume, V(Vph)	780	520	650															
2	Traffic: Vehicle Av. Speed, S(km/h)	88.5	80.5	80.5															
3	Traffic: Combined Veh. Vol.*, V_C(Vph)	N/A																	
4	Prop. Shielding: Observer-Roadway Dist., D_C(m)	93.17																	
5	Shielding: Line-of-Sight Dist., *L/S*(m)	93.17																	
6	Shielding: Barrier Position Dist., *P*(m)	30																	
7	Shielding: Break in Barrier, *B*(m)	3.0	1.0																
8	Shielding: Angle Subtended, θ (deg)	130																	
9	Prediction**: Unshield L_{10} Level (dBA)	67.5	65	73															
10	Prediction**: Shielding Adjust. (dBA)	5.5		4.5															
11	Prediction**: L_{10} at Observer (By Veh. Class)	62	59.5	68.5															
12	Prediction**: L_{10} at Observer – Total	70 dBA																	

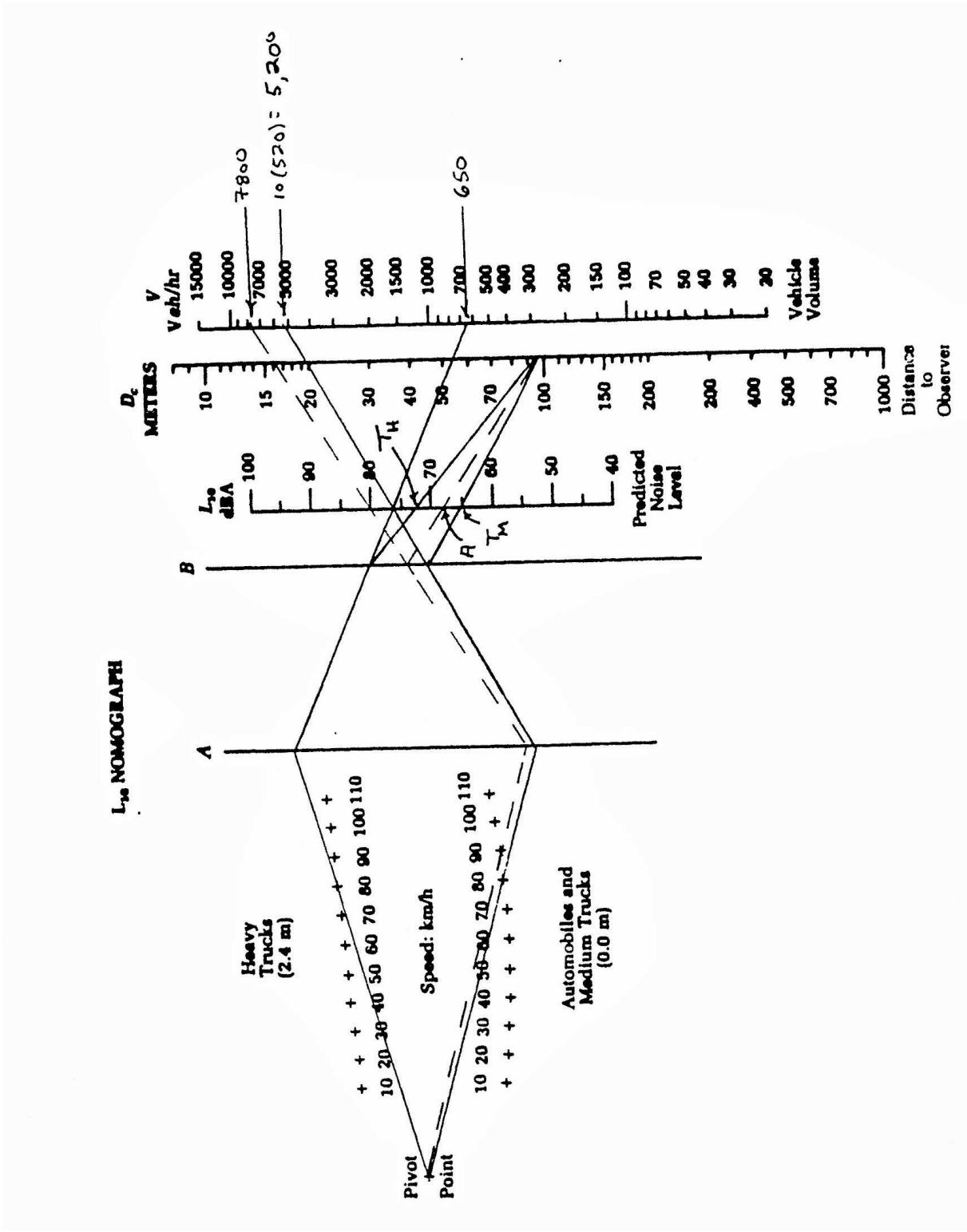
Code:

A = Automobiles, T_M = Medium Trucks, T_H = Heavy Trucks

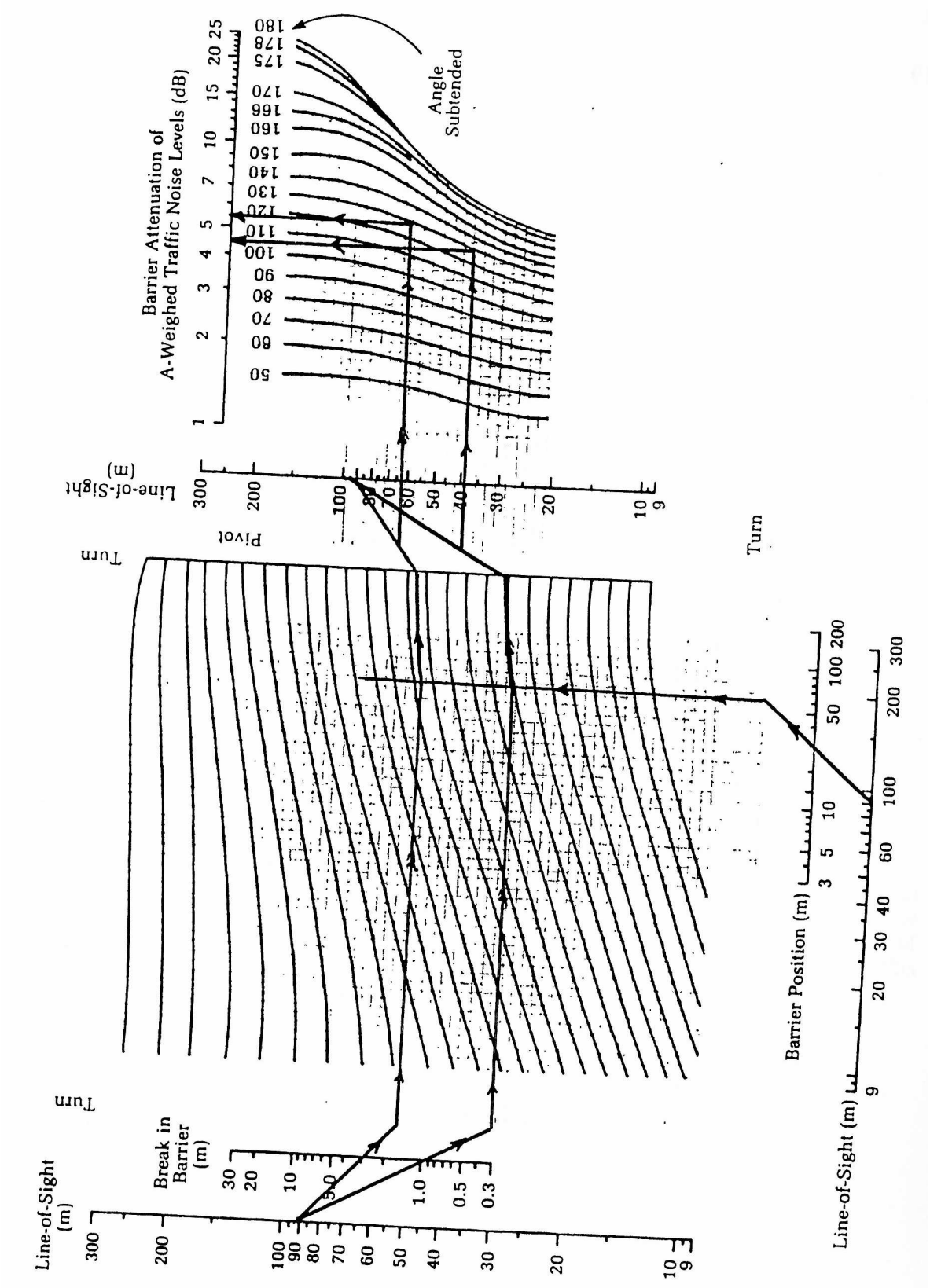
* Applies only when automobile and medium truck average speeds are equal. $V_C = V_A + (10)V_{T_M}$

** If automobile-medium truck volume V_C is combined, use L_{10} Nomograph prediction only once for these two vehicle classes

8-26



8-26



8-27 L_{eq} for traffic noise of Prob. 8-25

Given: Problem 8-25

Solution:

Using Eqn. 8-29 with D = 75.0 - 28.65 = 46.35

$L_{eq} = 42.3 + 10.2 \log (7{,}800) - 13.9 \log 46.35 + 0.13 (88.5)$

$L_{eq} = 42.3 + 39.70 - 23.16 + 11.51$

$L_{eq} = 70.35$ or 70 dBA

8-28 L_{eq} for traffic noise of Prob. 8-26

Given: Problem 8-26

Solution:

Using Eqn. 8-29 with D = 123.17 - 30 = 93.17

$L_{eq} = 42.3 + 10.2 \log (7{,}800) - 13.9 \log 93.17 + 0.13 (88.5)$

$L_{eq} = 42.3 + 39.70 - 27.37 + 11.51$

$L_{eq} = 66.14$ or 66 dBA

DISCUSSION QUESTIONS

8-1 Classification of noise type

Given: four noise sources

Solution:

(a) electric saw = intermittent

(b) air conditioner = continuous

(c) alarm clock (bell type) = not in any of the three classifications

(d) punch press = impulse

8-2 Sonic boom

Given: True/false statement
Solution:

False. Two sonic booms occur as an aircraft travelling at speed greater than the speed of sound passes overhead.

8-3 Cause of hearling loss

Given: True/false satement

Solution:

False. Excessive continuous noise causes hearing damage by wearing out the hair cells.

8-4 Reducing exposure time as a hearing protection method

Given: high speed grinder on steel girders

Solution:

Limiting the time of exposure is an acceptable method for reducing hearing damage. From the NIOSH damage-risk criteria shown in Figure 7-19, a 100 dBA noise level should be limited to one hour of exposure per day. This limits the feasibility because one hour of work a day is not adequate. However, job rotation may make it possible to avoid this excessive exposure.

8-5 Application of noise control techniques

Given: Figure 8-43

Solution:

Refer to following figure.

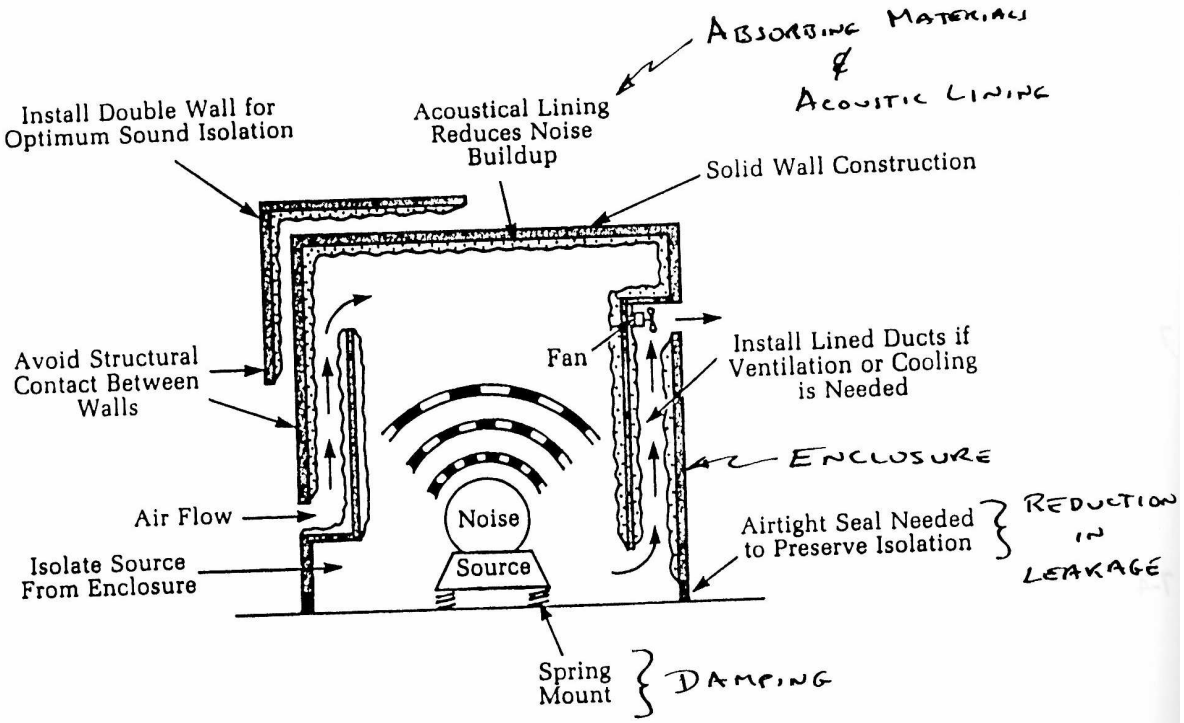


FIGURE 7-43
Enclosures for controlling noise. (*Source: National Bureau of Standards Handbook 119,* 1976.)