ENGR 9601, ENVS 6004

NOISE PROBLEMS - 2

10-18)

10-19)

- Noise Problems Continued.

10-18: Sound Power level = 139 dB at 4,000 Hz at source.

Find SPL at 408 m downwind.

Wind speed = 4.5 m/s (can be neglected).

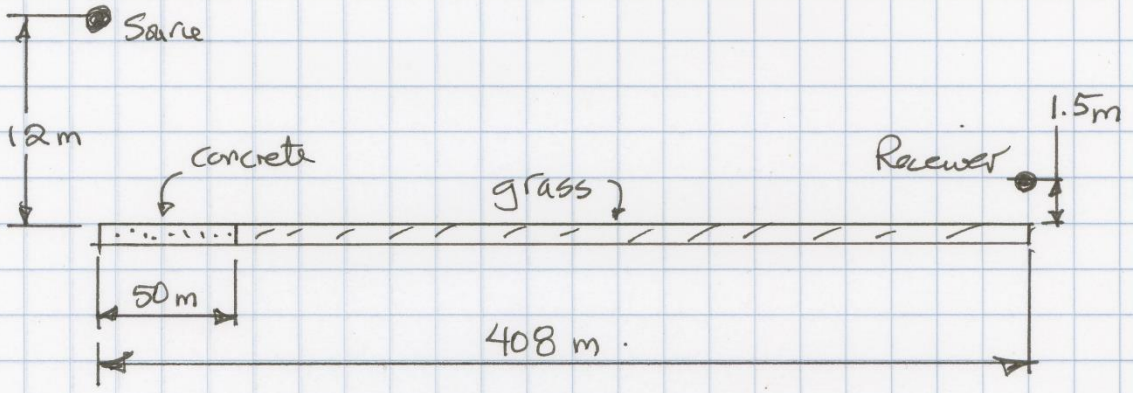
Temp. = 0.0°C.

RH = 30.0%

Barometric Pressure = 101.3 kPa (as in Table 10-8)

Boiler Height = 12 m.

Receiver Height = 1.5 m.



Source zone = 30 hs = 30(12m) = 360 m.

Receiver zone = 30 hr = 30(1.5 m) = 45m.

360 + 45 = 405.

Mid zone = 408 − 405 = 3 m.

Table 10-8: air attenuation coefficient, α = 69 dB/km.

$$Ae_1 = \frac{\alpha d}{1000\ m/km} = \frac{(69\ dB/km)(408\ m)}{1000\ m/km} = 28.152\ dB.$$

$$Ae_2 = A_s + A_r + A_m$$

$$e = 1 - \left[\frac{30\,(h_s + h_r)}{r}\right] = 1 - \left[\frac{30\,(12+1.5)}{408}\right] = 0.00735$$

10-18 cont'd.

$A_B = (1-G) - 1.5 = A_R.$

$A_m = -3e(1-G) = -3(0.00735)(1-1) = 0$

Source zone = 360 m
= 310 m grass + 50 m concrete

$G = (310/360)(1) = 0.861$

Receiver zone is completely soft (grass) so $G = 1$.

$A_B = (1-G) - 1.5 = (1-0.861) - 1.5 = -1.361$

$A_R = (1-G) - 1.5 = (1-1) - 1.5 = -1.50$

$A_{e2} = A_B + A_R + A_m = -1.361 - 1.50 + 0 = -2.861$

$A_e = A_{e1} + A_{e2} = 28.152 + (-2.861)$
$= 25.291$

$L_p \cong L_W - 20 \log r - 11 - A_e$

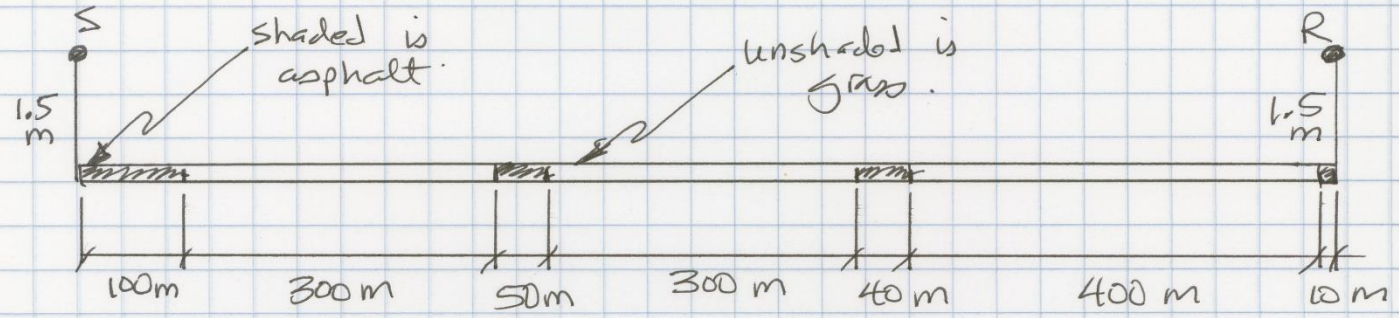
$\cong 139\ dB - 20 \log 408 - 11 - (25.291\ dB)$

$\cong 139 - 52.213 - 11 - 25.291$

$\cong 50.496$

$\cong 50.5\ dB.$

10-19 Sound Power Level, at source is 149 dB and has a 125-Hz frequency.
Find SPL at 1,200 m downwind.
An inversion can amplify sounds but wind speed of only 1.50 m/s is negligible.
Temp. = 25°C.
R.H. = 70%
Barometric Pressure = 101.3 kPa (as in Table 10-8)
Source Height = Receiver Height = 1.50 m.
Ground characteristics as in figure.



Air attenuation: Table 10-8: $\alpha = (0.34 + 0.26) \div 2 = 0.30$ dB/km

$$A_{e1} = \frac{\alpha d}{1000\ m/km} = \frac{(0.30)(1,200\ m)\ dB/km}{1000\ m/km} = 0.36\ dB.$$

Ground attenuation:

$$A_{e2} = A_S + A_R + A_m.$$

$$A_S = (a \cdot G) - 1.5 = A_R$$
$$A_m = -3e(1-G)$$
} from Table 10-9.

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

$$= 0.925$$

From Table 10-9 Factor $q = 6.6$

10-19 cont'd.

Source zone = $30 h_s = 30(1.5\ m) = 45\ m$.
Receiver zone = $30 h_R = 30(1.5m) = 45\ m$.

mid zone = $1200 - 45 - 45 = 1,110\ m$.

Source zone is asphalt so $G = 0$

Receiver zone is 10 m asphalt and 35 m grass.
so $G = 1(35/45) = 0.778$

Mid zone is
grass = 300 m + 300 m + 365 m = 965 m.
(concrete / asphalt) = 55 m + 50 m + 40 m = 145 m.

so $G = 1(965/(965+145)) = 0.869$.

$A_s = (a \cdot G) - 1.5$
$= (6.6 \cdot 0) - 1.5 = -1.50\ dB$.

$A_R = (a \cdot G) - 1.5$
$= (6.6 \cdot 0.778) - 1.5\ dB$
$= 3.635\ dB$.

$A_m = -3e(1-G)$
$= -3(0.925)(1-0.869)$
$= -0.364\ dB$

$A_{e2} = -1.50\ dB + 3.635\ dB - 0.364\ dB = 1.771\ dB$

$A_e = A_{e1} + A_{e2} = 0.36\ dB + 1.771\ dB = 2.131\ dB$.

$L_p = L_w - 20 \log r - 11 - A_e$
$= 149\ dB - 20 \log 1,200 - 11 - 2.131\ dB$
$= 149 - 61.584 - 11 - 2.131\ dB$
$= \underline{74.33\ dB}$.