TAMPERE UNIVERSITY OF TECHNOLOGY
Department of Mechanics and Design

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KSU-3287 Noise Control

Exam
May 13, 2011

No literature.

If there is no mention about the wave speed and density in the assignment, use for air c_o = 343 m/s and ρ_0 = 1.19 kg/m^3.

Problem 1

Noise from a workshop site is caused by four items of plant. The periods of operation of each item during the work day and noise level each produced at a noise sensitive property at the boundary of the site are shown below. Calculate the equivalent continuous noise level over a 8-hour working day.

Compressor	83dB(A) operating for 5h
excavator	85dB (A)operating for 2h
pump	76dB(A) operating for 6h
pile-driver	88dB(A) operating for 1.5h

Problem 2

In a classroom with dimensions 6 x 30 x 50 m^3, with 50 people inside, each of them produces an acoustic output of 100 μW while talking. The measured reverberation time is 2s. Assume a diffuse field in the classroom.

a) How much is the equivalent absorption area?
b) What is the sound pressure level?
c) At what distance from an individual talker in a direct field the same pressure is reached?(The directivity index Γ=1)

Problem 3

Consider a loudspeaker, mounted into an opening of one side of an airtight 15x15x15 cm^3 box, to which it makes airtight seal. Suppose it radiates a sound at 300Hz, with a time-averaged power $\overline{W} = 0.5W$.

(a) Determine the wavelength of radiated sound in air.
(b) What type of ideal radiator closely approximates the radiation from the loudspeaker and why.
(c) Calculate the sound pressure level in dB at point 15m away from the speaker in a free field.
(d) Re-express the result as a sound level in dB(A)
(e) How much the particle velocity at the same point?

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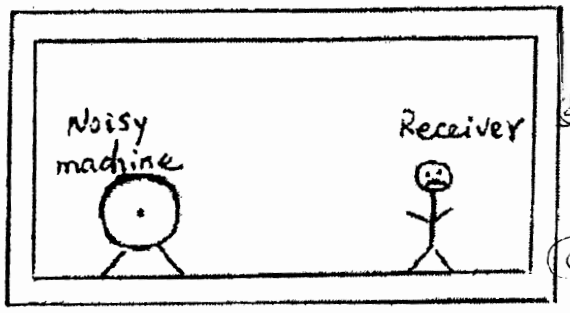
Problem 4

A double wall consists of two light single wood (ρ= 0.67kg/m^3) wall elements separated by an air gap provides considerably better insulation. The thickness of the two wood elements are 30mm and 20mm. In room acoustics the most significant resonance frequencies are between 100-4000Hz. In order to achieve an effective insulation, what is the air gap (between two walls) range needed?

$$100 \text{ or } 4000 = f = \frac{1}{2\pi}\sqrt{\frac{\rho_0 c^2 (\rho_1 h_1 + \rho_2 h_2)}{\eta \rho_1 h_1 \rho_2 h_2}}$$

Problem 5

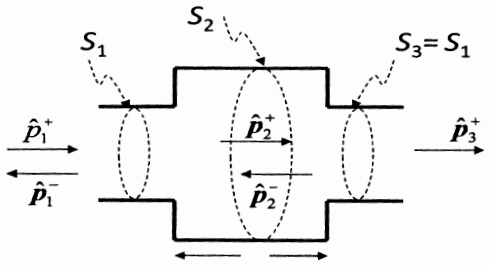
Consider a workshop room illustrated in the figure below.



(a) What are the noise transmission paths?
(b) Give some remedies which reduce the noise transmission to the receiver.

Problem 6

Expansion chambers occur frequently in exhaust systems. For example, the SAAB 9000 has a 35cm long expansion chamber, with an approximately elliptical across-section with principle axes of a=5 cm and b=8cm (the elliptical area equals to $S_2 = \pi ab$). The inlet and outlet pipes are circular, with 3cm radii. The exhaust gas temperature is about 400°C.(Hint: $c = c_0\sqrt{T/273}$)



(a) The case is considered when the frequency of noise is 100Hz. What is the transmission reduction (transmission loss) gained from the expansion chamber?
(b) At what specific tonal frequencies does the reduction have maxima? How much maxima of the transmission reduction?