

EELE 217 Spring 2014

Assigned Thursday, February 20, 2014

Due at the start of class on Thursday, February 27, 2014

A large, rectangular lecture room has floor dimensions 20m wide x 60m long, and a floor-to-ceiling height of 15m. A balcony attached to the middle of the back wall extends 15m into the room. The balcony is 3m thick.

Use the following surface types to calculate estimated reverb time for this room:

- The entire main floor area is Occupied audience, orchestra, chorus.
- The top of the balcony is Upholstered seats, cloth-covered, perforated bottoms.
- The two side walls and the balcony front and underside are constructed of Wood paneling, 3/8-1/2 in. over 2-4" airspace.
- The ceiling is Acoustic tile on rigid surface.
- The back wall above and below the balcony is Glass, heavy plate.
- The front of the hall is Concrete block, painted.

(1) Create a table showing the surface area of each material and the absorptivity of that material at 125 Hz, 500 Hz, and 4 kHz (see the attached material information table).

(2) Calculate the total absorption for the room at the three frequencies by summing the product of the surface area and the absorptivity for all surfaces.

(3) Calculate the estimated Sabine reverberation time (T_{60}) at 125 Hz, 500 Hz, and 4kHz.

$$T_{60} = \frac{0.161V}{\sum_i S_i a_i}$$

V = total volume in m^3

S_i = area of surface i in m^2

a_i = absorptivity of surface i

Be careful to calculate the volume of the room *subtracting* the volume (3x15x20) occupied by the balcony. Similarly, be careful to calculate the wall surface areas taking into account the balcony.

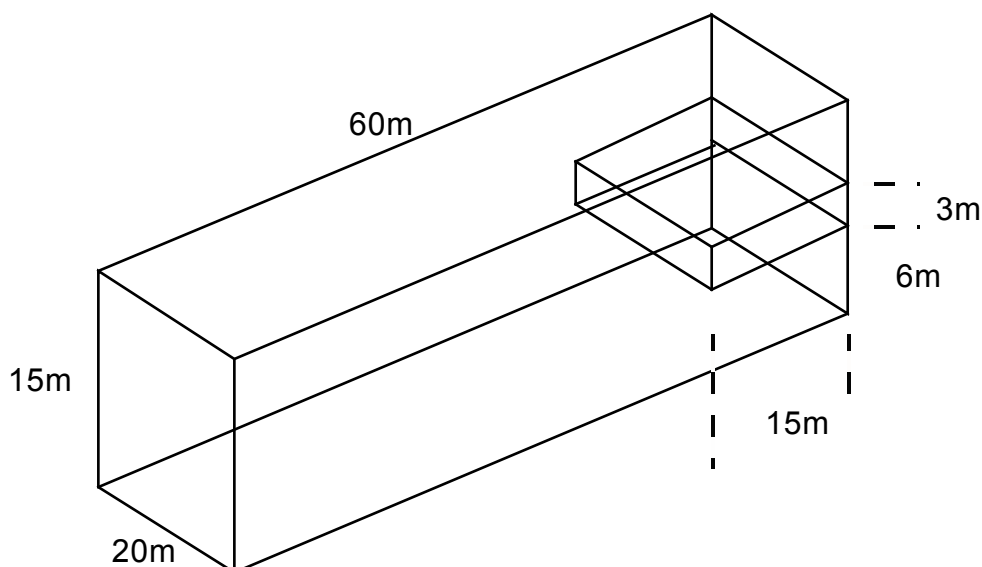


Table 12.5.1 Representative Sabine absorptivities and absorptions

<i>Description</i>	<i>Frequency (Hz)</i>					
	125	250	500	1000	2000	4000
	<i>Sabine Absorptivity a</i>					
Occupied audience, orchestra, chorus	0.40	0.55	0.80	0.95	0.90	0.85
Upholstered seats, cloth-covered, perforated bottoms	0.20	0.35	0.55	0.65	0.60	0.60
Upholstered seats, leather-covered	0.15	0.25	0.35	0.40	0.35	0.35
Carpet, heavy on undercarpet (1.35 kg/m ² felt or foam rubber)	0.08	0.25	0.55	0.70	0.70	0.75
Carpet, heavy on concrete	0.02	0.06	0.14	0.35	0.60	0.65
Acoustic plaster (approximate)	0.07	0.17	0.40	0.55	0.65	0.65
Acoustic tile on rigid surface	0.10	0.25	0.55	0.65	0.65	0.60
Acoustic tile, suspended (false ceiling)	0.40	0.50	0.60	0.75	0.70	0.60
Curtains, 0.48 kg/m ² velour, draped to half area	0.07	0.30	0.50	0.75	0.70	0.60
Wooden platform with airspace	0.40	0.30	0.20	0.17	0.15	0.10
Wood paneling, 3/8-1/2 in. over 2-4 in. airspace	0.30	0.25	0.20	0.17	0.15	0.10
Plywood, 1/4 in. on studs, fiberglass backing	0.60	0.30	0.10	0.09	0.09	0.09
Wooden walls, 2 in.	0.14	0.10	0.07	0.05	0.05	0.05
Floor, wooden	0.15	0.11	0.10	0.07	0.06	0.07
Floor, linoleum, flexible tile, on concrete	0.02	0.03	0.03	0.03	0.03	0.02
Floor, linoleum, flexible tile, on subfloor	0.02	0.04	0.05	0.05	0.10	0.05
Floor, terrazzo	0.01	0.01	0.02	0.02	0.02	0.02
Concrete (poured, unpainted)	0.01	0.01	0.02	0.02	0.02	0.02
Gypsum, 1/2 in. on studs	0.30	0.10	0.05	0.04	0.07	0.09
Plaster, smooth on lath	0.14	0.10	0.06	0.04	0.04	0.03
Plaster, smooth on lath on studs	0.30	0.15	0.10	0.05	0.04	0.05
Plaster, 1 in. damped on concrete block, brick, lath	0.14	0.10	0.07	0.05	0.05	0.05
Glass, heavy plate	0.18	0.06	0.04	0.03	0.02	0.02
Glass, windowpane	0.35	0.25	0.18	0.12	0.07	0.04
Brick, unglazed, no paint	0.03	0.03	0.03	0.04	0.05	0.07
Brick, smooth plaster finish	0.01	0.02	0.02	0.03	0.04	0.05
Concrete block, no paint	0.35	0.45	0.30	0.30	0.40	0.25
Concrete block, painted	0.10	0.05	0.06	0.07	0.09	0.08
Concrete block, smooth plaster finish	0.12	0.09	0.07	0.05	0.05	0.04
Concrete block, slotted two-well	0.10	0.90	0.50	0.45	0.45	0.40
Perforated panel over isolation blanket, 10% open area	0.20	0.90	0.90	0.90	0.85	0.85
Fiberglass, 1 in. on rigid backing	0.08	0.25	0.45	0.75	0.75	0.65
Fiberglass, 2 in. on rigid backing	0.21	0.50	0.75	0.90	0.85	0.80
Fiberglass, 2 in. on rigid backing, 1 in. airspace	0.35	0.65	0.80	0.90	0.85	0.80
Fiberglass, 4 in. on rigid backing	0.45	0.90	0.95	1.00	0.95	0.85
	<i>Sound Absorption A in m²</i>					
Single person or heavily upholstered seat (± 0.10 m ²)	0.40	0.70	0.85	0.95	0.90	0.80
Wooden chair, table, furnishing, for one person	0.02	0.03	0.05	0.08	0.08	0.05