UNIVERSITY OF MIAMI

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

EEN 502 Engineering Acoustics
Project No.3

A 15x10x6 (LxWxH in meters) room is to be used for musical performances of small ensembles consisting of up to 8 musicians. The floor is wooden, three of the walls and the ceiling are of unpainted concrete and one 10x6 wall is glass. The concrete walls are 25 cm thick with mass of 300 kg per unit area, critical frequency of 100 Hz and loss factor, η, of 0.1. The room includes 50 upholstered seats to be used by the audience.

A 8x5x6 adjacent room shares an 8x6 meter wall with the performance room. Its floor is carpet on concrete, the walls are painted concrete and it has a drop ceiling consisting of 5/8" gypsum sheetrock tiles at 50 cm from the unpainted concrete ceiling. The transmission loss for the gypsum tiles varies in a straight line between 40 and 70 dB over the 100 to 5 kHz octave frequency range.

You are required to perform the following acoustic analysis and design for the frequency range of 100 Hz and 4 kHz.

1. Determine the reverberation time constant (RT60) of the unoccupied performance room and plot it against frequency.

2. Determine the power transmission loss associated with any of the concrete walls and plot it against frequency.

3. When an 8-people musical ensemble uses the room for rehearsals the measured sound pressure level (SPL) is the diffuse field on the room is [75 80 82 76 70] dB for frequencies [125 250 500 1k 2k] Hz. The acoustic equivalent area for each [musician+instrument+seating] is 1 m^2 for the frequency range of interest.
   a. Determine RT60 of the room in rehearsal and plot it against frequency.
   b. Determine the SPL that leaks into the adjacent room and plot it against frequency.
   c. It is required that the surface of the wall separating the two rooms be altered only from the side of the adjacent room so that the maximum leaked SPL is within 20 dB of the threshold of audibility. Specify how the wall surface should be changes so that you achieve the desired acoustic power transmission loss and plot it against frequency. (Consider any meaningful and practical way of achieving that with the smallest cost and smallest loss of room volume.)
   d. If the desired leaked sound reduction is not achievable then consider altering the wall in the performance room as well, compute the achieved acoustic power transmission loss and plot it against frequency. (Consider any meaningful and practical way of achieving that with the smallest cost and smallest loss of room volume.)

4. Consider the performance room fully occupied.
   a. Determine RT60 of the occupied room and plot it against frequency.
   b. It is required that a RT60 of 1.7 sec is achieved for the 500 Hz band. Alter the wall or ceiling surface properties to achieve that design goals and plot the achieved RT60 against frequency.

5. Recompute the leaked diffuse field SPL in the adjacent room and plot it against frequency. Check if it still is within 20 dB of the threshold of audibility.