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IBANA-Calc: NEW SOFTWARE TO CALCULATE THE EFFECT OF SOUND INSULATION AGAINST AIRCRAFT NOISE

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RÉSUMÉ - Disponible aussi tôt que possible.

Introduction

As part of the IBANA project (Insulating Buildings Against Noise from Aircraft), new software has been developed for calculating the effect of sound insulation against aircraft noise. The software is intended to be both more accurate and more convenient than previous approaches that have used look-up tables and single number ratings of sound insulation[1]. The program includes a large database of new sound transmission loss data of building façade components as well as aircraft noise spectra. While the included database is quite extensive, the user can add new data themselves. Users simply select the construction type of each façade element and enter its area. The total sound reduction or the expected indoor sound levels are calculated and displayed graphically. Multiple scenarios can be calculated and compared to evaluate their relative effectiveness either in terms of graphical results or audible simulations. The program is written in Visual Basic and is intended to run on a standard PC type computer.

Calculations

The user first enters the outdoor aircraft noise level either as an NEF or an Leq24 value. NEF values are assumed to be those calculated by Transport Canada's NEF_1.7 noise contour prediction software. The relationship between these NEF and Leq24 values is[2],

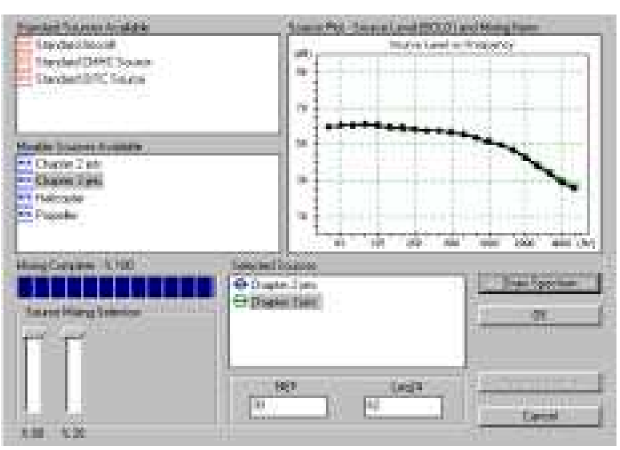

Fig. 1 Source selector screen.

Leq24 = NEF + 32, dBA

The aircraft noise source type is then selected (See Fig. 1). Users can select one of several standard sources or create a mix of several types of aircraft. The overall level of the selected source is adjusted to equal the chosen NEF value. The user also has the option of entering their own source spectrum for other source types. The selected outdoor sound level and source spectrum are assumed to be the free field outdoor sound levels.

The indoor sound level is calculated for each 1/3 octave band from 50 to 5k Hz as,

$$L_2(i) = L_1(i) - TL(i) + 10 \log[S/A(i)] + 3, \text{ dB}$$

Fig. 2. Façade element selection screen.

Here, $L_1(i)$ is the outdoor sound level, $L_2(i)$ is the indoor sound level, TL(i) is the transmission loss measured in the laboratory, A(i) is the sound absorption in the receiving room and S is the area of the particular façade element. Sound absorption is entered as a fraction of the floor area.

Where a particular façade is made up of several components such as a wall section, a window and a door, the total transmission loss is calculated from the area-weighted transmission coefficients of each element.

Data Bases

The program includes databases of source spectra and of laboratory transmission loss measurements of façade elements. The program currently includes aircraft noise spectra for: Chapter 2 and Chapter 3 jet aircraft as well as spectra for propeller aircraft and helicopters. It also

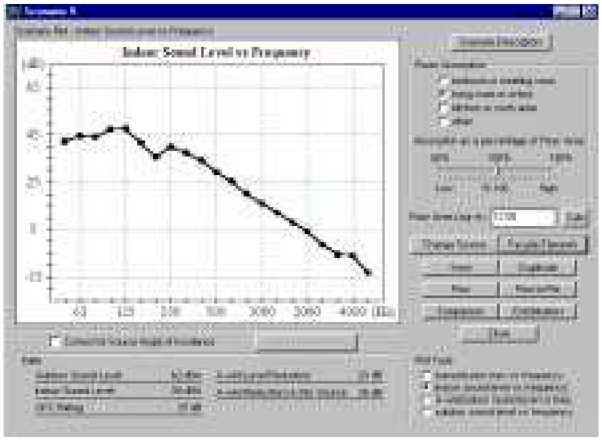

Fig. 3. Scenario results screen.

includes several standard spectra such as previously used in the CMHC Guide[1], the spectrum in the ASTM OITC standard [3] and a new standard aircraft spectrum based on measurements at Ottawa, Vancouver and Toronto airports. These spectra can also be corrected for the effects of air absorption at different distances. The user can also add their own source spectra. Further corrections are being developed to account for the orientation of the façade relative to the flight track of the aircraft.

There is also a database of laboratory transmission loss measurements for various building façade elements. These were mostly obtained in tests for the current project and include 50 exterior walls, 50 roof-ceilings, 40 windows and glazing units and a few doors. Again the user is able to add their own new transmission loss results to the database using the screen shown in Fig. 4.

Scenarios

Each calculation is referred to as a *scenario*. The user can calculate and display multiple scenarios. For example, one could try various combinations of wall and window constructions to determine which combination gives the desired result. For each scenario, either the total transmission loss or the indoor sound levels can be displayed as shown in Fig. 3.

Scenario Comparisons

Multiple scenarios can be compared in terms of either indoor sound levels or sound transmission loss values (see Fig. 5).

Reports

The results of a particular scenario or the comparisons of several scenarios can be printed out as complete reports. The associated results can also be printed to a file for importing into a spreadsheet or other software.

Scenario Combinations

The results of several scenarios can be combined. For example, a room at the corner of a building might have exterior walls exposed to quite different incident sound. The sound transmitted through each could first be calculated in separate scenarios and the results combined to give the total indoor sound levels.

Audible Simulations

The program can also produce audible simulations of several scenarios. The sound of an aircraft fly-over is modified according to the calculated sound attenuations of each scenario and played back using a standard sound card. For each audible simulation, up to four scenarios can be compared. Of course, the quality of the playback is improved with an external amplifier and reasonable quality loudspeakers.

Acknowledgements

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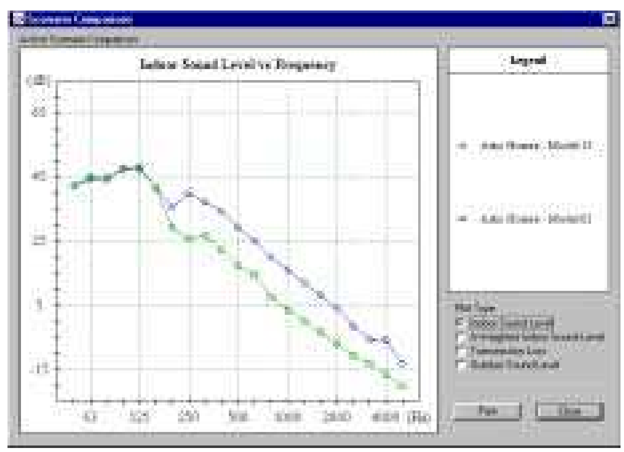

Fig. 5. Scenario comparison screen

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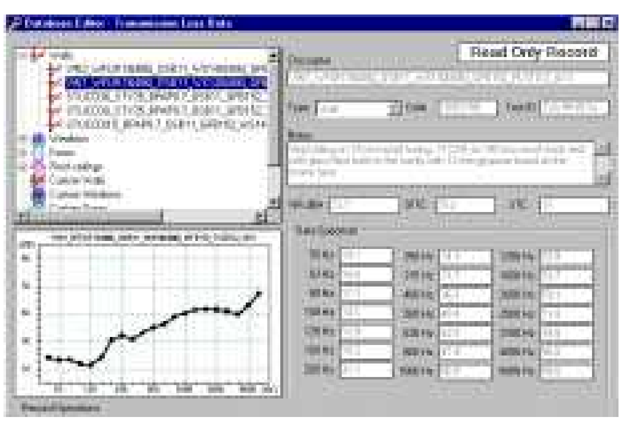

Fig 4. Transmission loss database screen.