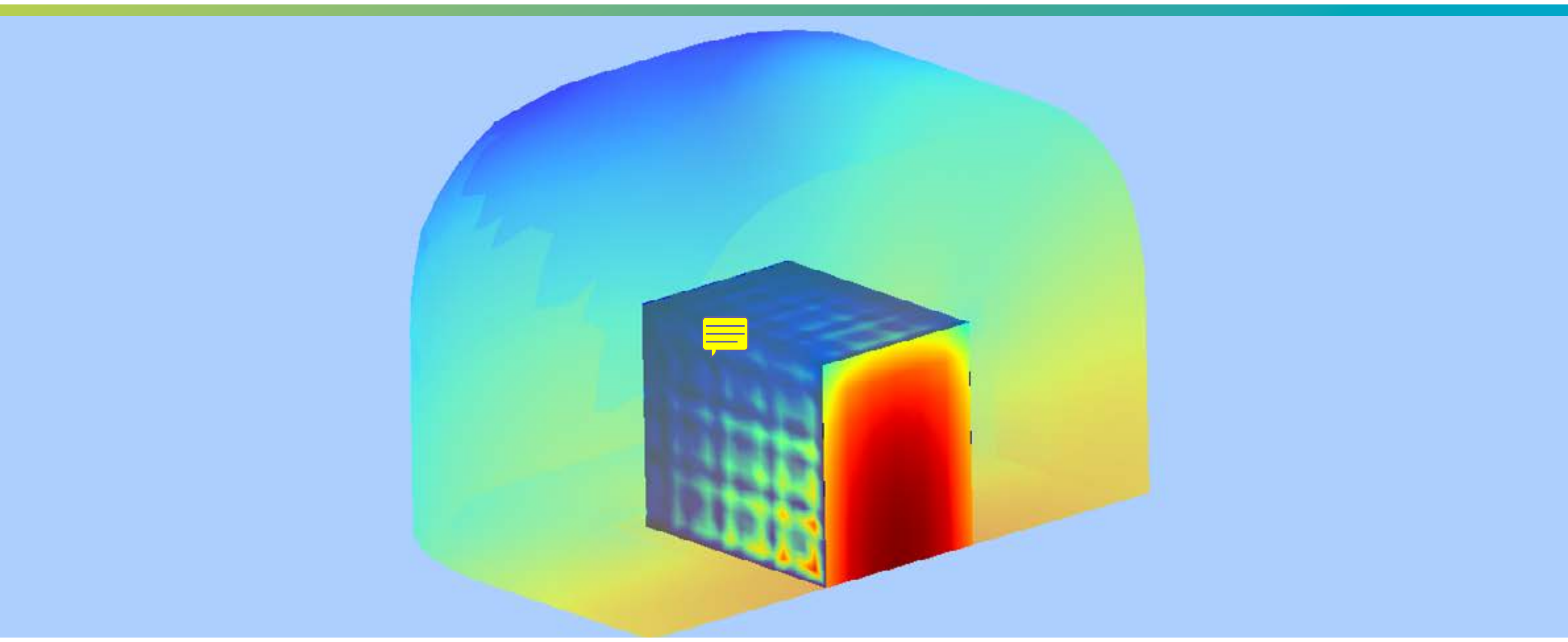
Case study

Acoustic design of enclosures to minimize noise

Actran enabled students to study and visualize noise patterns for different natural acoustic board materials and different dimensions, to find the optimum design for equipment enclosure



Bangalore-based B.M.S. College of Engineering (BMSCE) is an autonomous engineering college affiliated with the Visvesvaraya Technological University. It has the distinction of being India's first private engineering college and is known as a quality educational institution.

As part of their curriculum, final year engineering students of the College are expected to undertake a project that solves a specific real-life/industry challenge. One group of final year chemical engineering students from the College decided to use this opportunity to address the issue of equipment noise in the chemical engineering department laboratories on campus.

The chemical engineering laboratories have several noisy machines and equipment. The noise levels force certain restrictions in terms of the time of day during which the machines can be used for experiments, so as to minimize disturbance to other students. The group decided to focus on solving the acoustics problem associated with the enclosures that housed these noisy machines, as part of their final year project.

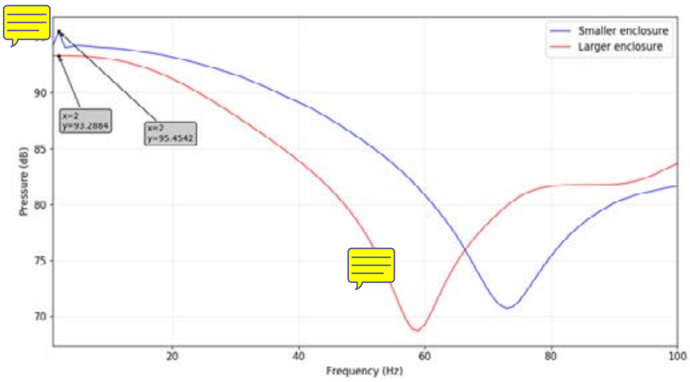


Fig 1: Plot of pressure against frequency for two enclosure dimensions

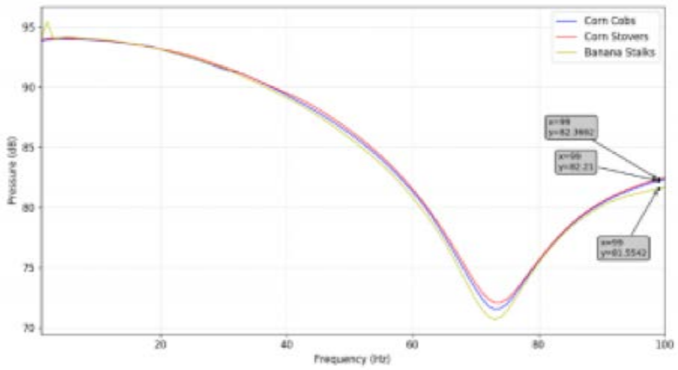


Fig 2: Plot of pressure against frequency for the smaller enclosure using

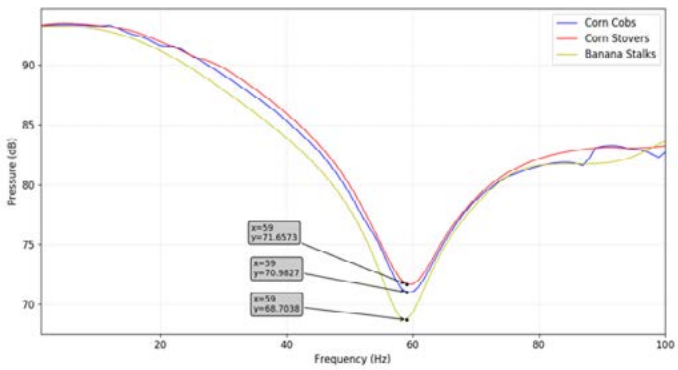


Fig 3: Plot of pressure against frequency for the larger enclosure using

Initially, the students planned to physically create acoustic boards using different materials, test them through experimentation, and then follow this up with simulation. However, there were several challenges to this approach. First, there were issues such as non-availability of certain components such as impedance tubes, due to the pandemic-induced lockdown. Second, the organizations that possessed the physical testing capability for these materials had certain confidentiality clauses and restrictions around data sharing. Given these circumstances, the team decided to go ahead with a simulation-only set-up to solve the problem at hand.

Simulating for different materials and enclosure dimensions

The team used Actran Student Edition ~~to test for noise levels of enclosure models,~~ The team conducted simulations with three different materials and two different enclosure dimensions to identify the best material as well as the optimum enclosure size to minimize noise. The students studied the pressure maps and displacement maps for each of the iterations. They considered three materials made out of natural waste materials - corn cobs, corn stovers, and banana stalks. ~~They simulated for both the smaller and larger enclosures.~~ They simulated for different noise levels emanating from the source (which is the equipment itself).

The team found that up to a frequency of 50 Hz, both enclosures behaved in the same way in terms of the pressure map. However, beyond 50 Hz, the larger enclosures resulted in higher acoustic pressure spread. Changing material properties too had an effect, especially for the frequency range of 40 Hz - 75 Hz for the smaller enclosure and 30 Hz - 65 Hz for the larger enclosure. The results showed that banana stalks had better sound absorption potential followed by corn cobs and corn stovers at frequencies in the range 40 Hz - 70 Hz.

Ease of use and in-built material properties

The various in-built formulations allowed the students to set values for parameters such as thickness of the board/ equipment, the inner and outer air volume, and porous materials properties. Using Actran, the students could achieve desired results, plot graphs with in-built plotters, and iterate with material properties through various options to get detailed insight into the enclosure performance.

Given the ease of use and quick results, the students were able to get the desired results in a timely manner. Despite the lockdown, the students could get the results using only their laptops, without the need for any high-end physical infrastructure.

The students were also able to publish the results of their study through a paper in the Global Journal of Material Science and Engineering, also winning a prize for Best Presentation (http://www.knowvel.com/analysis-of-prepared-acoustic-boards-from-natural-waste-materials-using-actran-software-and-its-applications/).

Prof. Shabnam Siddiqui said, "On behalf of the Department of Chemical Engineering, I'm thankful to MSC to have launched a software like Actran that only comes with ease of use and provision of quick and reliable results, enabling the students to get the desired inferences in a timely manner.

Despite the uncertain times faced for the last couple of months, the students could complete their aims and objectives, using only minimal utilities like laptops, without the need for any sophisticated physical infrastructure."

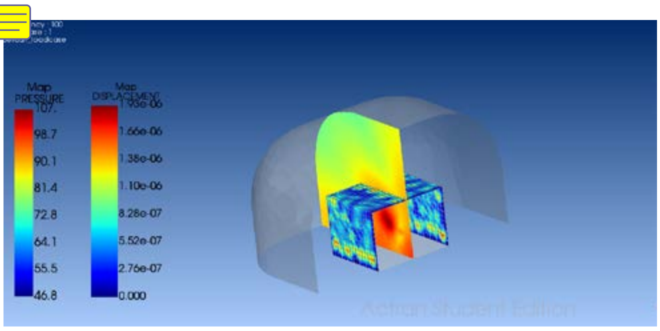


Fig 4: Map of acoustic pressure and displacement of enclosure at 100 Hz

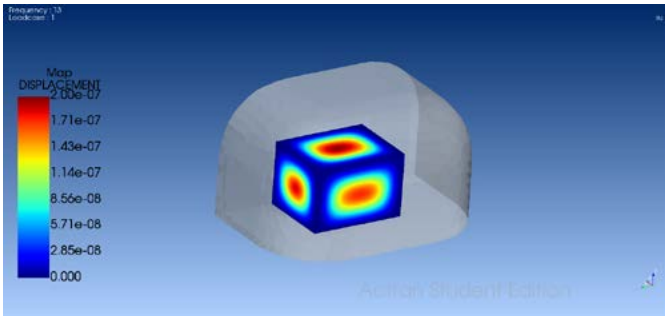


Fig 5: Map of displacement of enclosure at 13 Hz

From left to right - Nidhi, Harshitha, Amrita, Rebecca

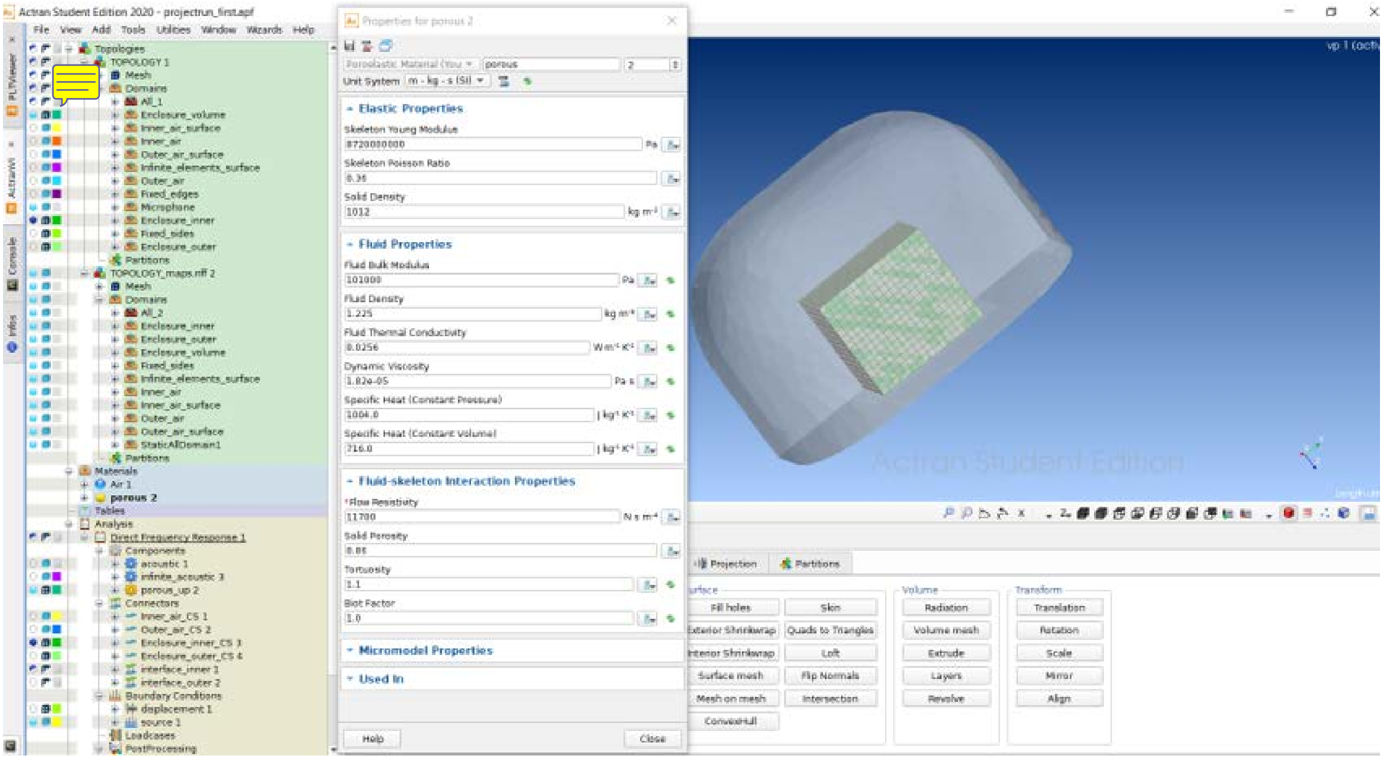


Fig 6: View of enclosure model in Actran Student Edition

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