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AcoubatBIM by CYPE

Acoustic insulation and conditioning of buildings

AcoubatBIM by CYPE is a tool developed by CYPE and the CSTB (Scientific and Technical Centre for Building) with the aim to help users study the insulation and acoustic conditioning of buildings. It calculates the indices that evaluate the insulation of airborne sound (indoor and outdoor), impact sound insulation and the reverberation level in indoor spaces, in accordance with the procedure contained in the EN ISO 12354:2017 code.

This software has been partially developed in the framework of Holisteec project that has received funding from the European Union's FP7 research and innovation programme under grant agreement No 609138.

This application is integrated in the Open BIM workflow using the **IFC** standard. AcoubatBIM by CYPE can be downloaded via the "BIMserver.center" platform.

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Program properties

AcoubatBIM analyses the following parameters to determine the grade of acoustic insulation and conditioning of buildings:

- Acoustic insulation for indoor airborne and impact sound for each pair of space types.

- Acoustic insulation for outdoor airborne sound.

- Reverberation times and minimum sound absorption areas.
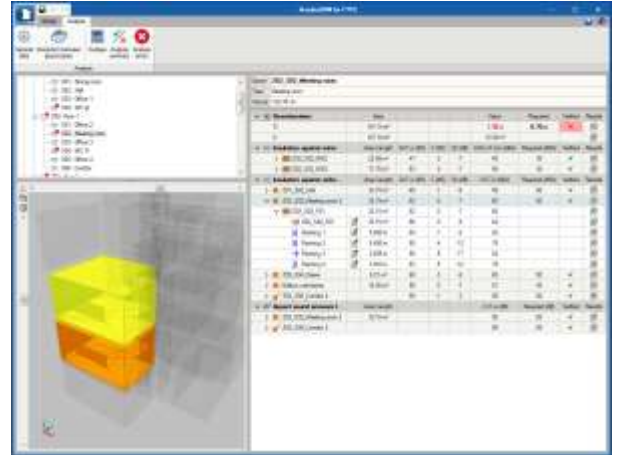
Main properties of AcoubatBIM by CYPE

The following sections describe some of the main properties of AcoubatBIM by CYPE.

User interface

The AcoubatBIM user interface is divided into two tabs:

- **Model**
  The main parameters of the project are specified in this tab, as well as the acoustic properties of each component of the building that intervenes in the analysis. To do so, the program contains a library where the acoustic properties of all the elements can be defined to then apply them to each component of the building.

- **Analyse**
  Once the model has been defined, users can launch the analysis in this tab. The program allows users to inspect the results obtained for each space and each element that is involved, so they can be compared to the levels required by the code.
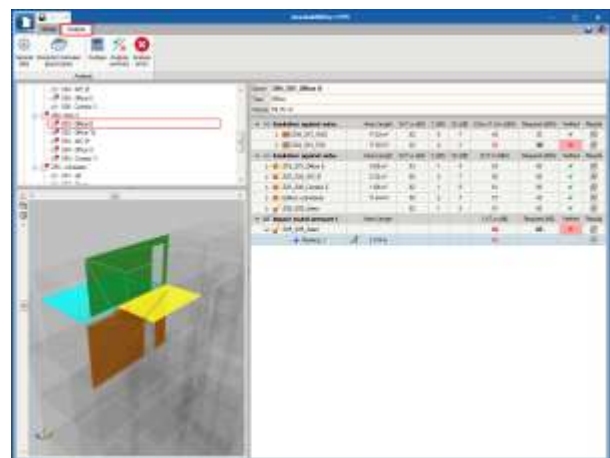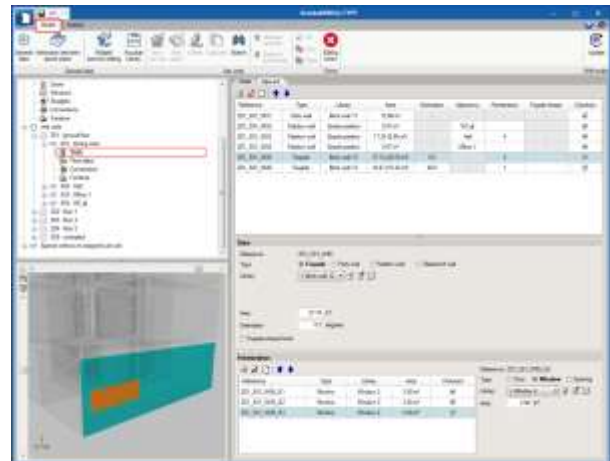
General data

Users can indicate the global acoustic index which is to be applied for the evaluation of each type of insulation.

- **Magnitudes for outdoor airborne sound insulation**
  - Normalised level difference in façades and roofs, $D_{2m,n,w}$
  - Standardised level difference in façades and roofs, $D_{2m,nT,w}$
  - Normalised, A-weighted level difference, in façades and roofs, for pink noise and dominant railway or train station outdoor noise, $D_{2m,n,A}$
  - Standardised, A-weighted level difference, in façades and roofs, for pink noise and dominant railway or train station outdoor noise, $D_{2m,nT,A}$
  - Normalised, A-weighted level difference, in façades and roofs, for pink noise and dominant automobile or aircraft outdoor noise, $D_{2m,n,Atr}$
  - Standardised, A-weighted level difference, in façades and roofs, for pink noise and dominant automobile or aircraft outdoor noise, $D_{2m,nT,Atr}$
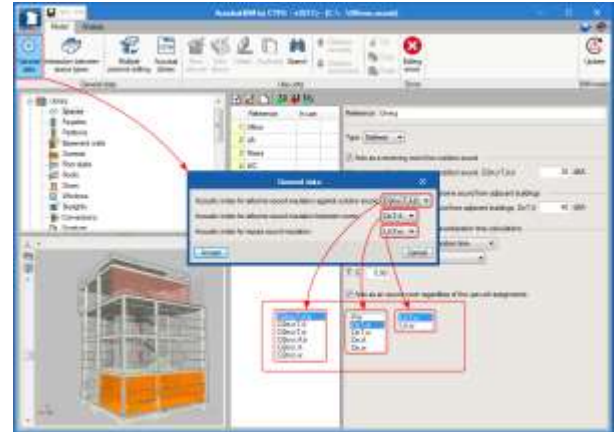
- **Magnitudes for indoor airborne sound insulation**
  - Global apparent sound reduction exit, R'_w
  - Normalised global level difference, $D_{n,w}$
  - Standardised global level difference, $D_{nT,w}$
  - Normalised, A-weighted, level difference, $D_{n,A}$
  - Standardised, A-weighted, level difference, $D_{nT,A}$

- **Magnitudes for impact sound insulation**
  - Standardised global impact sound pressure level, $L'_{nT,w}$
 - Normalised global impact sound pressure level, $L'_{n,w}$

Acoubat database

AcoubatBIM incorporates the sound trial database of the Acoubat analysis engine, which is managed by the CSTB. Each product is classed in accordance with the following categories depending on its use in the building:

- Traditional masonry

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- Load bearing walls and concrete slabs
- Partitions
- Lightweight partitions
- Floor covers
- Linings
- Doors and windows
- Technical equipment
- Suspended ceiling and access floors
- Curtain wall façades
- Thermal bridge breaker
- Absorbing object

Apart from the products incorporated by default by AcoubatBIM, the program allows users to add new elements by manually introducing their acoustic properties, which can then be used in any project.
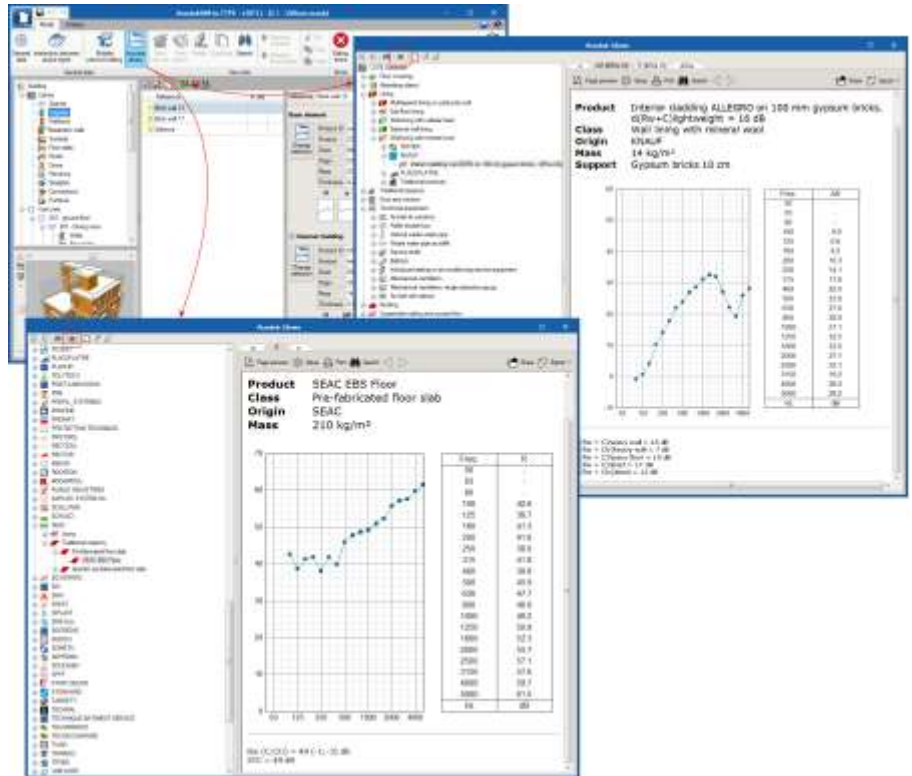
The products of the database are assigned by users to the types of elements defined in the program library (in the "Model" tab).

Space definition

The program offers users the possibility to define a library with the existing types of spaces in the building. The types can be assigned limit values for outdoor airborne sound and sound from adjacent buildings. Users can jointly activate the calculations for the reverberation time and indoor sound absorption.

The specific spaces of the building have to be linked to one of the existing types, and their geometric properties, such as volume and surface area, must be introduced. This data can be obtained from the information contained in the BIM model, if the work is being carried out in the Open BIM workflow.
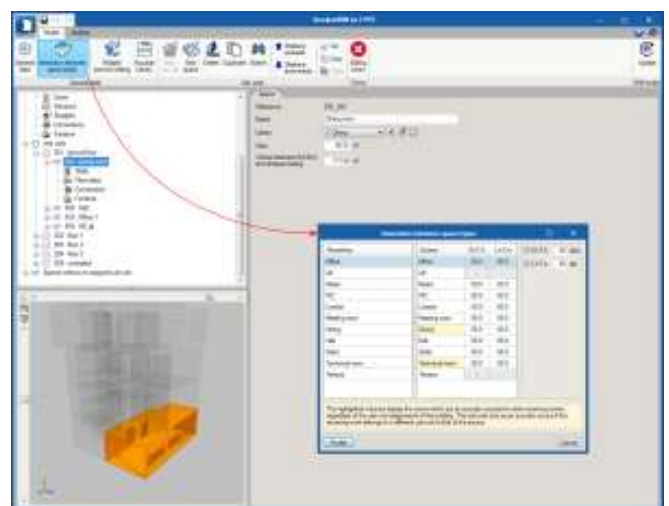
Interaction between different types of spaces

AcoubatBIM allows users to calculate the level of indoor airborne noise insulation and impact sound between pairs of spaces based on their type. Users can indicate limit levels for each acoustic magnitude in order to verify the code in force.

Use units

The spaces of the building can be grouped in use units. The values for indoor airborne noise insulation and impact sound insulation that have been indicated in the Interaction between space types section, will not be calculated for pairs of spaces of the same use unit, unless indicated otherwise in "Space definition".

The spaces that do not belong to a use unit can be grouped in "Spaces without an assigned use unit", this way the program understands they act as independent units.

Walls

Users can define types of vertical separators such as façades, partitions and basement walls in the program library. The construction solution of the base element can be selected and internal and/or external linings can be introduced.

Once the types have been defined, they can be assigned to the spaces of the project, where their location and dimensions can be assigned. Similarly, the program allows users to indicate whether there are doors, windows or openings in partitions or façades.
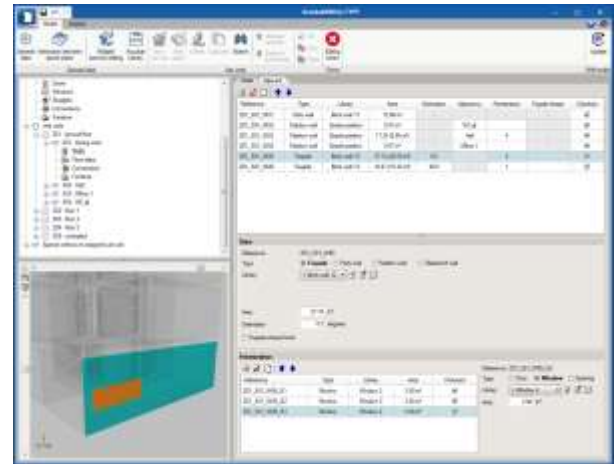
Façade shape factor

For the calculation of insulation against outdoor airborne sound, for vertical façades of the building, AcoubatBIM by CYPE allows users to include the level difference due to the shape of the façade for the shape façades and orientations of the sound source, as indicated in the EN 12365-3:2000 code.

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Floor slabs

Horizontal separation elements are defined in a similar manner as are walls except, in these cases, the selected products can contain impact sound data. Contained in this group are screeds, floor slabs and roofs.

As occurs with walls, users can select a bottom cladding (dropped ceiling) and top cladding (floor covering).
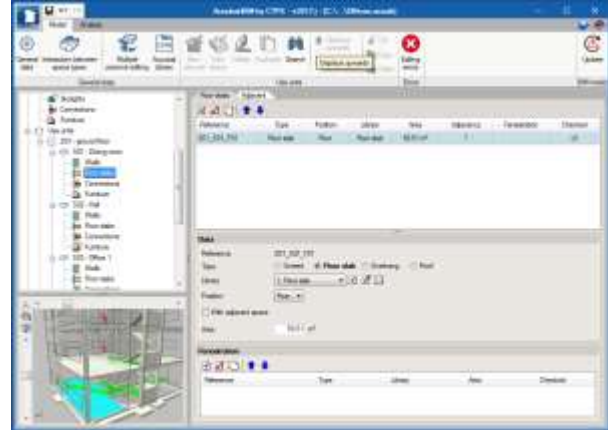

Openings

Openings such as doors, windows and skylights are defined in the program library. Openings are introduced in the façades of the project, where their area is specified and one of the classes defined in the library is assigned to them.
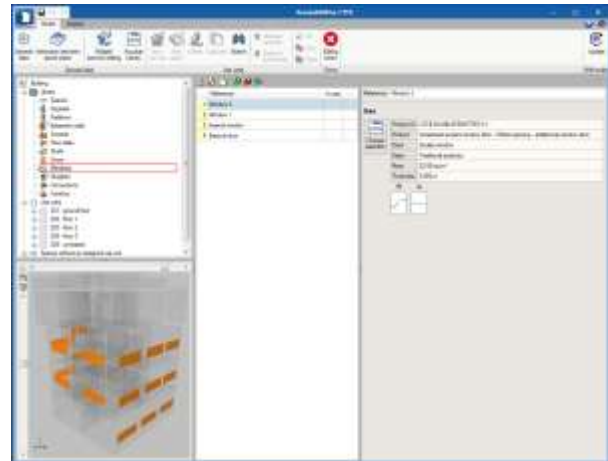

Connections

AcoubatBIM allows users to define the connections between construction elements of the project, which are required to determine the vibration reduction index, K_{ij}, which is used in the indirect or flanking sound transmission. Users can indicate which components make up the connection, the angles formed between them and the length of the connecting edge, l_{ij}.
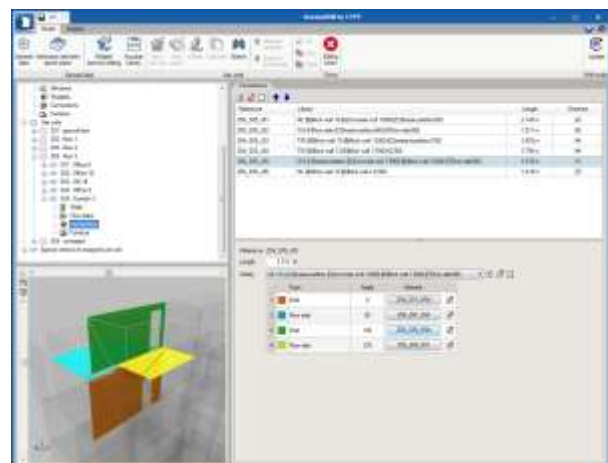
Furniture

Three-dimensional objects, such as people or furniture, with absorption area values can also be introduced inside spaces. These devices increase the sound absorption area of the space and consequently, reduce the reverberation time.
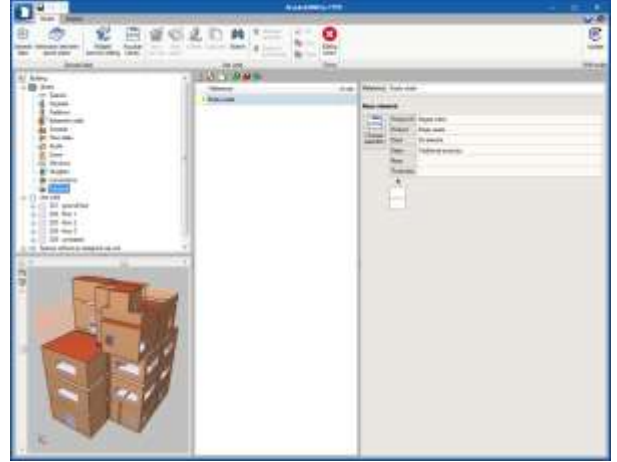

Integration in the Open BIM workflow

AcoubatBIM by CYPE is an application that is integrated in the Open BIM workflow. This integration is achieved by interchanging IFC information files with a previously defined BIM model.

- **BIM model import**
  A BIM model can be imported using IFC format files generated by CAD/BIM programs such as IFC Builder, Allplan, Archicad or Revit. This function allows AcoubatBIM by CYPE to automatically incorporate the spaces that make up the building, as well as its construction elements. Furthermore, during this process, the connections between separators, and their edges are processed, so users do not have to define the connections manually.

- **Synchronisation with the BIM model**
  Each time the BIM model is modified, the program can incorporate the changes into the AcoubatBIM by CYPE project, so users can work in parallel with other technical specialists.

More information on the Open BIM workflow proposed by CYPE can be found on the Open BIM technology in CYPE programs webpage.

Results and checks

Once the analysis has been carried out, AcoubatBIM allows users to view the magnitude of the evaluated sound values, so they can analyse the results in the most efficient manner depending on their needs.

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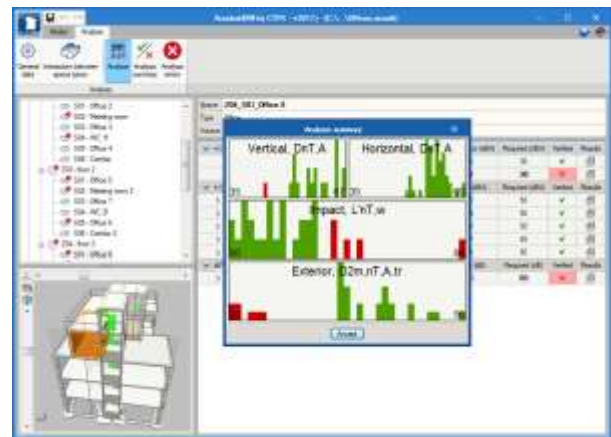
Global indices

When the analysis process has ended, a general summary, in histogram format, is displayed which allows users to quickly identify the values of the global sound indices that lie outside the allowable range.

AcoubatBIM by CYPE displays a drop-down menu, for each receptor space, with the results of the global indices that have been selected to measure each sound magnitude. If the verification of a limit value has been selected, it will be viewed next to the value obtained for the sound index.


When work is carried out on a BIM model, when a result is selected from the list, the elements involved in the analysis (pairs of spaces, connections, partitions...) are highlighted in the 3D view of the building.
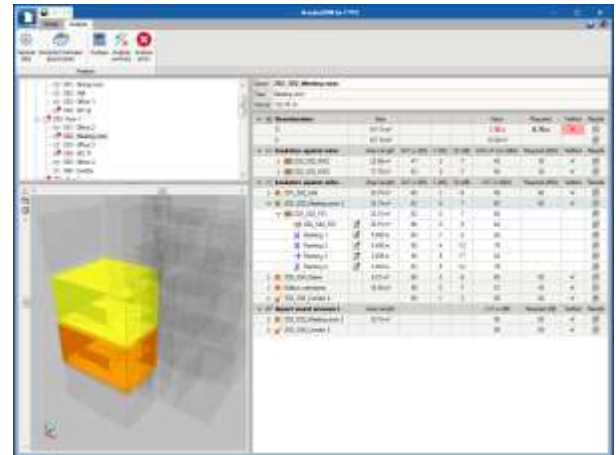
Detailed results

For each analysis that is carried out, the program offers users the option to generate a report containing the values obtained in octave third bands. The document also includes information regarding the analysis, such as the spaces involved and formula used.

The results for each frequency can be viewed in three different ways:
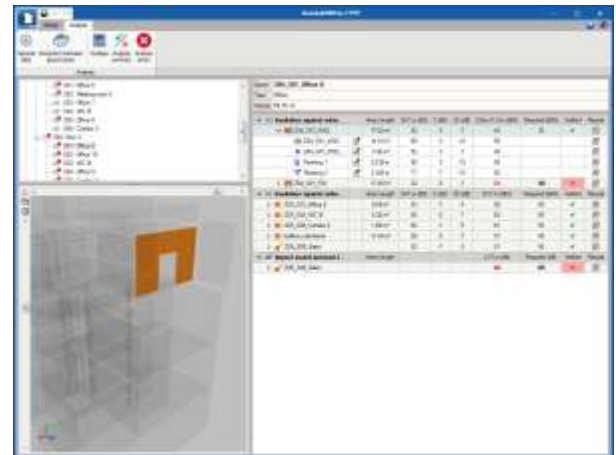
- **Results**
  A table and graph of the results are displayed in third octave bands of the sound index.

- **Analysis (Table)**
  The results, in third octave bands of the sound index, are displayed in table format, as well as the values of the variables used to calculate them.

- **Analysis (Graph)**
  The results, in third octave bands of the sound index, are drawn on a graph, as well as the values of the variables used to calculate them.

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Finally, each of the paths of the connections (direct-flanking, flanking-direct and flanking-flanking) can be inspected, as well as the values obtained for the velocity difference in the connection ($D_{v,ij}$).
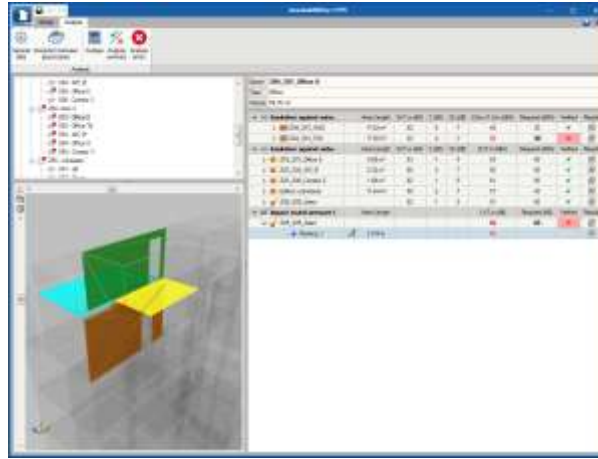
Required user license permits

To be able to work with AcoubatBIM by CYPE, users must have the corresponding permission to use the program.

For project consultancy and detailed information; support@cypetr.com