



SABIN 3.0 tutorial

The step by step procedures described below are meant to clarify the use of Sabin. For three different problems a solution using Sabin is shown. In all examples the database file Demo.mdb is used. Additional information concerning specific topics can be found through the Help menu.

Problem 1

The reverberation time of a newly designed room has to be given a certain desired value.

Problem 2

The reverberation time of an existing room has to be reduced to a given value. One of the materials present has unknown absorption coefficients.

Problem 3

The speech intelligibility in a given room with a noise source present has to be improved.

Problem 1

The reverberation time of a newly designed room has to be given a certain value.

Given

Room volume: 200 m^3

Total floor area: 50 m^2

Total ceiling area: 50 m^2

Total wall area (doors and windows included): 120 m^2

Floor material: concrete. To be covered completely by linoleum.

Ceiling material: plaster. May be covered completely or in part by any suitable material.

Wall material: smooth brickwork. May be covered completely or in part by any suitable material.

Door type: wood

Window type: double glazing

Total door area: 4 m^2

Total window area: 10 m^2

Desired reverberation time at 125...4000 Hz: 0.60 0.55 0.50 0.45 0.40 0.35 s

Audience: 20 persons seated on wooden chairs, 2 persons/ m^2

Step by step solution

1. Start-up Sabin

At the left, the so-called Project tree is displayed. At the right, you can fill out a dialog box. It may be convenient to maximize the Main window.

Next, some administrative information is entered.

2. In the dialog box, enter the project name, a description of the project and the client data.

A project name could for instance be "Tutorial Building". A project description could be "Building, accomodating 3 rooms, address, etcetera". Finally, the client could be described as "Mr. Project Developer, his address, etcetera".

If the project consists of one room only, you may want to choose the same name for the project and the room.

Next, the relevant construction details of Room 1 are entered.

3. Click "Room 1" in the Project tree on the left.

At the right, the room dialog box is shown.

4. In the dialog box, type the room description (hereafter assumed to be "Tutorial Room 1"), and the given empty room volume (200 m^3).

5. Click "Floor" in the Project tree, and enter the given total floor area (50 m^2) in the dialog box.

6. Click "Ceiling" in the Project tree, and enter the given total ceiling area (50 m^2) in the dialog box.

7. Click "Wall" in the Project tree, and enter the given total wall area (120 m^2) in the dialog box.

Next, the desired reverberation times are entered.

8. Click "Tutorial Room 1" in the Project tree.

9. Click the "Desired" tab in the lower part of the dialog box, and enter the given desired reverberation times in seconds (125Hz: 0.60, 250Hz: 0.55, 500Hz: 0.50, 1000Hz: 0.45, 2000Hz: 0.40 and 4000Hz: 0.35).

Next, the so-called surface default materials are entered.

Any uncovered part of a surface will have the default material's absorption coefficients. A default material is the first material listed below the corresponding surface in the Project tree.

10. Click "Floor" in the Project tree, then click "Edit" in the menu bar and choose "Set default material" from the Edit menu.

Now the database manager is invoked, and a database is opened. Make sure that the opened database file is Demo.mdb, or otherwise open it through the database manager file menu. From the database, you can select the default material.

11. From the materials list in the database, select "Floor covering: linoleum" or code 501, and then click the "Select" button.

You could also choose the floor construction material “concrete” to be the default material. However, because the floor is to be covered completely by only one, known material, it is more convenient to take this known material as the default. Moreover, it is common practice to first cover a floor completely, and then put absorbing materials on it, which partly override the absorption properties of the original floor covering.

12. Click “Ceiling” in the Project tree, and then choose “Set default material” from the Edit menu.
13. From the materials list in the database, select “Plaster” or code 104, and then click the “Select” button.

Because it is not yet known how the ceiling will be covered, the ceiling construction material “plaster” is chosen to be the default material. Now, any uncovered part of the ceiling will have the absorption properties of plaster.

14. Click “Wall” in the Project tree, and then choose “Set default material” from the Edit menu.
15. From the materials list in the database, select “Brickwork, smooth” or code 103, and then click the “Select” button.

Next, the given absorbing materials or constructions are added to the surfaces.

16. Click “Floor” in the Project tree, and then click the “+” button on the Main toolbar.

The database is opened, from which you can choose a material or construction to be added to the floor.

17. From the materials list in the database, select “Audience, wooden chairs, 2 persons/m²” or code 701, and then click the “Select” button.

Audience can be regarded as an absorbing construction that is placed on a floor. After the selection is made, audience with area 0 is ‘placed’ on the floor.

18. Click “Wall” in the Project tree, and then click the “+” button on the Main toolbar.

The database is opened, from which you can choose a material or construction to be added to the wall.

19. From the materials list in the database, select “Door (wood)” or code 601, and then click the “Select” button.

20. From the materials list in the database, select “Window, double glazing” or code 602, and then click the “Select” button.

Doors and windows can be regarded as absorbing constructions that are added to a wall. After selecting doors and windows, both constructions with total area 0 are ‘built’ in the wall.

21. Click “Audience, wooden chairs, 2 persons/m²” in the Project tree, and enter the total audience area in the dialog box on the right (20 persons / 2 persons/m² = 10 m²). This can be done with the slider, or by typing the value directly into the textbox.

Where the audience covers the floor, the floor absorption plays a reduced role. In this case, the audience is assumed to reduce the effective absorbing floor area by 50% of the audience area. This is reflected by the so-called cover factor of 0.5 (displayed in the lower right corner) and taken into account in the calculations.

22. Click “Door (wood)” in the Project tree, and enter the total door area in the dialog box on the right (4 m²).

Where doors are placed, wall material is removed. In this case, the doors reduce the effective absorbing wall area by 4 m², which is simply the total door area. This is reflected by the door cover factor of 1.0.

23. Click “Window, double glazing” in the Project tree, and enter the total window area in the dialog box (10 m²).

The windows reduce the effective absorbing wall area by 10 m².

Next, the actual engineering work is started.

First the reverberation time graph is activated.

24. Click the T60 graph button on the Main toolbar, or choose T60 from the “Window” menu.

It may be convenient to position the T60 window in the bottom left corner of a maximized main window.

25. In the T60 window click the “D” button (desired reverberation curve).

Now, 2 reverberation time curves should be visible: the red Desired and the green Eyring reverberation curve.

If this is not the case, choose “Setup” from the “Options” menu, and make sure that on the “General” tab, Eyring is chosen as the Default Calculation Method. Finally, make sure that in the

T60 window, the toolbar buttons “D” and “E” are switched on, and “M” and “S” are switched off.

In order to better illustrate the effect of applying materials, the vertical scale of the T60 graph is set to a fixed range.

26. Click the “Scale Options” button on the T60 window toolbar, choose the “Manual Scale” option, enter 2 as the maximum value in seconds, and then click the “Close” button.

Next, the ceiling has to be covered by a material from the database, in order to get the actual reverberation curve closer to the desired reverberation curve.

This could be done manually, but in this example it will be done automatically by the AutoSearch function.

27. Click “Ceiling” in the Project tree, and then click the “AutoSearch” button on the Main toolbar.

Now, the AutoSearch dialog box is displayed. You can have AutoSearch find the optimal material with or without the option of covering the total ceiling area.

28. With the option “Optimal Area” active, click “Search”.

AutoSearch returns materials suitable for ceilings. These are listed in order of approximation error between the resulting calculated reverberation curve and the desired reverberation curve. In this case, for each candidate material the optimal area seems to exceed the available ceiling area, and hence the actual area is restricted to this maximum available area.

29. Click the first material in the list (wood-wool-mortar), and then scroll through the list by means of the Cursor Down key, while watching the T60 graph.

As expected, the first material in the list gives the best approximation of the desired reverberation curve.

30. Click the first material in the list, and then click “Apply”.

Because this best approximation is still not satisfactory, you can conclude that it is not possible to do the job with only one material applied to the ceiling. Because a second material is to be applied, the actual reverberation time will decrease for all frequencies. Therefore, before applying a second material, the area of the previously applied material should be reduced, until the actual curve exceeds the desired curve completely. You have to do this empirically, but you will quickly gain experience with this step.

31. With the slider, reduce the amount of the material wood-wool-mortar to 39.0 m².

78 % of the ceiling is covered now. The second material will be applied to the wall.

32. Click “Wall” in the Project tree, and then click the “AutoSearch” button on the Main toolbar.

33. With the option “Optimal Area” active, click “Search”.

34. Click the first material in the list, and then click “Apply”.

Now the actual reverberation curve closely approximates the desired curve. Doors and windows excluded, 69 % of the total wall area is covered.

Finally you can save the project and print a report. You can set report options through the “Options” menu.

Note

For the best practical results, all applied materials should be uniformly distributed over the surfaces, while maintaining the characteristic material absorption properties, such that maximum diffusion is obtained.

Problem 2

The reverberation time of an existing room has to be reduced to a given value. One of the materials present has unknown absorption coefficients.

Given

Room volume: 200 m³

Total floor area: 50 m²

Total ceiling area: 50 m²

Total wall area (doors and windows included): 120 m²

Floor material: concrete. To be covered completely by linoleum.

Ceiling material: covered completely by a single unknown material that has to be retained.

Wall material: smooth brickwork. May be covered completely or in part by any suitable material.

Door type: wood

Window type: double glazing

Total door area: 4 m²

Total window area: 10 m²

Desired reverberation time at 125...4000 Hz: 0.60 0.55 0.50 0.45 0.40 0.35 s

Measured reverberation time in the current situation at 125...4000 Hz is 1.70 2.50 2.80 2.80 2.00 1.20 s

Step by step solution

1. Start-up Sabin

At the left, the so-called Project tree is displayed. At the right, you can fill out a dialog box. It may be convenient to maximize the Main window.

Next, some administrative information is entered.

2. In the dialog box, enter the project name, a description of the project and the client data.

A project name could for instance be "Tutorial Building". A project description could be "Building, accomodating 3 rooms, address, etcetera". Finally, the client could be described as "Mr. Project Developer, his address, etcetera".

If the project consists of one room only, you may want to choose the same name for the project and the room.

Next, the relevant construction details of Room 1 are entered.

3. Click "Room 1" in the Project tree on the left.

At the right, the room dialog box is shown.

4. In the dialog box, type the room description (hereafter assumed to be "Tutorial Room 2"), and the given empty room volume (200 m³).

5. Click "Floor" in the Project tree, and enter the given total floor area (50 m²) in the dialog box.

6. Click "Ceiling" in the Project tree, and enter the given total ceiling area (50 m²) in the dialog box.

7. Click "Wall" in the Project tree, and enter the given total wall area (120 m²) in the dialog box.

Next, the measured and desired reverberation times are entered.

8. Click "Tutorial Room 2" in the Project tree.

9. Click the "Measured" tab in the lower part of the dialog box, and enter the given measured reverberation times in seconds (125Hz: 1.70, 250Hz: 2.50, 500Hz: 2.80, 1000Hz: 2.80, 2000Hz: 2.00 and 4000Hz: 1.20).

10. Click the "Desired" tab in the lower part of the dialog box, and enter the given desired reverberation times in seconds (125Hz: 0.60, 250Hz: 0.55, 500Hz: 0.50, 1000Hz: 0.45, 2000Hz: 0.40 and 4000Hz: 0.35).

Next, the so-called surface default materials are entered.

Any uncovered part of a surface will have the default material's absorption coefficients. A default material is the first material listed below the corresponding surface in the Project tree.

11. Click "Floor" or the material below in the Project tree, and then choose "Set default material" from the Edit menu.

Now the database manager is invoked, and a database is opened. Make sure that the opened database file is Demo.mdb, or otherwise open it through the database manager file menu. From the database, you can select the default material.

12. From the materials list in the database, select "Floor covering: linoleum" or code 501, and then click the "Select" button.

You could also choose the floor construction material "concrete" to be the default material. However, because the floor is to be covered completely by only one, known material, it is more convenient to take this known material as the default. Moreover, it is common practice to first cover a floor completely, and then put absorbing materials on it, which partly overrides the absorption properties of the original floor covering.

13. Click "Ceiling" in the Project tree, and then choose "Change Default to Unknown" from the Edit menu.
14. Click "Wall" in the Project tree, and then choose "Set default material" from the Edit menu.
15. From the materials list in the database, select "Brickwork, smooth" or code 103, and then click the "Select" button.

Next, the given absorbing materials or constructions are added to the surfaces.

16. Click "Wall" in the Project tree, and then click the "+" button on the Main toolbar.

The database is opened, from which you can choose a material or construction to be added to the wall.

17. From the materials list in the database, select "Door (wood)" or code 601, and then click the "Select" button.
18. From the materials list in the database, select "Window, double glazing" or code 602, and then click the "Select" button.

Doors and windows can be regarded as absorbing constructions that are added to a wall. After selecting doors and windows, both constructions with total area 0 are 'built' in the wall.

19. Click "Door (wood)" in the Project tree, and enter the total door area in the dialog box on the right (4 m^2).

Where doors are placed, wall material is removed. In this case, the doors reduce the effective absorbing wall area by 4 m^2 , which is simply the

total door area. This is reflected by the door cover factor of 1.0.

20. Click "Window, double glazing" in the Project tree, and enter the total window area in the dialog box (10 m^2).

The windows reduce the effective absorbing wall area by 10 m^2 .

Next, the unknown absorption is calculated.

This is possible now, because for the situation described so far, the reverberation time is known. First the reverberation time graph is activated.

21. Click the T60 graph button on the Main toolbar, or choose T60 from the "Window" menu.

It may be convenient to position the T60 window in the bottom left corner of a maximized main window.

22. In the T60 window click the "M" button (measured reverberation curve) and the "D" button (desired reverberation curve).

Now, 3 reverberation time curves should be visible: the black Measured, the red Desired and the green Eyring reverberation curve. If this is not the case, choose "Setup" from the "Options" menu, and then make sure that on the "General" tab, Eyring is chosen as the Default Calculation Method. Finally, make sure that in the T60 window, the toolbar buttons "M", "D" and "E" are switched on, and "S" is switched off.

In order to better illustrate the effect of applying materials, the vertical scale of the T60 graph is set to a fixed range.

23. Click the "Scale Options" button on the T60 window toolbar, choose the "Manual Scale" option, type 4 as the maximum value in seconds, and then click the "Close" button.
24. From the "Edit" menu, choose "Calculate Unknown Absorption".

The unknown absorption is calculated, and can be handled just like any other material. As expected, the calculated and measured reverberation time curves coincide now.

Next, the actual engineering work is started.

The wall has to be covered by a material from the database, in order to get the actual reverberation curve closer to the desired curve. This will be done automatically by the AutoSearch function.

25. Click "Wall" in the Project tree, and then click the "AutoSearch" button on the Main toolbar.

26. With the option “Optimal Area” active, click “Search”.
27. Click the first material in the list, and then click “Apply”.

Now the actual reverberation curve closely approximates the desired curve. Doors and windows excluded, 50 % of the total wall area is covered.

Finally you can save the project and print a report. You can set report options through the “Options” menu.

Note

For the best practical results, the applied material should be uniformly distributed over the wall, while maintaining the characteristic material absorption properties, such that maximum diffusion is obtained.

Problem 3

The speech intelligibility in a given room with a noise source present has to be improved.

Given

Room volume: 200 m^3

Total floor area: 50 m^2

Total ceiling area: 50 m^2

Total wall area (doors and windows included): 120 m^2

Floor material: concrete. Covered completely by linoleum.

Ceiling material: plaster. May be covered completely or in part by any suitable material.

Wall material: smooth brickwork. May be covered completely or in part by any suitable material.

Door type: wood

Window type: double glazing

Total door area: 4 m^2

Total window area: 10 m^2

Audience: 20 persons seated on wooden chairs, 2 persons/m^2

Air-grid, radiating airconditioning noise, relative¹ position: $X = 2.5 \text{ m}$, $Y = 5 \text{ m}$, $Z = 4 \text{ m}$, sound power level L_w at 125...4000 Hz: 47, 48, 48, 47, 44, 37 dB.

Relative¹ speaker position: $X = 2.5 \text{ m}$, $Y = 8 \text{ m}$, $Z = 1.8 \text{ m}$.

Average relative¹ listener position: $X = 2.5 \text{ m}$, $Y = 4 \text{ m}$, $Z = 1.2 \text{ m}$.

¹ Relative to any fixed reference position, defined as $(X,Y,Z) = (0,0,0)$.

Step by step solution

1. Start-up Sabin

At the left, the so-called Project tree is displayed. At the right, you can fill out a dialog box. It may be convenient to maximize the Main window.

Next, some administrative information is entered.

2. In the dialog box, enter the project name, a description of the project and the client data.

A project name could for instance be "Tutorial Building". A project description could be "Building, accomodating 3 rooms, address, etcetera". Finally, the client could be described as "Mr. Project Developer, his address, etcetera".

If the project consists of one room only, you may want to choose the same name for the project and the room.

Next, the relevant construction details of Room 1 are entered.

3. Click "Room 1" in the Project tree on the left.

At the right, the room dialog box is shown.

4. In the dialog box, type the room description, and the given empty room volume (200 m^3).

A room description could for instance be "Tutorial Room 3".

5. Click "Floor" in the Project tree, and enter the given total floor area (50 m^2) in the dialog box.

6. Click "Ceiling" in the Project tree, and enter the given total ceiling area (50 m^2) in the dialog box.

7. Click "Wall" in the Project tree, and enter the given total wall area (120 m^2) in the dialog box.

Next, the so-called surface default materials are entered.

Any uncovered part of a surface will have the default material's absorption coefficients. A default material is the first material listed below the corresponding surface in the Project tree.

8. Click "Floor" in the Project tree, then click "Edit" in the menu bar and choose "Set default material" from the Edit menu.

Now the database manager is invoked, and a database is opened. Make sure that the opened database file is Demo.mdb, or otherwise open it through the database manager file menu. From the database, you can select the default material.

9. From the materials list in the database, select "Floor covering: linoleum" or code 501, and then click the "Select" button.

You could also choose the floor construction material “concrete” to be the default material. However, because the floor is to be covered completely by only one, known material, it is more convenient to take this known material as the default. Moreover, it is common practice to first cover a floor completely, and then put absorbing materials on it, which partly overrides the absorption properties of the original floor covering.

10. Click “Ceiling” in the Project tree, and then choose “Set default material” from the Edit menu.
11. From the materials list in the database, select “Plaster” or code 104, and then click the “Select” button.

Because it is not yet known how the ceiling will be covered, the ceiling construction material “plaster” is chosen to be the default material. Now, any uncovered part of the ceiling will have the absorption properties of plaster.

12. Click “Wall” in the Project tree, and then choose “Set default material” from the Edit menu.
13. From the materials list in the database, select “Brickwork, smooth” or code 103, and then click the “Select” button.

Next, the given absorbing materials or constructions are added to the surfaces.

14. Click “Floor” in the Project tree, and then click the “+” button on the Main toolbar.

The database is opened, from which you can choose a material or construction to be added to the floor.

15. From the materials list in the database, select “Audience, wooden chairs, 2 persons/m²” or code 701, and then click the “Select” button.

Audience can be regarded as an absorbing construction that is placed on a floor. After the selection is made, audience with area 0 is ‘placed’ on the floor.

16. Click “Wall” in the Project tree, and then click the “+” button on the Main toolbar.

The database is opened, from which you can choose a material or construction to be added to the wall.

17. From the materials list in the database, select “Door (wood)” or code 601, and then click the “Select” button.

18. From the materials list in the database, select “Window, double glazing” or code 602, and then click the “Select” button.

Doors and windows can be regarded as absorbing constructions that are added to a wall. After selecting doors and windows, both constructions with total area 0 are ‘built’ in the wall.

19. Click “Audience, wooden chairs, 2 persons/m²” in the Project tree, and enter the total audience area in the dialog box on the right (20 persons / 2 persons/m² = 10 m²). This can be done with the slider, or by typing the value directly into the textbox.

Where the audience covers the floor, the floor absorption plays a reduced role. In this case, the audience is assumed to reduce the effective absorbing floor area by 50% of the audience area. This is reflected by the so-called cover factor of 0.5 (displayed in the lower right corner) and taken into account in the calculations.

20. Click “Door (wood)” in the Project tree, and enter the total door area in the dialog box on the right (4 m²).

Where doors are placed, wall material is removed. In this case, the doors reduce the effective absorbing wall area by 4 m², which is simply the total door area. This is reflected by the door cover factor of 1.0.

21. Click “Window, double glazing” in the Project tree, and enter the total window area in the dialog box (10 m²).

The windows reduce the effective absorbing wall area by 10 m².

Next, the air-grid is placed in the room.

22. Click “Sources” in the Project tree, and then click the “+” button on the Main toolbar.

The database is opened, from which you can choose a noise source to be added to the room.

23. From the sources list in the database, select “Air-grid (airco)” or code 2, and then click the “Select” button.

24. Click “Air-grid (airco)” in the Project tree, and enter the relative position in the dialog box on the right (X = 2.5 m, Y = 5 m, Z = 4 m).

Next, the relative positions of the speaker and the receiver are entered.

In this example, only one receiver position is taken into consideration, being the average listener position. In practice, you may want to examine more receiver positions.

25. Click "Receiver" in the Project tree, and in the dialog box on the right, enter the relative Receiver Position ((X = 2.5 m, Y = 4 m, Z = 1.2 m) and the relative RASTI Source Position (X = 2.5 m, Y = 8 m, Z = 1.8 m).

The RASTI Source represents the speaker. In the same dialog box, the RASTI value, as the measure for the speech intelligibility, is shown. From this value it is clear why improvement is desired: the speech intelligibility is poor.

Next, the actual engineering work is started.

All surfaces are highly reflecting. Improvement may be expected from increased sound absorption in the voice frequency band, ranging from 300 to 3500 Hz. Therefore a material with a corresponding absorption curve has to be found.

26. Click "Ceiling" in the Project tree, and then click the "+" button on the Main toolbar.
27. Click the first material in the database, and then watch the small graph at the bottom,

Note

For the best match of the practical results with these modeling results, the chosen material wood-wool-mortar should be uniformly distributed over the total ceiling for maximum diffusion.

while scrolling through the list with the cursor up/down keys.

Wood-wool-mortar seems to be the material that best meets the above-mentioned requirement.

28. From the materials list in the database, select "Wood-wool-mortar" or code 401, and then click the "Select" button.
29. Click "Wood-wool-mortar" in the Project tree, and then enter the maximum area (50 m²).
30. Click "Receiver" in the Project tree.

Now, the speech intelligibility is good.

Next, the minimum required area of wood-wool-mortar for a good RASTI value is investigated.

31. Click "Wood-wool-mortar" in the Project tree, and then enter 25 m².
32. Click "Receiver" in the Project tree.

The speech intelligibility is still good. In fact, the limit between 'good' and 'fair' can be found to be below 21 m². For a good speech intelligibility it would therefore be sufficient to cover half the ceiling area with wood-wool-mortar.