Acoustics has become a very important discipline in almost all fields of construction: more and more regulatory instruments refer to acoustics, thereby indicating its importance in construction.

The sustainability of buildings is also affected by its functionality and durability – as well as the lifetime of the construction itself and ecological aspects, because the building’s long term value is always defined by its usability and flexibility.

In this context, low noise levels in living and working environments, as well as good speech and music intelligibility, directly contribute to the functional value of buildings.

Lignotrend directly integrates the function of acoustic absorption into the building elements of floors, ceilings and walls. Thus, compared to conventional suspended acoustic panels, a cost benefit is gained.

The range includes load-bearing elements, as well as panels with the same appearance which can be used for retrofitting in existing buildings or as siding in new building construction.

Multifunctional cross laminated timber for sustainable, attractive timber construction.
Room acoustics with Lignotrend

**Construction elements with acoustic function**

Floor slab with integrated noise absorber, typical span up to about 7 m

- Floor finish, screed, impact sound insulation
- Lead distribution panel
- Rib reinforcement
- Ribs (height according to static demand)
- Voids between ribs for heavy material (against impact sound)

Flat roof with integrated noise absorber (shown here with ledge profile), typical span up to about 10 m and more

- Void for improved absorption of low frequencies, above: additional continuous layer for fire resistance
- Services (lengthwise)
- Connective board (shear forces)
- Transversal layer for high dimensional stability
- Sound absorption layer
- Finished surface
- Ledge profile type ‘Acoustic plus’

Flat roof with integrated noise absorber (shown here with board profile type ‘classic’)

- Roof system, waterproofing and insulation
- Connective board (shear forces)
- Ribs (height according to static demands)
- Voids between ribs for services, insulation
- Transversal layer for high dimensional stability
- Noise absorber (wood fibres)
- Finished surface
- Ledge profile type ‘Acoustic’
Wood/concrete compound-floor slab with integrated noise absorber for large spans up to max. 15 m.

Structural sloping roof with integrated noise absorber (shown here with board profile type ‘classic’)

Siding LIGNO Acoustic light

Battens as substructure for concealed fastening, or as suspended ceiling

Acoustic panelling LIGNO Acoustic light 3S with wood fibreboard for noise absorption and finished surface, for example knotless silver fir.
### Profile types
#### LIGNO Acoustic

<table>
<thead>
<tr>
<th>Type</th>
<th>Absorption coefficient</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acoustic profile 625-12-4</strong></td>
<td>Ledges (only available with knotless wood)</td>
<td>$α_W$ up to 0.75</td>
</tr>
<tr>
<td><strong>Acoustic profile 625-25-8</strong></td>
<td>Ledges</td>
<td>$α_W$ up to 0.70</td>
</tr>
<tr>
<td><strong>Acoustic profile &quot;reflective&quot; 625-12-4 625-25-8</strong></td>
<td>Ledges, grooves closed</td>
<td>$α_W$ approx. 0.10</td>
</tr>
<tr>
<td><strong>Acoustic profile 625-105-20 625-95-30</strong></td>
<td>Boards</td>
<td>$α_W$ up to 0.60</td>
</tr>
</tbody>
</table>

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**Free acoustic calculator.**

Test your rooms’ acoustic properties yourself...

The new online tool helps you compute a realistic estimation of rooms where Lignotrend acoustic panels shall be installed. Reverberation and noise reduction data are calculated and compared to typical statutory requirements. Take a look:

[www.lignotrend.com/raumakustik-rechner](http://www.lignotrend.com/raumakustik-rechner)
### Types of wood available for the elements’ surface layer

The elements are available in surface finish layers of different types of wood, for example:
- Silver fir, knotless [plain]
- Silver fir, knotless [patterned]
- Silver fir, knotless [patterned, raw material treated to B-s2,d0 for lower inflammability]
- Spruce with small knots or knotless
- Larch, knotless

Please refer to the data sheets for detailed information.

### Fire resistance

To improve fire resistance, additional continuous layers (Z1, Z1p, Z2, Z3) can be integrated behind the sound absorption layer:

For further information, please refer to the technical data sheets.

### Inflammability

To reduce inflammability, the surface layer of acoustic elements can be made of pressure impregnated raw material (only possible with patterned, knotless silver fir).

The raw material for the surface layer is impregnated to B-S2,d0, the absorption material used has low inflammability – B-s1,d0 / A2-s1,d0.

### Sound insulation

While room acoustic requirements are concerned with sound levels within a room, additional acoustic requirements are concerned with sound insulation between rooms.

Lignotrend structural acoustic elements are tested and meet the relevant requirements, for example, as floor slabs between different apartments.

Floor slabs using Lignotrend floor elements have excellent sound insulation properties in the low-frequency range, resulting in very low impact sound transmission values. This means that the hollow sound of somebody walking on the floor above, which is typical for conventional timber floor construction, can almost not be heard.
### Room acoustics in schools

In a classroom context, the competence of teachers and their method of teaching are of course of paramount importance. But it is also important that the teacher can be heard well in order to underpin the success of learning.

In classrooms with high reverberation times or high levels of background noise, it is much harder for the human brain to recognise and assimilate the information offered. During the course of long school days, the concentration of pupils will drop significantly faster than in rooms with good and balanced acoustic properties. This affects both children and adults, but younger children, for example in primary schools, face another problem: the young brains have not fully developed in their ability to translate what is heard into meaningful information.

The PISA survey includes scientific findings that the acoustic properties of classrooms also play an important role in the success or failure of education.

When building new schools, lecture or seminar rooms, the most economic solution covering the requirements regarding room acoustics is to integrate the sound absorbing function into the structural element, for example into the cross-laminated timber element. At the same time, an attractive wooden surface finish can be included.

This construction saves time and costs as no additional interior panelling needs to be fitted, involving 'working overhead', provided that the interior design takes place in parallel with the building design.

Lignotrend offers both: Load-bearing timber elements as well as acoustic panelling, both available with the same surface finishes. The latter are used both in new buildings and for retrofitting when there is a need to compensate for sonically hard surfaces [masonry, concrete, glass etc.].

Structural acoustic elements also fulfill stricter requirements for fire resistance and impact sound insulation, and can be used for wider spans such as those that are common in classroom construction, where conventional timber structures are quite limited.
Grammar school, Engen
Concrete walls panelled with LIGNO Acoustic light.

Assembly hall, grammar school, Kenzingen
(Arch.: Dinkel Herbstsitz Poetzsch, Herbolzheim).
Roof using LIGNO Acoustic Q3 classic BV. Free span of about 11 m.

Otto-Hahn-School, Furtwangen (Arch.: Harter+Kanzler, Freiburg, Photo: Herzog, Freiburg)
Two-storey annexe, floors and roof with large span:
Wood/concrete-compound elements LIGNO HBV Q2 Acoustic plus with ledge profile 625-12-4
Roof elements LIGNO Block Q3 BV Acoustic with ledge profile 625-12-4
Room acoustics
in business/industrial buildings and offices

The workplace environment has an impact on the performance and satisfaction of employees. Low noise levels have various positive impacts on work output. The health of employees is directly influenced: if the atmosphere of the workplace is good, the employer benefits from less absenteeism due to illness.

An additional benefit is that errors will decrease because lower background noise levels mean that employees can concentrate better and product quality can be significantly improved.

Finally, improved concentration helps to support safety at work, as dangers and warning signals are better perceived.

Thus, when designing workplaces, the additional expense of acoustic measures should be seen in the light of longer term cost savings in terms of employee and production benefits.

Often, the integration of noise absorbers into the load-bearing timber construction (that is built anyway) is even yet self-financing without including those savings.

The resulting improvements in efficiency, productivity and quality are benefits which should be considered in a balanced design decision.

It goes without saying that these aspects apply to industrial buildings, as well as offices.
Office building near Freiburg (Arch.: Barkow Leibinger, Berlin).
Concrete slabs panelled with LIGNO Acoustic light.

Left: Dark restaurant at Basel / Switzerland
(Arch.: in situ, Basel / CH)
Wood/concrete-compound slab LIGNO HBV Acoustic with ledge profile 625-25-8, free span: approx. 13 m.

Right: Acoustic sail in the office of the fire station at Frickingen
(Arch.: Fetscher, Illmensee)
Acoustic panels LIGNO Acoustic light.

Left: Exhibition building Erowa at Büron / Switzerland.
Roof elements LIGNO Block Q3 Acoustic with ledge profile.

Right: Office building at Gilching (Design, photo: Barth Architects, Gauting)
Wall panels LIGNO Acoustic light.
Room acoustics in kindergartens and nurseries

The design of nurseries and kindergartens involves a combination of the acoustic aspects mentioned in preceding chapters:

- There is a tendency that children are sent to school at an earlier age and this is one reason why it is becoming more important to optimise the intelligibility of the educational content in kindergartens by designing the acoustics appropriately.
- There is a tendency that learning shifts from school age to preschool age. This is one reason why it is becoming more important to optimise the intelligibility of the educational content in kindergartens by designing the acoustics appropriately.

In addition, these measures help to improve the atmosphere in nurseries and kindergartens by keeping noise levels low: children will remain calmer and more relaxed, reducing stress on educators and nursery staff.
Kindergarten, Würenlos / Switzerland (Arch.: Wiedemeier, Würenlos / CH)
LIGNO Acoustic classic (finish: spruce) as pavilion roof.

Kinderhaus at Ludwigsburg (Arch.: Dongus, Ludwigsburg).
Wide-span floor slabs with LIGNO Rippe Q3 BV Acoustic, special ledge profile 625-33-8.

Kindergarten at Bern-Gäbelbach / Switzerland (Arch.: Reinhardt+Partner, Bern / CH)
Roof elements LIGNO Block Q3 Acoustic with ledge profile (spruce with knots).
Room acoustics in gyms and multi-purpose halls

In the design of gyms or multi-purpose halls, it is imperative to consider room acoustics: the greater the built volume, the more difficult it is to handle reverberation effects. These effects are often made more severe by sonically hard surfaces such as glass or concrete.

Most people have experienced acoustic inadequacies or faults – naturally they are more noticeable than good acoustic quality. For example, often at festivals or fairs hosted in halls, it is difficult to communicate without shouting when there is booming background noise.

On the other hand, we know the acoustics are good when we can hear perfectly well in the back row of a theatre or lecture hall or when the sound of music – no matter what kind – still reaches the audience in a balanced way, and the tones are not distorted or lost on their way to the listeners’ ears.

Do good acoustics have to cost a lot of money? Of course, a certain design effort is required.

But when combining structural and acoustic functions it is possible to save a lot of costs. Lignotrend acoustic elements are specifically designed for this purpose.

Besides carrying the load of the roof or floor, they also provide rigidity to the construction (shear forces), doing away with the need for bracing members in most cases. Besides, the elements come with a finished surface, so there is no need for expensive installation work of fitting ceiling panels overhead.

The use of natural wood fibreboard as absorption layer is very efficient when integrated in the structural cross-laminated timber elements. Where stricter fire resistance requirements have to be met, the composition of the elements can be upgraded to meet these requirements.
Multi-purpose hall, Hawangen
(Arch.: Fetscher, Illmensee).
Roof elements LIGNO Block Q3 Acoustic with
ledge profile 625-25-8 (spruce with knots),
8 mm grooves.

Left: Indoor swimming pool, special school, Euskirchen
(Arch.: design: 3pass, Köln).
Roof: LIGNO Block Q3 Acoustic with
ledge profile 625-12-4,
surface: silver fir knotless, patterned.

Above: New trade fair, Hamburg
(Arch.: Ingenhoven, Düsseldorf).
Roof: LIGNO Acoustic classic,
surface layer made of material treated for low inflammability.
Room acoustics in auditoriums and assembly rooms

Assembly at fire station at Frickingen (Arch.: Fetscher, Illmensee)
Roof elements LIGNO Rippe Q3 Acoustic with ledge profile 625-25-8, silver fir knotless.

Church at Heimenschwand / Switzerland (Arch.: Jöhr, Heimenschwand / CH)
Roof elements LIGNO Block Q3 Acoustic with ledge profile 625-12-4, silver fir knotless, (4 mm groove).
Office building at Freiburg  
(Arch.: Barkow Leibinger, Berlin).
Concrete slabs panelled with LIGNO Acoustic light, white stained finish.

Church at Schwäbisch Hall  
Roof elements
LIGNO Acoustic Q3 classic, silver fir knotless

Refectory for a school at Herrenberg  
(Arch.: Frank & Schulz, Herrenberg)
Roof panelings LIGNO Acoustic light, silver fir knotless.
Room acoustics at home

One might think that room acoustics is not an important issue in private homes.

But modern building design often uses sonically hard surfaces on floors, ceilings or walls. Large rooms with sparse furniture or big glass surfaces have a negative effect on reverberation and atmosphere.

Lignotrend structural acoustic elements and acoustic panelling do not impose on the architectural design language.

In rooms with a low construction height, such as in private houses, the preferred element used is the one with the ledge profile and 4 mm groove. The most popular wood finish is silver fir, as it is bright, plain and restrained. It is processed knotless, resulting in an even colouring.

If required, a factory-applied stain finish is available which will ensure that light colour is protected and the wood will not be subject to natural darkening.
Left: Annex to a detached house at Rickenbach / Switzerland.
Ceiling: LIGNO Acoustic light, silver fir knotless (4 mm groove)

Right: Detached house at Röschenz / Switzerland (Arch.: Jermann + Partner, Dittingen / CH)
Ceiling panelled with LIGNO Acoustic light, silver fir knotless (4 mm groove)

Private house at Egolzwil / Switzerland
Ceiling slabs LIGNO Decke Q3 Acoustic with ledge profile 125-12-4, silver fir knotless (4 mm groove)
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