

Knowledge Guide

Thermally Activated Building Systems



Ecophon[®]
SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Thermally activated building systems (TABS)

Modern buildings require effective cooling systems. One solution for lowering the temperature is to cool the slab, allowing the room to be cooled by the ceiling – so using thermally activated building systems (TABS). One advantage of this solution is that the slab can store the cold air that is available during the night, another is that the cooling takes place with hardly any air movement, which can otherwise cause draughts and discomfort.

A challenge arises when this system is combined with a requirement for good acoustics. The traditional solution – an overall, class A acoustic ceiling - does not work, as the cooling effect from the concrete is shielded by the ceiling. One solution is to use free-hanging units, which improve the acoustics in addition to allowing effective cooling.

Ecophon has performed tests based on the European standard EN 14240:2004 in order to evaluate how the cooling effect is influenced by free-hanging units. This test has been combined with similar test reports from other parties in a general graph. The results indicate that much of the cooling is produced by natural convection and that it is important not to impede the air movement around the ceiling units.

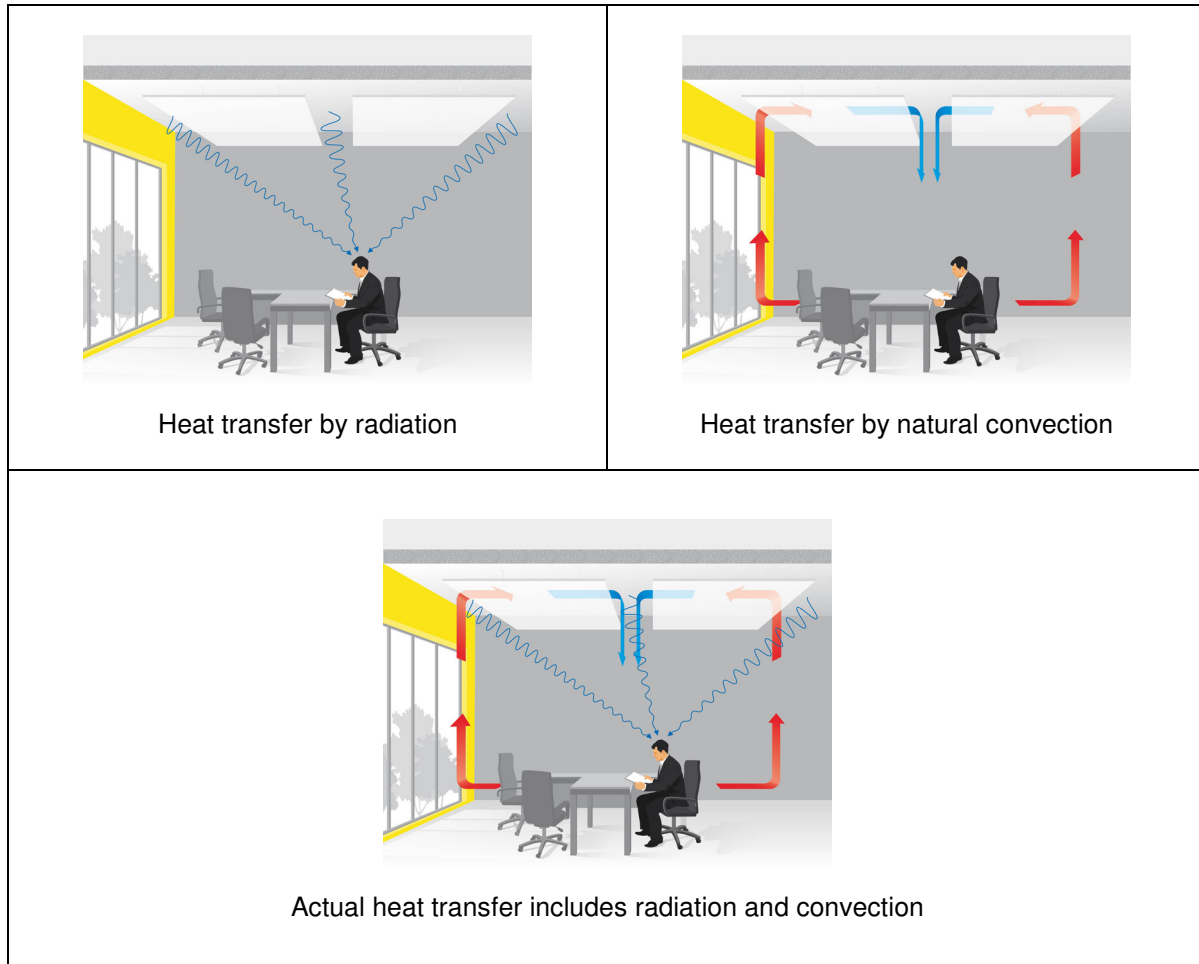
Ecophon consequently recommends free-hanging units in combination with other products in order to achieve an optimal sound climate with TABS. Wallpanels are recommended to be installed where possible.

Explanation of expression

TABS	Thermally activated building systems. The system can be active or passive.
Radiation	Heat transfer by electromagnetic heat-radiation due to different temperature between elements (bodies and slab).
Convection	Heat transfer through air. The warm air rises and cooler denser air falls.
Cooling efficiency	The remaining cooling effect from the cooling system in percent after acoustic treatment.
Ceiling coverage	Area of free-hanging units divided by the total ceiling area expressed as a percentage.

Heat transfer and cooling systems in general

The two main principles for providing a room with comfort cooling are to supply the room with cooled air or to reduce the temperature of one or some of the room's surrounding surfaces, e.g. ceiling and walls. In the former case, the cooling is carried out by forced convection and, in the latter, by radiation exchange with the room's warmer surfaces in addition to natural convection. Natural convection occurs when there is a difference in density between the heavier cooled air and the surrounding, warmer air.



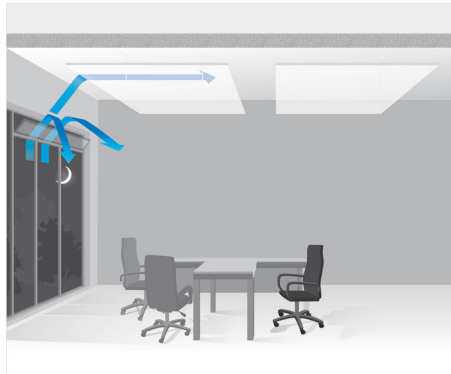
Cooling systems using forced convection

With forced convection, a fan moves the warm air in the room towards a cold surface that cools the air. Cooled air can be introduced by chilled beams, which can also function as air intake devices for ventilation. The air is cooled as it passes water-chilled lamellas before being emitted into the room. Chilled beams can cool incoming, fresh air as well as air that is already in the room. The ventilation air can also be cooled using centrally placed cooling machines. If there is no central ventilation, the room can be cooled with local cooling equipment (fan coil units).

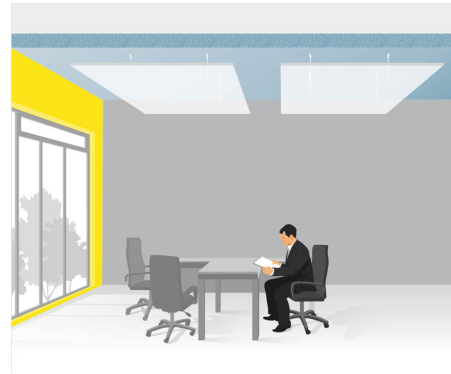
Some of the advantages of forced convection cooling are that it is possible to regulate the room temperature quite quickly and that the visible installation – the air intake devices – can be restricted to a small area. This is particularly the case with centrally placed cooling machines. Chilled beams are bigger and take up a relatively large part of the ceiling area. Disadvantages of air cooling/convection cooling are the risk of draughts and also that they may cause disturbing noise. However, with an effective control system, these problems can be minimised or completely eliminated.

Active and passive systems

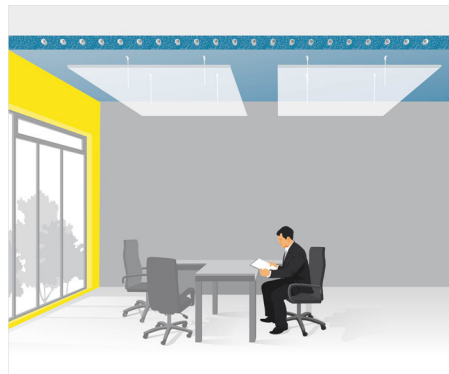
In the case of cooling using the room's chilled surfaces, the temperature of the ceiling surface is usually reduced. There is a difference here between passive and active systems. A passive system is when the building's concrete framework is allowed to cool down during the night when the outdoor temperature falls. Cooling is often achieved by leaving windows open sufficiently for cold air to flow in. The principle is based on the large volume and mass of the concrete having a high heat capacity and thus levelling out temperature variations occurring throughout the day and night. The major disadvantage is that passive systems are difficult to regulate.



Passive system during night



Passive system during day



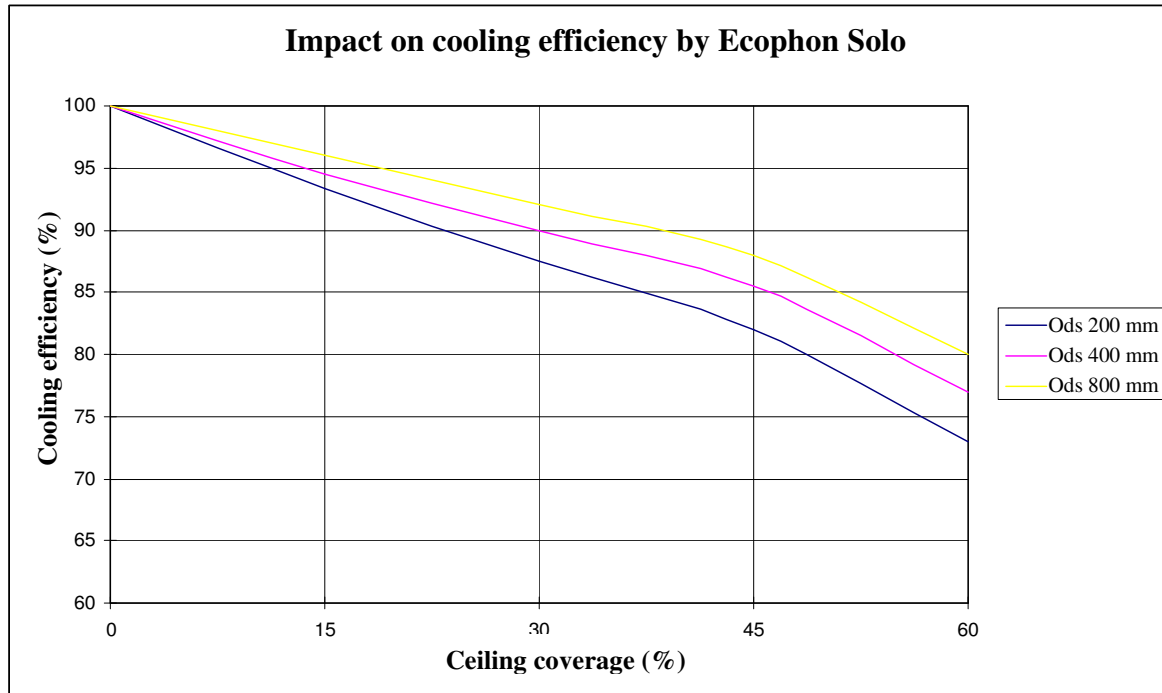
Active system

In large, modern buildings, active systems are frequently used. A system of pipes or tubing transports cold water that cools the ceiling area, this in turn has a cooling effect on the room. One advantage with this system is that a number of cooling sources can be used such as cold ground water, sea water etc. A limiting factor for the cooling capacity of an active system is that the cooling surface should not be too cold. At excessively low temperatures, there is a risk of condensation forming on the room facing surface and the difference between the temperature of the cooling surface and the rest of the room would not be pleasant for the people located in the room.

Measurements on Ecophon Solo and Master Baffle

For several years Ecophon has gathered information on the installation technique for TABS alongside our own measurements and external technical reports. A common fact from both laboratory and field tests are that the loss in cooling efficiency is low in relation to the degree of ceiling coverage. This occurs because the natural convection part of the heat transfer increases and compensates for the loss of radiation heat transfer when free-hanging units are installed.

The values shown are from measurements without ventilation in the room. In real situations the cooling efficiency will be higher due to air movements caused by ventilation and activity within the room.



This diagram represents Ecophon Solo when the minimum distance between the absorbers is 200mm and the distance between the absorbers and the wall is greater than 200mm. The cooling efficiency does not change if another size or shape of Solo – tile is used. It is recommended that absorbers are distributed evenly within the room. It is possible to use this diagram when either an active or passive cooling system is used.

If several tiles are installed on different levels the average distance between the absorber and concrete should be used. If a system has been installed with overlapping panels there has to be a column gap of at least 200mm to get an accurate result with regard to radiation and convection.

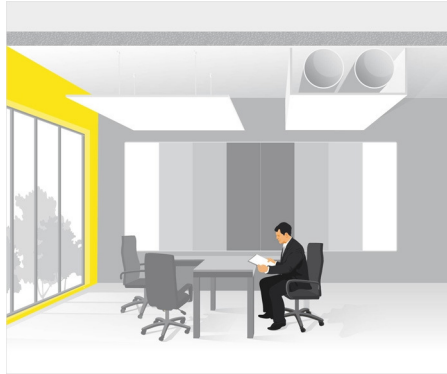
Master Baffle

Ecophon has done two measurements on baffles according to EN 14240:2004. The baffles were installed in rows with two different spaces between the rows. The baffles were installed to the soffit not on hangers.

Product	Degree of coverage	Ods	Cooling efficiency
16 x 3 pcs Master Baffle 1200 x 300	200 mm space between baffles	Direct installation	84%
9 x 3 pcs Master Baffle 1200 x 300	400 mm space between baffles	Direct installation	88%

Recommendations

It is advantageous to use solutions that allow a flow of air between the sound absorber and the concrete surface. In an actual installation, there is also considerably more air movement due to ventilation, open windows and activity in the premises than shown on test results. This air movement contributes further to reducing the effect of the free-hanging units on the cooling system. The basic principle for achieving good room acoustics is to introduce a sufficient amount of absorption into the room. With regard to TABS, this means that the free-hanging units are complemented with wall panels where possible, and those parts of the ceiling that have no cooling function are used for sound absorption. Visible ventilation pipes can be covered using Focus Fixiform.



Ecophon Solo combined with Wallpanels and Focus Fixiform

Sound absorption should be installed, as far as possible, on fixed interior structures in order to ensure a long-term, satisfactory sound environment.

References:

SP Technical Research Institute of Sweden, Testing of acoustic ceiling boards influence on cooling capacity according to EN 14240:2004 report ref P802750, 2008

Chigot, P., Office buildings and natural cooling: room acoustic demands and influence of acoustic treatment on thermal performance, Proceedings of Inter-Noise, 39th International Congress and Exposition on Noise Control Engineering, Lisbon, 13-16 June 2010

The cooling capacity of the thermo active building system combined with acoustic ceiling
Weitzmann, Peter ; Pittarello, E. ; Olesen, Bjarne W.
part of: Nordic Symposium on Building Physics (ISBN:) , 2008, DTU

Peperkamp, H., Vercammen, M., Thermically activated concrete slabs and suspended ceilings, Proceedings of NAG-DAGA International Conference on Acoustics, Rotterdam, 23-26 March 2009



A SOUND EFFECT ON PEOPLE

Ecophon dates back to 1958, when the first sound absorbers from glass wool were produced in Sweden to improve the acoustic working environment. Today the company is a global supplier of acoustic systems that contribute to good room acoustics and a healthy indoor environment with the focus on offices, education, health care and industrial manufacturing premises. Ecophon is part of the Saint-Gobain Group and has sales units and distributors in many countries.

Ecophon's efforts are guided by a vision of earning global leadership in acoustic ceiling and wall absorber systems by providing superior end user value. Ecophon maintains an ongoing dialogue with government agencies, working environment organisations and research institutes, and is involved in formulating national standards in the field of room acoustics where Ecophon contributes to a better working environment wherever people work and communicate.

www.ecophon.com

