

## The effect of environmental control systems on the interior residential space and its users

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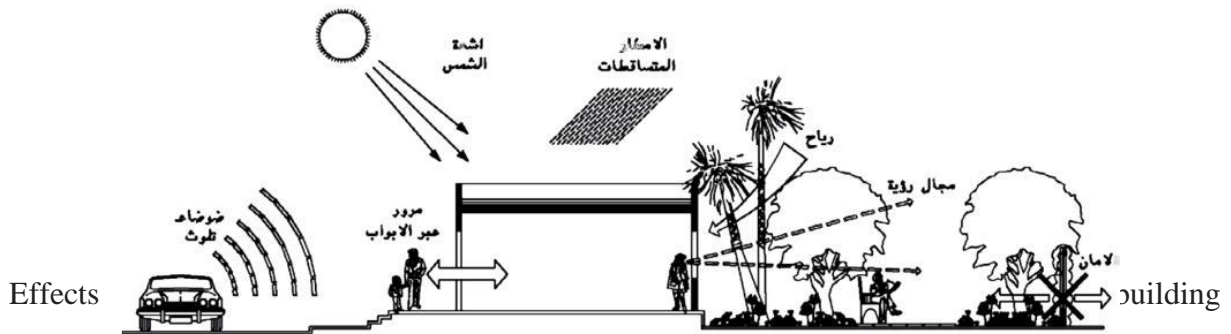
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Environmental control has a major effect on human comfort, whether psychological, thermal, audio or visual inside any space, and this affects its productivity and consequently its social and economic conditions are also affected.

There are natural and industrial methods for environmental control in the interior space, and we should make the best use of the natural ones in order to try to rationalize the energy used and conserve the environment from various pollution factors.



Man is affected by several external factors that affect him inside space, including heat, noise, wind and lighting. Therefore, some environmental control systems appeared to help in human comfort. Environmental control systems inside the space are divided into: air conditioning, ventilation, acoustics and lighting.

### (1) Air Conditioning:

Air conditioning means cooling and drying air. (ASHRAE) defines air conditioning as: the air treatment process, to control temperature, humidity, cleanliness, and distribution to meet the requirements of the air-conditioned space.

#### (1-1) Important steps by air conditioning:

- Temperature control.
- Humidity control.
- Air purification, cleaning and disinfection.

- Air movement and circulation.

Air conditioning also means changing the air condition to the appropriate condition for an application. According to this definition, air conditioning applications are divided into two main parts:

Air conditioning for human thermal comfort

Air conditioning for Industrial purposes

### (1-2) Air conditioning applications

Air conditioning engineers divide the air conditioning applications into convenience and practical applications.

\* Comfort applications: aims to provide a weather in closed buildings that remains relatively stable at a rate favored by humans despite changes in the external atmosphere or in internal heat loads.

\* Practical applications: aims to provide an appropriate environment for the process that has been occurring regardless of the internal temperature, humidity, and external weather conditions, although the environment is at a level of comfort, but conditions determine the needs of the process, not human preferences. Practical applications include:

-Hospital operation rooms: in which the air is purified to high levels to reduce the risk of infection, and humidity is controlled to reduce the patient's dryness, although the temperature is often at the level of comfort, but some special procedures such as open heart surgery require low temperatures (about 18 ° C), and like infants who need relatively high temperatures (around 28 ° C).

-Research rooms that produce integrated circuits, medicines: need very high levels of air cleanliness and temperature and humidity control which are necessary for the operation to succeed.

- Laboratory animal husbandry places.
- Planes air conditioning.
- data centers.
- Textile factories.
- Physical testing places.
- Agricultural plants and cultivation areas.
- Nuclear installations.
- Chemical and biological laboratories.
- Mines.
- Industrial environments.
- Cooking, food stuffs and their manufacturing areas.

**(2) Ventilation:**

It is the process of changing or replacing air with the outside in a space and circulating it inside that space to adjust the temperature, or removing excess moisture and unwanted odors, smoke, heat, dust, and airborne bacteria, renewing the air needed for the breathing process, and maintaining air movement inside the buildings to prevent air corruption in buildings and maintaining its quality, the methods of ventilation of buildings are divided into mechanical ventilation, and natural ventilation .

**(2-1) Mechanical or driven ventilation:**

It is used to control the indoor air quality, the excess humidity, odors and pollutants in the air can be controlled by disposal and replacement of the outside air, and additional energy can be required in the humid atmosphere to remove excess moisture from the air.

In kitchens and bathrooms there are mechanical ventilation fans to control odors and humidity, sometimes ceiling fans, table and floor fans are used to circulate air in the room in order to reduce the local temperature. As a result of the rise of hot air to the top, ceiling fans may be used to keep the room warm in winter by circulating the layers of hot air from ceiling to floor and ceiling fans do not provide ventilation, as in the definition of ventilation is bringing the air from the outside, but it only circulates the internal air.

**(2-2) Natural ventilation**

It is the ventilation of buildings with outdoor air without the use of a fan or any other mechanical system, and this ventilation is carried out through a window when the space to be ventilated is small with the possibility of having this window architecturally, in the more complex systems that allow hot air to rise in the building to come out from the top of the openings to the exterior atmosphere (the chimney principle) draws the cold air outside and make it enters the buildings naturally through nozzles in the lower areas of the building. These systems do not need much energy, but it is necessary to ensure the comfort of the users of these buildings.

**(3) Acoustics in Interior Design:**

Acoustic design is part of the integrated design process for specialized modern buildings. Sound, like other elements, must be employed to serve the space, and even the acoustic design may outweigh those elements.

**(3-1) Architectural Acoustics:**

It is a scientific and engineering branch that is concerned with achieving sound well in buildings or any type of indoor space such as a classroom, living room or bedroom, theater or music hall, radio or television studio, a patient room in a hospital and so on, which is one of the branches of audio engineering that was first invented by Wallace Sabin in the Vogue Museum lecture hall at the end of the nineteenth century. The aim of architectural audiology is to design indoor spaces to meet the purpose of their construction. The design of the room includes choosing its shape, dimensions, the ratio between those dimensions and sound-absorbing materials.

A good acoustic design for the room should not depend on strengthening the electrical sound by using a series of audio devices consisting of the audio pickup and amplifier, headphones or audio columns, but the audio architectural means must be used in order for the sound to reach listeners in every room with understandable words or music accompanied by a resonant time that is optimal for each type of music.

### **(3-3) The audio problems facing the architect :**

When studying acoustics in contemporary architecture, the architect faces many challenges posed by the nature and the following changes in the concepts of architectural and structural methods, can be summarized as follows:

- 1 - The steady increase in the numbers and types of auditoriums and the accompanying problems resulting from the increase in capacity, flexibility in design, and the multiplicity of usage functions.
- 2 - Conflict between modern architectural trends and acoustic privacy requirements, whether by visual integration of spaces such as open offices or by the flexibility of the distribution of the various building elements, which may result in the presence of sources of noise next to spaces that require calmness.
- 3- Using light building materials such as replacing non-load-bearing external walls with curtain walls or replacing internal walls with partitions which lack sound insulation.
- 4- Extending the use of devices and machines inside the building such as heating and cooling equipment, elevator machines, office equipment and home appliances.
- 5- Using lower floors as parking lots and for some mechanical equipment such as backup generators and water pumps.
- 6- Steady increase in external noise sources such as the sound of trains, planes, and cars.

### **(3-4) The objective of studying acoustics inside buildings:**

**First:** improving the process of spreading sound in all directions.

**Second:** Eliminate the inconvenience and noise.

Therefore, it is necessary to pay attention to the architectural elements that distort the direct voice and the indirect sound or the reflected sound resulting from the reflection of the direct sound on the surfaces of the hall or the closed space.

### **Volume control:**

Architectural methods used in volume control include several fields to keep the appropriate level of sound for a person in all kinds of space, namely:

**First:** planning methods from the beginning by determining sound sources status and linking them to buildings and the environment, and this is in the field of site planning and urban design.

**Second:** Design methods for interior space shapes, this is in the field of architectural design and interior space design.

**Third:** executive methods.

The planning methods are in the field of site planning and urban design. But for the design methods, they are in the field of architectural design and interior space design.

**Noise and how to control it**

**Noise:** It is hearing a large group of disturbing interfering sounds that have more than one source at the same time.

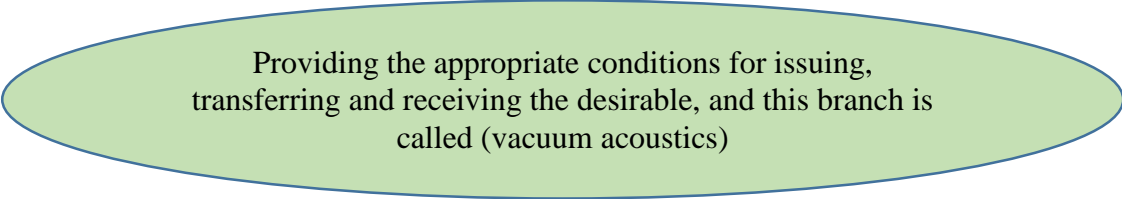
The best defense against noise and lack of access to the building:

**First**, natural methods before and during design: By increasing the distance as much as possible between the source of noise and the building to be protected or by placing rooms that are not affected by noise from a functional point of view (such as service rooms, for example) on the side of the building near the source of noise, which is often the street, and these rooms protect important rooms and spaces that are affected by noise, but if this is not possible, some simple design principles can be taken to reduce the noise reaching the building, for example, planting trees on the side of the noise source (such as the street, for example), especially those with large leaves, can reduce the degree of this noise by absorbing them, and planting plant belts next to the building by a distance ranging from 6-15 m will have the best effect in reducing the noise reaching the building .

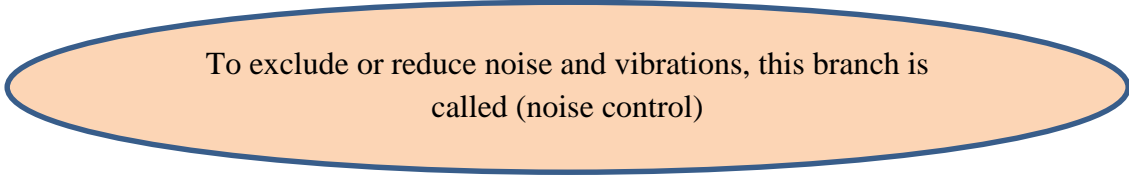
**Second**, industrial methods: using sound insulation materials and increasing the thickness of the walls.

**Voice control**

The objectives of voice control or the so-called environmental acoustics can be summarized in two main objectives:



Providing the appropriate conditions for issuing, transferring and receiving the desirable, and this branch is called (vacuum acoustics)



To exclude or reduce noise and vibrations, this branch is called (noise control)

**(4) Lighting in interior design:**

Lighting is one of the most important elements of interior design, and the beauty of design will not appear without good lighting and planning it in a correct way, because light is spread in the form of electromagnetic waves, and to identify the importance of the amount of lighting for human life, Dr. Sheard emphasizes that the vision process consumes a quarter of the total energy needed for the body in the case of Healthy Lighting and proper consideration, and that any shortage of this lighting means energy depletion from the body to make up for this deficiency, lighting is divided into natural lighting and industrial lighting and the natural must be exploited optimally in order to work to provide electrical energy.

**(4-1) Natural lighting:**

Nature is the main source of providing a large amount of light; The sun, the moon, as well as the flash of lightning are among the most prominent examples of the natural sources of light. As for the sun, it is the closest star to the planet Earth, which is a gas ball that sends glowing fragments throughout space, and other stars that glow in the sky on clear nights are gas balls that emit light and heat. However, they are very far from Earth so they appear as bright spots of light in the sky.

Light is of great importance to living creatures, including animals and plants, in addition to humans. There are a number of natural sources for it:

- \* The sun: it is the main source of light. It is also the largest provider of energy on the surface of the earth. The light produced by the sun is called white light, which is caused by explosions that occur in its center. These explosions produce heat alongside the light.
- \* Moon and Stars: stars are considered to be natural sources of light, although the light that we see is small due to their great distance from the earth. The moon is also considered a natural source of light, but its light is only a reflection of the sunlight.
- \* Living organisms: There are some types of organisms that produce light due to chemical reactions that occur inside them by special cells that produce light, for example some types of worms and incandescent butterflies.

**(4-1-1) Natural lighting and visual comfort:**

Achieving visual comfort and colors visualization as they are based on natural lighting, where natural lighting plays a fundamental role in the ability of seeing, as a person cannot see if the surrounding space is lit and the object to be seen is in a place with less lighting and also the opposite. Dr. Henry Logan's researches confirm that the more the industrial lighting decreases, the more the feeling of stress increases and the toxins increase in the body in addition that the natural lighting achieves psychological comfort for the users. The role of the architect here is employing the industrial lighting commensurate with the user's comfort to raise efficiency and increase productivity.

Visual comfort can be defined as providing comfortable visual environment away from dazzling, and achieving the necessary level of lighting for work easier and without eye fatigue, as well as without errors and at an acceptable speed, but the problem that arises as a result of providing good lighting is the difficulty of avoiding dazzling light, but if dazzling is avoided, the visual comfort will be provided.

**(4-1-2) Sources of natural lighting inside the space:**

Windows and balconies: In every home, there should be some windows, whether big or small, and they are the most important element for natural lighting. Therefore, we must use glass windows that allow lighting to enter and avoid dark glass, as well as using light curtains to allow passing of light while placing one of the heavy curtains to obscure light when desired, and we should not lose the importance of daily exposure to natural lighting to avoid depression. In state of good natural lighting, we should make the best use of it, so it must be:

1-That each room have two windows, as far as possible, spread over two walls, in order to avoid the phenomenon of blurring.

- 2- Distributing the windows and choosing their locations to get the most natural light, especially the reflected ones, while trying to avoid direct light.
- 3- Allocating some open spaces (such as the courtyards, for example) in the building that allow a person to benefit from ultraviolet rays, taking into account the privacy factor.
- 4 - Take into account the layout of the site, the heights of the buildings and the distances between them so that the building does not obscure the natural light from another building close to it or in front of it, hence the importance of studying the various corners of the sun throughout the year appears to help in avoiding this.

#### **(4-2) Industrial lighting inside the building:**

It is used in two cases: the first is when natural lighting is insufficient in the parts far from the windows, and the second is when the sun sets and darkness falls.

The selection of industrial lighting should give a kind of lighting that is as close as possible to natural light, and the types that save in electrical energy consumption must be chosen.

They are man-made and created sources, and these sources are permanently numerous. As a person relied on his primitive life on fire, and after discovering light, he relied on filament and oil to obtain sufficient light, and then the matter developed into the human being's use of ordinary electric lamps. With the great industrial revolution, lighting and electricity became a basic source that a person could not dispense with.

#### **Artificial light sources can be divided into two parts:**

**The first section:** It is based on heating liquid or solid objects, such as light bulbs.

**The second section:** It is based on the priming, or heating of liquids such as candles and the oil lamp.

#### **Another division of industrial light sources**

With the advancement of time, a person can use light sources that he creates, including the following:

\* **Fire:** It is produced by burning the candles made of grease and igniting the oil, and then kerosene was discovered.

\* **Electricity:** There are several ways to generate light using electricity:  
Light bulb, mercury lamp, incandescent lamp, fluorescent lamp, halogen lamp.

#### **(3-4) The philosophy of the colors using and their relationship to sunlight and lighting:**

The choosing of the colors of external facades has important environmental and climatic effects. The light colors or close to white have a great ability to reflect solar radiation, as studies have shown that the effect of choosing colors on the ceilings is more effective.

Colors have a psychological sense of heat or cold, as well as reversing the light or absorbing it. The light colors close to white work to increase the natural light inside the place in the daytime, in contrast to the dark colors.

The colors are divided into hot colors such as red, orange, and yellow, and cool colors such as blue, green, and close to them. Also the deception in regard to surfaces and sizes has an effect on the psychological effect of colors.

The western and eastern facades of the building are more affected than the northern, while the southern facade represents a special case because its reception of solar radiation in the winter is greater than summer and it is required to make the best use of the sun's heat in winter. This should be exploited in the purpose of heating and cooling, which requires lots of energy.

color	Degree of absorption of solar radiation
Completely black	100%
Plain black	85%
Dark green or gray	70%
light Green or gray	70%
White oil paint	20%
New white paint	12%

The absorption degree of some colors to sunlight

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