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BIO- ECOLOGICAL SUSTAINABLE WINDOWS

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Abstract

Window is a vital part of any house they permit natural light into the house as long as views and fresh air. In the same time we can consider that the window is an extremely influential factor in climatic design, as the weakest climatic element of the building envelope. Well designed and protected windows improve comfort year round and reduce the need for heating in winter and cooling in summer. Aesthetics appearance, view, and optical performance, are usually quite important to the occupant. In reality, the serious lighting designer cannot take any notice of the energy implications of window choices. New technologies help to resolve the historic problem of the transaction between windows that reflect unwanted solar gains in the summer and those that admit a maximum quantity of useful light. Well designed windows and shading devices allow solar heat gain in winter and shade and ventilation in summer while providing enough day lighting. Solar gain achieved by heaving 60% of the building's windows orientated correctly can reduce the heating load of a house by ≈22%.In houses, low solar heat gain coefficient glazing should be used on east and west orientations, while high glazing should be used when passive solar and day lighting are being utilized. Today's window technologies can replace more primitive strategies for shielding interior spaces from unwanted sunlight, such as tinted windows and curtains.

1. Energy manipulate on windows

That represent regulates of the input and output energy, where the window's layers must be sufficient to limit the heat transfer in a dynamic system or limit the temperature change, with time, in a static system. In order to realize how glass layers mechanism, it is vital to understand the concept of heat flow or heat transfer. In general, heat always flows from warmer to cooler. This flow does not stop until the temperature in the two surfaces is equal. Heat is "transferred" by four different means: conduction, convection, radiation and infiltration. Insulation decreases the transference of heat.

a) Conduction, conduction is the transfer of heat in a solid or fluid at rest. This transfer of heat is by direct molecular interaction.

b) Convection, convection is the process of heat transfer by flow and mixing motions in fluids. If the fluid movement is caused by density difference (as a result of temperature differences) it is called free convection. This is not the case, for instance where a blower or pump cause the flow-forced convection results. Convection originating from wind is also considered to be forced convection.

c) Radiation**,** radiation is the process of temperature transfer by means of electromagnetic wave. All molecules emit radiation, depending on their temperature, and they absorb radiation from their environment.

This absorption of radiation by the air can be neglected in the case of average distances between walls in architectural elements.

d. Infiltration is heat loss by air movement through the seals around the sash or cracks and other openings where the window attaches to the wall.

In the winter a window's interior surface temperature drops. How far it drops depends on the insulating value of the window. The surface temperature of single-glazing, for example, will be extremely bad insulating to external temperatures. That is to say interior surface temperature of double glazing will be much warmer but still significantly lower than interior temperature. Frames, which can take an area 10-30% of a typical window, also have perceptible effects; surface temperatures of insulating frames will be much warmer than those of highly conductive frames. Warmer glass surface temperatures translate into more comfortable

spaces or occupants during the winter because comfort is a function of radiant heat transfer among people and their surroundings.

For thermal treatment of windows we must know the components of Windows that play a thermal role correlated to energy exchange interior exterior in cold winter and contrary in summer. These are pane glass and frames. By perceptive how windows control thermal comfort, windows designer can create an optimal resolution of windows, which collaborated welcoming with environment. Windows in residential building consume approximately 2% of all the energy used in industrials countries. Well organized windows can greatly improve the thermal comfort on houses during both heating and cooling seasons. Therefore Windows play significant role in the design strongly affect their energy use.

2. Improvement of thermal functions

Bio-ecological window combines the interests of sustainability, environmental consciousness, green, natural, and organic approaches to evolve a design solution. Sustainability is a wise approach to the way we live. And using energy in a more sustainable way is a part of this approach. Heat loss in winter is a severe problem in which architects, engineers, must get basically explanation, for the thermal part of windows problems, in the following part of this research we will try to describe these problems and suggest the best ecological solution.

2.1. Heat transfer break concept

The concept of heat break consist of occurring an thermal layer between exterior and interior to stop or decrease the transfer's flux of energy from interior to exterior in winter Architect can employ of heat break concept by move a flux of convenient air from the underground space by means of the insulate ducts canals to generate a thermal obstacle, to stop or annihilate the transfer of energy interior-exterior and inverse.

2.1.1. Air such as intermediary thermal layer

Energetic role of intermediary thermal layer is between cold exterior spaces and comfortable interior living spaces, therefore the essential role of intermediary layer are such as thermal buffering. For the parent building, a thermal intermediary layer represents a reduction in heat loss/gain through the windows. This is because those elements lose/gain heat to a space which is at a higher or lower temperature than the outdoors. The magnitude of the heat loss/gain reduction depends on the temperature of the intermediary space. The optimal temperature for this layer is around 8ºC for houses in winter season. The air in intermediary thermal layer must have a higher temperature than exterior on winter and reverse on summer. Therefore creators of intermediary thermal layers must find the source of energy which has a constant temperature in all seasons.

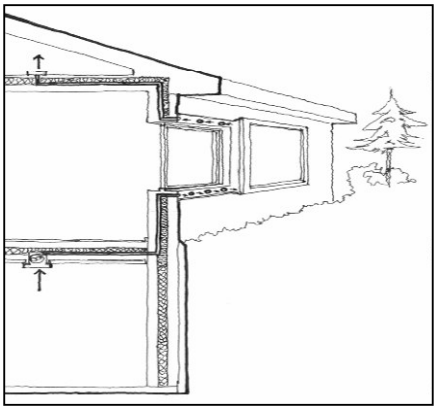

Figure 1. Heat transfer break concept

2.1.2. Underground such as source of energy

Its high thermal capacity keeps the soil temperature, below a certain depth, considerably lower than the ambient air temperature during summer or higher that the ambient air temperature during winter. The temperature of the soil at depth of 2-3 meters can be low enough during summer or high enough during winter, to serve as a cooling or heating source. Using of the underground constant temperature can be useful for architects and designer because the temperature is between 8ºC- 13ºC, and 2- 3 m above the earth, can help us to find a controlled thermal flux from underground to house elements (windows) by means of a determinant tube canals. We can create a form of heat transfer break concept on windows.

2.2. Heat recovery systems by comfort ventilative

Fresh air is a vital for the healthy life form of house occupants the highest values of comfort are achieved by introducing controlled ventilation with energy recovery; health and thermal comfort being on one occasion again the majority significant factors for planning a project. The system consists of two separate air

management arrangement, one collects and exhausts stale indoor air, and the other draws in fresh outdoor air and distributes it right through the house. That means using of stale indoor air eliminate in air refreshing process and charging the outdoor fresh air set up with optimistic energy these process can be present by using mechanical ventilation.

These mechanical ventilation systems use fans to preserve a low velocity flow of fresh outdoor air into the house at the same time as exhausting out an equal amount of stale indoor air. The energy recovery system is intended to provide continuous or timed ventilation throughout a house, and recover the energy carried in the exhausted stale air. Uniform and comfortable ventilation is best achieved with a tight house and mechanical ventilation particularly in extreme seasons. An energy recovery system brings the fresh air from the outside, pre-heats it in the winter and pre-cools it in the summer. It can give clean fresh air every day at the same time as helping to keep energy costs low. One set of ducts collects stale moist air from the kitchens, bathrooms. This stale polluted air passes through the energy recovery system unit and is exhausted to the outside. The other ducting system draws in fresh clean air from outdoors through the energy recovery system unit. When the house is with a high value ventilation system, so man can controlled the excellent the ventilation rate.

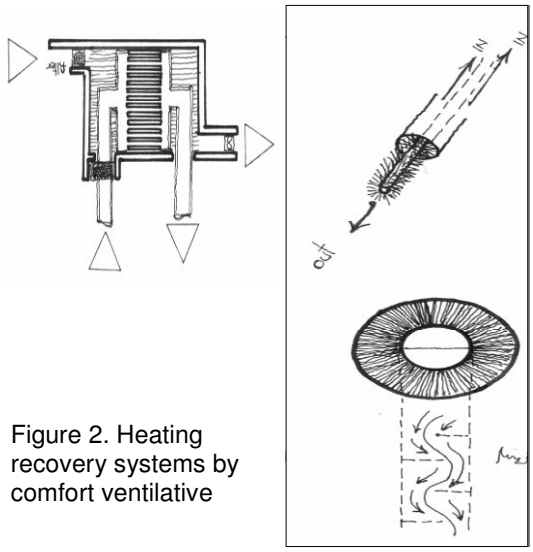

Figure 2. Heating recovery systems by comfort ventilative

3. Improvement of illumination variety by light shelves

The concepts of light shelves function consists of windows that have face towards the sun which receive a vast quantity of energy that could be used for day lighting. In principal, if a window faces anyplace between southeast and southwest and if it receives direct sunlight, each component of window area could illuminate 20-100 component of interior space. However, this is possible only if the sunlight can be distributed efficiently. The challenges in distributing this free lighting energy are lighting geometry and glare. In order for illumination to be useful, it must come from overhead. A light shelf is basically a mirror that is inside a window, facing upward. The mirror reflects incoming sunlight towards the ceiling. The ceiling then distributes the light into the interior space. A light shelf is a horizontal light-reflecting overhang placed on top of it. This devise, which is most effective on southern orientations, improves daylight penetration, creates shading near the window, and helps reduce window glare. Exterior shelves are more effective shading devices than interior shelves. A combination of exterior and interior will work best in providing an even illumination gradient. As with any kind of daylight entering the space becomes heat energy.

3.1. Light shelves advantage

We can declare that the vital role of light shelf is that such a passive bio-climatic device that permits daylight to enter deep into a house. Light shelves are reflective horizontal surfaces that extend from the exterior into the interior of a house. They can extend the useful variety of perimeter day lighting on a house's south side to about 6-8 m on sunny days depends of the city climatically situation. The exterior types of this system used also as sunshades.

Light shelves can stop unwanted direct sunlight, which is a source of glare, from incoming a space. Sunlight is reflecting onto the ceiling, minimizing glare and boosting light levels in the space.

Light shelves work well at high solar angles, but at lower angles the shelves require to extend deeper into the room to catch the sunlight.

Light shelves can also reduce the amount of heat that enters a space. The glare problem is avoided by this system that limits the use of diffusers to make use of day lighting through windows. It also provides the unique advantage of variable the light from the window so that it comes from a more overhead direction, humanizing the quality of illumination.

The light shelf itself is a simple device that is installed inside the window. In most applications, it must be combined with other devices to avoid glare from sunlight incoming the lower portion of the window. The light shelf itself is not difficult to install. Light shelf systems, including exterior shading device, are now available from manufacturers as prefabricated components. The biggest disadvantage of light shelves is that only the

portion of windows above head height is working for day lighting. Light shelves require periodic cleaning, which is easy to abandon.

3.2. Light shelves position and functions

For an efficient function of light shelf system, it requires direct sunlight. The windows should face towards the sun for a large portion of the time that the space is occupied. Tinted or reflective glazing may very much reduce the potential benefit of light shelves, or make them uneconomical. These types of glazing typically block about 70-80% of incoming sunlight. In some cases the system may be used with glazing at lower heights where people cannot get close to the glazing. As with any kind of day lighting, the electric lighting must be arranged and controlled so that it can be turned off to exploit the daylight provided by the light shelf system. The location is apparent for tall windows, where the light shelves can provide deeper penetration than day lighting that achieved by shading windows. This is because light shelves can throw all the energy of direct sunlight into the space. In contrast, using shading to tame sunlight for day lighting leaves most of the potential day lighting energy outside the building. For a well-organized function of light shelf system that needs;

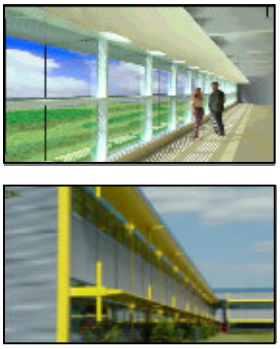

Figure 3. Light shelves position

- The good treatment of windows. The portion of the window below the light shelf needs separate treatment to prevent glare. A window must be exposed to direct sunlight to be an applicant for a light shelf. Effective day lighting by any method is still infrequency. It is impossible to communicate the visual effect of day lighting by words or figures.
- The simplest materials and function of light shelf such reflector. It could be as simple as aluminum foil taped to a piece of cardboard.
- The distribution function of day lighting is from the portion of the window that extends above the light shelf. The bottom portion of the window contributes daylight only to the thin zone under the light shelf. The window must face towards the sun for a large part of the time, and it cannot be shaded by outside objects. If the window glazing is tinted or reflective, the day lighting potential is reduced substantially.
- The ceiling is another and vital distributor form of sunlight, which is received from light shelf. The ceiling then distributes the light to the occupants. The ceiling plays the same role as the electric lighting equipment. In most cases, the ceiling should be highly reflective to save as much light as possible. The height and orientation of the ceiling and the diffusion characteristics of the ceiling distributes the daylight.

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