A Study on Designing of a HVAC system in Green Building Environment

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Abstract – This paper illustrates the study on designing of a HVAC system and converses the role of HVAC for make certain of elevated performance of sustainable buildings in design and process. The design plans for effectual and green HVAC systems are explained and the novel emerging HVAC technologies for green buildings are depicted. It is anticipated that HVAC designers and other building professionals could expand an enhanced perceptive of green buildings and apply efficient approaches and techniques for meeting the objective.

Index Terms – Green building, HVAC, design and operation.

1. INTRODUCTION

As normal resources swiftly exhaust around the world, the want for green or environmentally responsive building practices is becoming supplementary and more perceptible. So-called "green buildings" are constructed or refurbished under sustainable expansion, a design process that condenses the detrimental impact on natural resources and looks at the life-cycle costs of the facility [10]. The benefits of green buildings are not complicated to comprehend. By subsequent green design practices, building possessors and developers can do well monetarily by doing good environmentally and socially. First, exceedingly energy-efficient green buildings have inferior operating costs than conservatively designed buildings. Second, sustainable design helps to diminish broad ecological brunt, such as water usage, ozone layer depletion and raw materials handling. As a finishing point, workers in well-lighted, secured, contented environments are industrious and cheerful, which is a key aspect in the present rigid labor market [1]. This paper portrays the fundamental perception of green building and discusses the function of heating, ventilating and air-conditioning of HVAC for making certain of high performance green buildings in the design and process. The design approaches for effectual and green HVAC systems are elucidated and the novel emerging HVAC technologies for green buildings are illustrated [4] . It is in expectancy that HVAC designers and other building professionals might grow a better appreciative of green buildings and apply effectual strategies and modus operandi for meeting the goal. An integrated and holistic approach to HVAC and building design, a sustainable built atmosphere is able to be accomplished and the environmental performance of buildings can be enhanced [5].

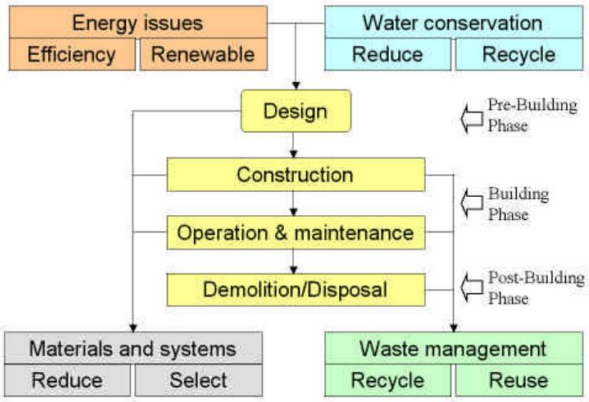

Fig.1: A Typical Building life cycle and sustainable construction

2. THE ROLE OF HVAC

HVAC systems possibly will harm the atmosphere by superfluous use of energy which results in diminution of non-renewable energy resources, mainly fossil fuels, moreover by the production of electricity or thermal energy, together of which add to environmental pollution [3]. Environmental destruction by HVAC systems may also be rooted by outer shell or noise, and by the emancipation of unhygienic water and air be filled with lubricating oils, chemicals, refrigerants, particulate or gaseous matter, heat transfer fluids, or microbiological organisms. In the majority state of affairs, HVAC systems will radically impact how "green" a building is. Consequently, the project team is supposed to not ignore the potential and influence when escalating the design [6]. HVAC engineers are capable of taking part in a decisive role in environmental design by being the technical or analytical resource for the team, and by heartening the expansion of more meticulous assessment tools that are fitting, practical and friendly, and justifiable. To make dissimilarity for the green design goal, they should thrust architects to design enhanced envelopes, support HVAC decisions based on life-cycle costing, interleave their authority previous in the process and prop up the appropriate commissioning of buildings. They ought to try and to edify building owners and developers the value of a green and sustainable design so that the green process can be carried out effectively. It is supposed that the green design process necessitates an

elevated level of teamwork, interdependence and upbeat effort among team members who are expectant to cross conventional regulation boundaries with the shared mission to perk up building performance. The engineer or project manager is habitually accountable for creating and managing that progression. The engineer should notify the process from a technical as well as scientific basis and to vigorously connect the other team members in the dialogue.

3. SUGGESTED DESIGN PRACTICES

Observe load evasion strategies such as condensed lighting power, high-performance glass and skylights, cool roofs, and enhanced roof insulation techniques in the by and large building design. Size units appropriately using acceptable methods that account for the load evading strategies implemented in the design and use rational assumptions for plug load power and freshening air quantities when sizing equipment.

Select the unit size and airflow based on deliberate levelheaded loads devoid of over sizing. Regard as escalating unit flow rate to advance reasonable capacity in dry climates. Stipulate units that meet Tier 2 efficiency standards reputable by the conglomeration for Energy Efficiency; incorporate first-rate effectiveness fan motors, thermostatic expansion valves, and factory-installed and run tested economizers with disparity rather than single-point switch control [13].

Design sharing systems with minor velocities to lessen pressure drop and noise. Fasten and insulate duct systems located exterior the building's thermal envelope. Maneuver ventilation systems incessantly to endow with sufficient ventilation air. Slot in demand-controlled aeration to lessen heating and cooling loads. Denote commercial mark two-stage cooling thermostats with the potential to schedule fan operation, heating and cooling set points autonomously. Commission the systems proceeding to tenancy through a amalgamation of checklists and purposeful testing of equipment control, economizer process, airflow rate and fan power.

Expand clear expectations on the services provided by HVAC safeguarding personnel. The emblematic costs to raise a building to enhanced efficiency with high competence lighting, high-performance cool roof, glass, improved roof insulation and an energy-efficient HVAC system ranges from \$2.75 per ft² in coastal climates to \$3.55 per ft² in desert climates. When employing integrated design the cooling system credit for abridged system size ranges from \$2.10 per ft² in coastal climates to \$3.40 per ft² in desert climates with a net first cost impact of \$0.80 per ft² in coastal climates to \$0.30 per ft² in desert climates. These primary costs are counterbalance by annual energy cost savings on the order of \$0.40 to \$0.80 per ft² per year, providing 30% to 45% energy savings with a simple payback period of 3 years or less.

4. PROPOSED DESIGNING OF HVAC SYSTEM

Disarticulation ventilation is based on the essential principle of air that it rises upwards after being heated by the machines and populace. The increasing air is then enthused outwards from the exhaust placed at a stature [9]. This procedure requires low energy utilization and provides efficient air circulation which in term with its sustainability but it wants an inlet of pre-conditioned air from exterior. Combining air sharing systems with floor entrée could be a supplementary advantage.

Out-of-doors air pre-heating amalgamating systems bank on joint solutions, co-ordination to get maximum compensation. A punch a hole in metal plate is used to make a non-languishing Trombe wall is used to preheat the air from outer or to create an exterior wall shaded revelation to the southern direction is mainly beneficial for this product [10]. It is cost efficient as the majority of the heat formed is reusable using simple gas-fuelled systems relatively than boiler or reheating coils which means minor cost and superior performance.

Heat pumps: Geothermal heat makes use of the restricted heat of earth or water body to improve the performance of a standard heat pump mechanism by contraction of the range of loop temperature. The structures of this field loop as well as the assortment of the water body rely on the site characteristics. Photovoltaic systems are extra cost efficient today. The chief cost generates in exchange and in providing bond to its utility grid [11]. Solar thermal systems are the best forms of renewable energy. Its heat be capable of being valuable in industrial as well as domestic needs for hot water and could also be used to hasten the air conditioning plant. Fluid desiccant conditioners and absorbent chillers might be used to intangible latent heat for air supply of a building [12].

The integrated photovoltaic system is self-possessed of roofing materials like metal panels and tiles pr glazing materials similar to skylights performing like substrates for solar cells and hence stops the need of the customary framing systems which in turn curtails its cost. Cooling of solar cell puts the cell in order such that it employs expected convection of the building or its conditioned relief, reducing the cell's temperature and hence contributing to its conversion efficiency. A sustainable technique of heating and cooling as well is to utilize temperature of water solution on beaming large surfaces applying high temperature for cooling and little for heating. A smaller amount energy is desirable when an standard temperature is maintained of water (18- 28°C) closer to the environs comfortable temperature. These systems are incorporated in the building's structure parting a smooth fascia for the building and interior architecture.

5. NEW TECHNOLOGIES IN HVAC SYSTEMS

It is apart from the design of sustainable whole-building design as the "precise things to do", advances in technology

are magnetizing the imagination of building designers these days [2]. Under floor air systems, building-integrated photovoltaics, radiant cooling and heating, sulfur and magnetic-induction-based lighting systems, fuel cells, elevated performance glazing, and progressively more urbane digital controls as well as the sensors are being considered on many present projects. Novel systems and deliverance methodologies are sprouting and they may proffer momentous technical benefits to any project. A small number of significant technologies that have the prospective potential to advance the ecological performance of HVAC systems are described below.

5.1 Under floor air-supply systems

This is a theme that has established a bunch of coverage recently. Figure.2 illustrates an uncomplicated schematic of an under floor air-supply system. Similar to most systems, there are both extremely fitting and less than idyllic applications. Some pace-setting and sustainable designers locate it appealing since all of the exterior air is delivered to the building volume in secure propinquity to the occupants. Perhaps the most undeniable applications are huge, high spaces like gathering centers and airport terminals where the main drafty air flows will be of negligible apprehension to what is a persistently fleeting occupancy. This notion of delivering cooling and ventilation air downward low is suitably known as displacement ventilation.

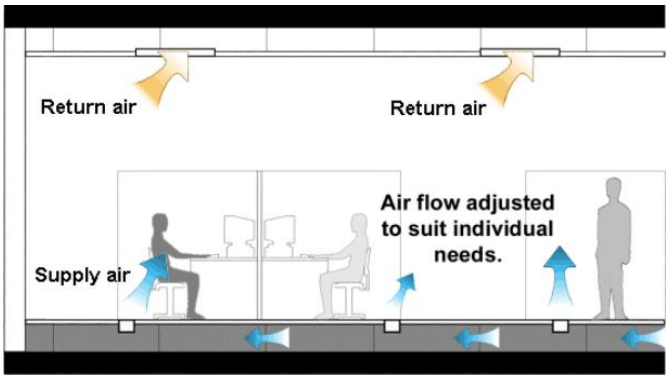

Figure 2 : Under floor air supply system (Credit: Center for the Built Environment, University of California, Berkeley)

A supplementary underneath floor air-supply approach utilizes of a plenum space that lodges cabling systems for bringing conditioned air and evades the requirement for air ducting. It is extremely flexible and has the latent to make available enhanced thermal comfort, indoor air eminence and lifecycle cost savings for today's contemporary offices [14]. In modern years, with the mounting requirements of information technology equipment and network the use of raised-floor construction has paying attention in numerous cities. Combined with an under floor air system the raised-floor design can tender an effectual solution for offices and profitable spaces. On the other hand, apprehensions about the predicament of dust rousing from the floor and the probable uneasiness caused by draft and vertical temperature differences still requires to be examined.

5.2 Desiccant-based cooling systems

The majority mechanical cooling system designs endeavors to address both the rational and latent cooling loads with the similar pieces of equipment. This need not have to be the same case. Numerous applications can be addressed through the make use of desiccants and other techniques to control latent loads. The Desiccant-based system is considered to provide cooling without refrigeration [8]. In this system a desiccant eliminates moisture from the air, which releases heat and augments the air temperature. The dry air is refrigerated utilizing either evaporative cooling otherwise the cooling coils of a conservative air conditioner. The adsorbed moisture in the desiccant is followed by removal of using thermal energy given by natural gas, electricity, desecrate heat, or the sun. Commercially obtainable desiccants include silica gel, activated natural synthetic zeolites, titanium silicate, lithium chloride, alumina, and synthetic polymers. Figure 3 gives a schematic of a desiccant-based cooling system. The different system components necessitate electricity to function, but in general they use less than a conservative HVAC system.

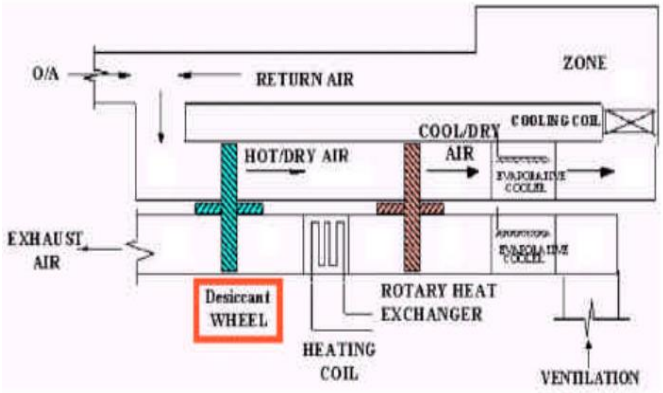

Figure 3: A archetypal Desiccant-based cooling system

6. CONCLUSION

Green building advancement facilitates building possessors and executives to lessen energy consumption, advance the work environment and diminish the environmental collisions of building operations. If the building can trim down operating costs, augment occupant productivity, and reduce health grievances, as well as be environmentally accountable, it is said to be a green building. To assure this HVAC systems have a significant role to play because many of the green building factors are unswervingly or indirectly pretentious by the presentation of the HVAC systems. An integrated and complete design process commencement at a project's

inception is requisite to optimize the HVAC design and maneuver for green buildings. A small number of innovative HVAC technologies have been used and have been considered at present. At present, these technologies are being utilized productively in some alcove applications and performance enhancements will prolong to drive down system costs and pick up the pace in integration of the novel systems within conservative HVAC systems. If green means more contented tenants and healthier habitation rates more building owners would desire to slot in these technologies to gain a influential market benefit. HVAC and building designers are accountable for bringing this into authenticity and causative to the green revolution.

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