Chilled Beam Technique-A Review

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Abstract- *The aim of this paper is to determine the consequences of utilizing different hvac & energy efficient techniques to make the building sustainable. Sustainable building is that building that seeks to attenuate the negative environmental impact of the building & it's achieved by the installation of a number of the innovative techniques within the building (during construction or some after the completion of the building).Sustainability are often defined because the quality of causing little or no damage to the environment & meeting the requirements of this without compromising the power of future generations to satisfy their own needs. It's been observed from the studies wiped out in the past that a number of the techniques are very effective in making the building more energy-efficient & sustainable.*

Keywords: Sustainable, Smart Construction Techniques-Chilled Beam, Building Envelope, Energy-Efficient

1. INTRODUCTION

The concept of Sustainability seems to be greatly focused on this moment & on keeping track of the items above a particular level i.e. keep exploring new & innovative techniques by which we will conserve natural resources & making it an extended term vision too. One of the popular sayings in the relation to this is " The most sustainable energy is the saved energy".It should also cover the aspect of societal progress & a rise in quality of life.

Construction technology is liable for a minimum of 40% of energy use in most of the countries. Increase in building construction and economic sustainability are the key factors within the development of infrastructure which results in the expansion of energy demand. Infrastructure development in line with the green building concept is the requirement of present days. Need of energy conservation is now the planet's priority topic, therefore green building concept has been gaining popularity.

Indian Green Building Council (IGBC) and National Housing Bank (NHB) have signed a memorandum of understanding on 13th July 2013 to supply home loans at lower interest rates for purchasing of certified green and energy–efficient homes. This MoU may be a major initiative to market the green homes concept in India and towards saving the world. Building industry hold a big portion of energy consumption worldwide. For e.g:- If we divide our energy use among three economic sectors:- Residential & Commercial(40%), Transportation(28%) & Industrial(32%).

The primary energy sources is usually the non-renewable sources like Petroleum(37%), Natural gas(29%), Coal(14%), Renewable energy (11%),Nuclear electrical power (9%).

In order to attenuate dependence on these sources, we should always apply some innovative techniques to our building construction which will ultimately results in much energy efficient building without decreasing the comfort & quality of living.

1.1 Importance of Chilled Beam Techniques:

Sustainable building approach under consideration is taken into account the knowhow of building industry to manoeuver towards sustainable development taking into account Environmental, Economic & Social issues.

- Building projects that causes less harm to the environment.
- Profitable & cost-efficient.
- Resource conservation mainly energy conservation.
- Design for human adaptation.
- Beneficial to the society as an entire and may sustain within the future generations too.

2. LITERATUREREVIEW

Literature review is administered by study of varied Research papers supported the concept of Sustainable building, Green building, Energy efficient techniques & Chilled beam technique its comparison and other construction details.

Design of A Sustainable Building: A Conceptual Framework for Implementing Sustainability in the Building Sector by Peter O. Akadiri, Ezekiel A. Chinyio and Paul O. Olomolaiye [1] in this paper the authors said that "building industry may be a vital element of any economy but includes a significant impact on the environment. They stated in their study that "A sustainable project is supposed, built, renovated, operated, or reused in an ecological and resource efficient & conservative manner. It should meet a spread of certain objectives: resources and energy efficiency; CO2 and GHG

emissions reduction; pollution prevention; reducing noise; improved indoor air quality; harmonization with the environment". An ideal project should be inexpensive to make, last forever with modest maintenance, but return completely to the planet when left. They contribute to the industry and sustainability research by demonstrating the dimensions of the issues involved, beginning with an assessment of the environmental challenges the industry faces.

The Importance of Green Technologies and Energy Efficiency for Environmental Protection by Mohd. Wira Mohd Shafiei and Hooman Abadi [2] In this paper authors have focussed on the phrase that "Economic development is closely linked with the energy development". It's feared that not only these levels of energy production and use from current energy sources are difficult to appreciate but also unsustainable. Therefore, energy use efficiency must be increased to moderate the expansion of energy, while the contribution from clean energy sources must be increased to reduce the unfavorable environmental impacts on energy usage. Green energy offers a positive alternative to traditional energy sources. They conclude in their study that the actual fact that renewable energy accounts for fewer than a modest proportion in meeting the world's (commercial) energy demand means there's an ape-man in their potential and their implementation - barriers in their implementation. These barriers (either financial or non-financial) need to be identified and addressed so as to style innovative policy approaches for international and domestic financing or renewable energy technologies. Renewable energy can play a vital role in helping to satisfy basic energy needs through the employment of recent technologies.

To Identify the HVAC Energy Savings through Chilled Beam Cooling Techniques by Mohammed Ubied Ali & Mohammed Ishaq[3] They stated that a completely effective HVAC system must also address many other indoor environmental issues that affect occupant comfort, productivity and health like ventilation air, air distribution, humidity control, noise levels, etc. they often find that chilled beam systems are the proper "green" solution for several buildings. There's also a full comfort and economy for the employment of active chilled beam systems over other of the more conventional systems choices. In India, chilled beam systems are proven and while successfully getting utilized in Europe since a decade. The chilled beam system promotes excellent thermal comfort, energy conservation, and efficient use of space due to the high heat capacity of water used as heat transfer medium. it's an energy efficient HVAC technology which works on dry cooling principle. Chilled beams system would be examined which could show energy conservation and has the potential to save lots of 30-40% HVAC energy consumption in a very standard Air conditioned Building scenario.

A Comparison study for active chilled beam and variable air volume systems for an office building by Y.H. Yau, J.H.Tam[4], They comparatively studied and analyzed two hvac systems i.e. VAV and ACB respectively, the most area of comparison deals with the price and energy efficiency by calculating the cooling load requirement they concluded in their study that ACB may be a clear winner when it involves energy efficiency and VAV wins at the angle of low initial cost. They also stated that ACB includes a lower operational cost that may be much beneficial when used for the longer period of the time.

Low energy consumption Hvac systems for green buildings using chilled beam technology by Syed Moazzam ali [5], He studied the benefits of chilled beam systems over other hvac systems available within the market and draw result on the idea of simulation results and concluded that a chilled beam system would potentially save 30-40% hvac energy consumption over conventional air conditioning building techniques.

Study the role of chilled beams in improving cooling efficiency of buildings: literature review by Saeed Reza Mohandes1, (Hossein Omrany2) [6], They stated that Chilled beams save an excellent deal of energy in terms of transferring cooling, ventilating of airflow, using higher chilled water temperature and eliminating the requirement for reheating the cooled air. To realize the simplest results of efficient cooling of chilled beam in false ceiling, the return openings of false ceiling should be located within the perimeter of the space. Furthermore, the dimensions of its area should be doubled compared to the beam. When it involves to the asymmetric workstation using chilled beams in office building, workstation shouldn't be located within the downfall area so as to not cause local draught risk. Besides, asymmetric workstation causes circulation in a room which ends in high air speed on at the ground.

Design Considerations for active chilled beams by Darren Alexander, P.Eng.; and Mike O'Rourke [7] , that they had given the detail about the specification of an active chilled beam systems, their uses , capacity and appropriateness informations.

A Case Study of Energy and Condensation Analysis for Chilled Beam Systems in the Office Building Located in Hot and Humid Climate Zone by Kuei-Peng Lee, Kuan-Ting Lin 1 and Bo-Huei Wu [8], Their findings show that the chilled beam saves 12.7% of energy consumption compared with VAV system; the chilled beam saves 10.4% of energy consumption compared with FCU system. The chilled beam system with ice storage saves 19.2% of electrical charge annually compared with the chilled beam system without ice storage; the VAV system saves 20.6% of electrical charge annually; the FCU system saves 15.2% of electrical charge annually.

Chilled Beam Systems- A Green Energy Solution for Hvac Systems by Kenneth Gong [9] In this they stated that the chilled beam is certainly a "viable green hvac solution" even within the tropics if problem of condensation is managed properly. The limited number of chilled beam installations that are currently in operational Malaysia and Germany have demonstrated that chilled beam system can provide satisfactory comfort condition within the tropics.

Green building: A case study of Indra Paryavaran Bhawan, Delhi by Rachna dhingra*1 and Puja gupta2 [10], They stated that Green building practices can substantially reduce or eliminate negative environmental effects and improve existing unsustainable design, construction and operational practices. In this case study it had been revealed that this building achieved LEED India Platinum Rating and GRIHA 5 star rating. The fundamental design concept of the project was to form net zero energy green building. For improving Indoor Air Quality and thermal comfort The Hvac System utilized within the building is Chilled beam which reduces energy consumption by utilizing radiative cooling panels that rely on localized induction cooling by chilled water. This also reduces the AHU/FCU fan power consumption because it avoids the necessity for huge quantities if air travel from the user space to the thermal heat exchange point.

Chilled beam technology overview: by John Woollett1, Jonas Åkesson2 [11], Their findings are that Beam indoor climate technology has the power to supply a high level of comfort to the users. Model tests show that indoor climate parameters are extremely comfortable and may provide the idea of the indoor climate system for several decades with minimal maintenance at the area level. Energy usage of beam system can be significantly lower than other indoor climate systems due to the upper chiller temperatures on a system level or a minimum of reduced cooling loads at lower chilled water temperatures.

Application of the Active Chilled Beam in Air-conditioning Engineering by Wenhong Yu Hui Li[12], He stated that Active chilled beam system has many advantages, like high comfort, low energy consumption, low noise, long equipment life and then on. It is a replacement technology worth popularizing under the background of energy saving and emission reduction in today's green building. The active chilled beam adopts the working rule of the air conditioning system which is induced by the primary air from the nozzle, therefore the active chilled beam has its own particularity within the design and operation control. The FCU system design experience is not any longer completely suitable. Due to the special working rule of the chilled beam, the cooling and heating capacity of the chilled beam is low, especially for curtain wall buildings with high cooling and heat load. To achieve the thermal comfort of indoor air conditioning and to achieve building energy saving, the floor convection at the exterior enclosure is recommended to adopt.

Performance Evaluation of Active Chilled Beam in Real Office Conditions in a High-Performance Building in Heating by Rohit Upadhyay Rodrigo Mora PH.D. Student Member ASHRAE [13], They had found out that the temperature and air distribution were found satisfactory which concludes that the ACB is effective in providing cooling as well as heating. Coanda effect was realized which prevents direct throw of cold and hot air to the occupied zone. The velocity and temperature distribution at the supply slots of ACB were found not even and same, this is because the heat exchanger design and duct connection to primary air plenum.

Performance Evaluation of a Passive Chilled Beam System and Comparison with a Conventional Air System by Janghyun KIM1*, James E. BRAUN1,2, Athanasios TZEMPELIKOS1,2, W. Travis HORTON1,2, [14], The following observations were inferred from this study:

- Energy can be saved up to 12% by using a passive chilled beam system under Midwest weather condition compared to a typical conventional air system that only controls the space temperature and not space humidity.
- Using a separate chiller with higher chiller water operating temperature (14^0C) for passive chilled beams can provide an additional 11% energy savings.
- The improvement mostly comes from the reduced relative air speed rather than the increased radiation cooling effect.
- Radiation cooling of passive chilled beams is calculated as 5-7% of total cooling capacity for the configuration considered in this study and it is almost insignificant in terms of thermal comfort estimation.

Design and Analysis of the Air Conditioning System using Chilled Beam Technology by1V.Suvarna Kumar, 2 G.Prasanna Kumar, 3G. Bhasker [15]**,** They found out that the use of chilled beams although a little heavy on the pocket initially, results in a significantly lesser consumption in terms of power and cost in the long run. Apart from the savings factor, the use of Chilled Beams also results in better air quality, virtually no noise and prevent of cold drafts thereby increasing the overall human comfort significantly. Chilled Beams gives the designer to alternate large supply and return air ductwork with small chilled water pipes. This results in significant savings in terms of plenum space and increases usable floor space. The sole purpose of the project was to come up with a HVAC system which is more efficient, more energy saving and eco-friendly in nature than the

conventional air conditioning systems. By using Chilled Beams, we could save approximately 35% of tonnage which is a huge difference. Although they are not the solution for every space within commercial and institutional buildings, the strengths of the Chilled Beam Air Conditioning System are becoming a more useful tool to handle challenging spaces in today's high performance and low energy consumption buildings.

3. DISCUSSIONS

From the above literature it's clear that a lot of researchers have put their efforts to review the varied methods to realize sustainability, making the building energy efficient with minimal environmental effects and that they have proposed ideas to form the building sustainable by various theoretical approaches that are needed to be applied within the construction and designing phases of building to realize more fruitful results.

4. CONCLUSIONS

According to literature the researchers have done many studies to define sustainability, describe the varied parameters of sustainability, theoretical approaches are given to realize sustainability in the future. A number of development techniques which will cause sustainable and energy efficient design of building are elaborated in the papers.

As per the previous research work, encompassing this field mostly theoretical approaches and principles were discussed & the sensible studies are still not much prevalent, thanks to the strict and conservative thinking of the practitioners that are been involved. Sometimes the Fund also act as an obstruction to try to such projects in practical.

Some of the points that should be considered are:

- To find an appropriate balance between economic, environmental & social issues
- Changing the way construction practitioners think.
- Total cost of the technology should be affordable for their wider use.
- LCCA should be done in order to make people understand about the long term viability of any new construction technology & method.
- Evolutionary capability of technology i.e.it should not be static(i.e. one technology can be used to provide multiple benefits and satisfy various needs simultaneously).
- Multi-purpose technologies i.e. it can be used for variety of services at a time.
- A building block accounts for 40% of the energy consumption so if we start from the building itself we will be able to achieve sustainability and a more energy efficient environment.
- Focus should be on the new and innovative technologies like Chilled beam system, Building insulation from Aerogel & Vacuum insulated panels etc, and analyse their effects on the building efficiency and an overall protection of natural resources.

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