International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 10 Issue: 06 | Jun 2023 www.irjet.net p-ISSN: 2395-0072

IBMS IN HIGH RISE BUILDINGS (HVAC AND LIGHTING) COST OPTIMIZATION

Ar. V.Sanjay kumar. D[1], Ar. Vidya [2]

[1] Post Graduate Student, M. Arch – Construction Project Management, Faculty of Architecture, Dr. MGR Educational and Research Institute, Maduravoyal, Chennai
[2] Head of the department, M. Arch – Construction Project Management, Faculty of Architecture, Dr. MGR Educational and Research Institute, Maduravoyal, Chennai

---

Abstract *- The ubiquitous availability of Internet connection in office space in high raise building environments enabled limitless possibilities of connecting local sensor networks using various cloud technologies to provide value-added services for intelligent management of building facilities. In the context of implementing distributed smart building management systems, a significant challenge lies in establishing interoperability among diverse computational platforms. This involves enabling a common protocol across a wide range of devices with varying capabilities and resources. In this paper, we propose an infrastructure software framework designed to facilitate the establishment of extensive interconnected sensor networks primarily aimed at building management applications. In our work, we define and establish the terminology used in the context of our system. We also provide specifications for the system elements and describe the functionalities of different hardware and software building blocks. To ensure interoperability, we introduce a thin common layer that facilitates seamless communication between various components, utilizing a well-defined message semantic and an event-driven framework. This modular architecture not only allows for easy adaptation but also enables extension of the system to meet evolving requirements.. Sensor nodes are connected through the data aggregators, which communicate with the remote salable cloud service, designed for large sensor data collecting, syncing, storage, and event processing.*

Key Words: *IBMS frame work, building management, building facilities.*

1. INTRODUCTION

Integrated building management systems (IBMS) are the technology involved in modern buildings. The integration of building management systems with the internet and associated IT infrastructure leads to the development of Integrated Building Management Systems (IBMS). These systems allow for the consolidation of various management systems within a building by leveraging an Internet Protocol (IP) network. Through this network, the different management systems installed in the building can be seamlessly interconnected and centrally controlled within the IBMS framework. A single front-end interface is provided in the IBMS through which all the subsystems are managed. To study , analyse and implement the needs & the main elements of Integrated Building Management System (IBMS) in high rise buildings and to understand and implement the cost techniques involved in up gradation of existing systems. To understand the time, cost, techniques involved in up gradation of existing systems of IBMS in an office building. To understand and design of an existing office building with up gradation techniques of HVAC and Lighting.

2. OBJECTIVE

To study and analyse the term IBMS from the root to the function in modern days and their impact in the building

- To enumerate new technology in IBMS
- To study about the IBMS fixtures and know about the capacity and their promising work done in their field of IBMS
- Propose and implement in the new or already constructed building ,compare with the old functional methodology of building

3. METHODOLGY

Synopsis framed at the initial stage of the project ,the researched gap is discovered , scope is developed datas related to the project is collected case study both net and live has been collected and analyzed comparative study in formulated. The proposal process start in the selected as identified office space which is already constructed .

4. LITERATURE REVIEW:

4.1. TECHNOLOGY TO MAKE BUILDINGS SMARTER

This includes monitoring and controlling systems such as ventilation, lighting, power systems, fire systems, and security systems. With the emergence of the Internet of Things (IoT), IBMS has evolved beyond being just a technological concept. It is now transforming businesses and revolutionizing the way they operate.

4.2. FUNCTION OF IBMS IN OFFICE

Integrated Building Management System (IBMS) is extensively implemented in hospitals to ensure seamless operations by connecting and integrating various systems. It serves as a centralized platform that connects and monitors mechanical, electrical, plumbing, fire protection, and security systems within the hospital infrastructure. By integrating these systems, IBMS enables comprehensive monitoring and control, ensuring efficient and coordinated operation of critical equipment and facilities. It facilitates real-time monitoring of HVAC (Heating, Ventilation, and Air Conditioning) systems, electrical power distribution, plumbing and water management systems, fire detection and suppression systems, and security systems. With IBMS in place, hospitals can enhance safety, optimize energy usage, streamline maintenance, and improve the overall operational efficiency of their facilities. The centralized monitoring and control provided by IBMS contribute to better facility management, enabling healthcare professionals to focus on delivering quality patient care.

STAGE 1-INFORMATION MANAGEMENT

- Centralized monitoring system
- Integral management server

STAGE 2-BUILDING AUTOMATION

Building management for individual locations encompasses various systems and technologies to ensure efficient operations and security. Some key components include: Access Control using RFID Reader: This system allows for controlled access to the premises through the use of RFID (Radio Frequency Identification) technology. Authorized individuals can gain entry using RFID cards or badges, enhancing security and restricting unauthorized access. Monitoring and tracking of activities using IP CCTV surveillance cameras: IP-based CCTV cameras are deployed to monitor and track activities within the premises. These cameras provide real-time video surveillance, enabling security personnel to monitor areas and respond to any suspicious or unauthorized activities promptly. Public Address Systems: Public Address (PA) systems are used to communicate important announcements or alerts to the occupants of the premises.

STAGE 3-PERIMETER SECURITY

Perimeter surveillance using CCTV/IP cameras

- Visitor Management
- Vehicle Access Control

4.3. CCTV INTEGRATED SERVICE SYSTEM

CCTV is one of the most important way of encryption or proof for the office security and safety, the cctv IBMS works in the flow of capturing.

4.4. FIRE DETECTION AND NOTIFICATION

Preventing fire-related hazards is a critical aspect of fire safety. Fire safety encompasses a range of techniques and measures aimed at reducing the destruction caused by fires. Certainly! Fire safety measures can be broadly categorized into two types:

1. Preventive Measures: These measures are intended to prevent the ignition of an uncontrolled fire. They include:

- Implementing proper housekeeping practices to minimize the accumulation of flammable materials.
- Ensuring the proper storage and handling of flammable substances.
- Regular inspection and maintenance of electrical systems to prevent electrical faults.

2. Protective Measures: These measures are used to limit the development and effects of a fire. They include:

- Installing fire detection and alarm systems to provide early warning of a fire outbreak.
- Implementing automatic fire suppression systems, such as sprinkler systems, to control and extinguish fires.
- Designing and maintaining proper fire escape routes and emergency exits.

By implementing comprehensive fire safety measures, the risk of fire-related hazards can be minimized, and the potential damage and harm caused by fires can be significantly reduced.

4.5. SECURITY AND SURVEILLANCE

The primary is to safeguard their service from unwanted personnel while also allowing a free flow of people who have a genuine purpose in engaging with the organization. Modern high-definition IP video surveillance systems generate massive amount of critical, access-sensitive data, thus providing protection. Video Analytic uses algorithms to examine, analyze and operate large volumes of video.

4.6. HVAC.

Indeed, HVAC (Heating, Ventilation, and Air Conditioning) systems play a crucial role in various settings, including high-rise buildings, commercial complexes, industrial units, hospitals, parking units, hotels, and more. These systems are responsible for maintaining optimal indoor air quality and thermal comfort, ensuring a conducive environment for occupants.

5. CASE STUDY

GENZYME CENTRE CAMBRIDGE

151 NORTH FRANKLIN BUILDING

FAGUN TOWERS

5.1. GENZYME CENTRE CAMBRIDGE

Architect: Behnisch, Behnisch & Partner

Developer: Lyme Properties, LCC

Contractor: Turner Construction Company

Building Type: Commercial/office

Size: 3,50,000 square feet

Total Cost: $140 million(110crore)

Location: Cambridge, USA

Schedule: June 2001 -November 2003.

FLOORS:12 FLOOR

It is designed to be one of the most environmentally responsible office buildings ever built in the United States. The construction of the building began in June 2001 and was successfully completed in November 2003. The design of the building prioritized creating an internal environment that emphasizes natural light, views of the outdoors, and an "open feel". Let's delve into the key features of this design:

STRUCTURE

The structural system of the building, such as in Genzyme Center, employed filigree wide slab construction. In this method, wide precast concrete slabs with open voids or "filigree" patterns are used. Additionally, exposed concrete surfaces were intentionally retained wherever possible to increase the amount of thermal mass or storage within the building.

BUILDING ENVELOPE

The building envelope is composed largely of glass46 percent of the envelope is single-glazed glass and 22 percent is solid cladding which provides ample daylight.

AIRFLOW

Genzyme Center, a prominent building, has implemented an air monitoring system to ensure optimal air quality within the premises. This system continuously monitors and evaluates the air quality parameters to maintain a healthy and comfortable indoor environment. Let's explore the significance and benefits of such a system

OPERABLE WINDOWS

Operable windows in a building, such as those found in Genzyme Center, offer the advantage of natural ventilation, which reduces the dependency on the heating and cooling system. Here are the key benefits of operable windows and natural ventilation:

INDOOR ENVIRONMENTAL QUALITY

Carbon Dioxide monitors installed throughout the building, which allow adjustments in airflow to reduce any CO2 levels in the building. HVAC systems and controls are designed to achieve an air quality standard above government requirements All chemical storage in the building is isolated and vented.

HELIOSTATS

Heliostats, large mirrors typically located on the roof of a building like Genzyme Center, are designed to track and reflect sunlight onto a set of fixed mirrors. These fixed mirrors redirect the reflected light downwards into the atrium. This architectural feature serves several purposes:

PERFORATED BLINDS

Computer-controlled blinds integrated into the building's design automatically track the sun's position throughout the day. They are programmed to open to desired angles that allow natural light to enter the building while effectively deflecting excessive heat. Here are the benefits and features of these computer-controlled blinds.

LIGHT

Photo sensors and occupancy sensors were installed in offices to make sure lights are off when employees leave the room. When lighting sensors detect sufficient natural light in the area, the overhead lights slowly dim to off and energy is saved. Energy efficient halogen metal vapor ceiling lamps are used at night; light from these spotlights is reflected off the prism chandelier.

ELECTRICITY

Electricity is from renewable sources, currently a mix of 10% wind, 12% landfill gas, 40% small hydro, and 38 biomass. Photovoltaic panels on the roof to generate power, helping reduce

BMS

Genzyme Center relies on integrated building automation systems to lower operational and energy costs This system is designed by And over Controls (TAC INTEGRATED SYSTEM) TACTICAL Intelligentsia's Smart Sensors give employees individual room. control for HVAC and lighting

HVAC

equipment, chiller and boiler interfaces, carbon monoxide/carbon dioxide levels and rainwater collection, to window, blind, and door controls. HVAC system if windows are open It also decreases the amount of air circulation when the office is not occupied.

5.2. NORTH FRANKLIN BUILDING IN CHICAGO

151 North Franklin building in Chicago

LOCATED- CHICAGO

ARCHITECT-John Ronan

PROJECT COST-145MILLION

Building Type-OFFICE BUILDING

AREA -8,07,000.SQ FT

FLOORS-36FLOORS

COMPLETED-2018

The digital experience:

Technology is continuously changing the way people work and connect, what's possible in high-performance buildings.151 North Franklin with a mobile smartphone application and a web-based tenant portal software

CHILLED WATER

The cooling system for the building at 151 North Franklin will be supplied by offsite district chilled-water production plants. This is achieved through pipe connections that run from the street distribution to the energy-transfer room, which is located at the lower level of the building. The district chilled-water production plants are responsible for generating chilled water, which is then circulated through the connected pipes to provide cooling for the building's air conditioning system.

HEATING SYSTEMS

To provide heating in specific areas of the building at 151 North Franklin, electric-resistance heating coils will be installed in dedicated outside air handling units, as well as in each amenity and lobby air handling unit. These heating coils serve as a heat source and are integrated into the air handling units to supply warm air when heating is required.

AIR CONDITIONING

By having four dedicated outside-air units in the Level 20 mechanical room, the building can efficiently distribute the required amount of fresh air to all the typical office floors. These units ensure that occupants have a constant supply of fresh air, creating a comfortable and healthy indoor environment.

DUCT DISTRIBUTION SYSTEMS

To ensure efficient and precise temperature control, the perimeter offices and interior offices of the building at 151 North Franklin will be supplied with separate variable air volume (VAV) series flow-fan-powered boxes. These boxes are equipped with system pressure-independent direct digital control (DDC) technology, which is managed by the building automation system (BAS).

LIGHTING

To enhance day lighting and provide control over shading, the building owner at 151 North Franklin will implement a day lighting and shade control system. As part of this system, the owner will provide conduit pathway infrastructure that connects the core of the building to the curtain wall. This infrastructure is intended to support the installation of motorized shades by future tenants during their fit-out process.

5.3, FAGUN TOWERS

FAGUN TOWERS

LOCATION : ETHIRAJ SALAI,EGMORE, Chennai.

TOTAL AREA :117,057SQ.FT

BUILDING TYPES-OFFICE

COMPLETED :2014

BUILDERS :Prakash Asrani

BUILT UP AREA :20,000SQ.FT

NO OF FLOORS: G+11 + 1 BASEMENT

AHU

TYPE OF AIR CONDITIONING :

There is totally 3 types of air units work station-centralized ac meeting-cassette cabins-split AHU is provided in larger spaces with 10 TR capacity with 10,000 CFM/min.

ELEVATORS

. Speed of elevators 1.75 m/sec.

TEMPERATURE STUDY:

AMBIENT TEMPERATURE 34 - 40 degree

HUMAN COMFORT TEMPERATURE : 27 degree

TEMPERATURE MAINTAINED INSIDE: 22 degree

WATER SUPPLY AND DISTRIBUTION

3,14,000 litres of water. Fire fighting requirements considered for UGT and OHT is as per the Fire NOC issued by the fire department

DIESEL GENERATORS

They have one generator of 750KVA and one generator of 500KVA and provision to add one more 750KVA

6. PROPOSAL COMPARISON

EXISTING

ibms facilities	Quantity	Brand	investment cost in Rs.
hvac system	40 hvac system	Daikin (8.5ton)1 floor 4 system total 340Ton	1unit cost 1,45,000 40units cost 58,00,000
working space Light manager room board room	850 lights 400 light 180 light	Philips led hanging lights philips 8 Watt philips full glow 15watt	21,25,000Rs(per light 2,500) 3,80,000Rs(per light 950) 2,70,000Rs(per light 1500)
Fire safety system			2,92,525Rs
Diesel Generator(DG)set	(750&500 kVA)	cummins diesel generator	22,50,000Rs(500 kva) 40,00,000(750kva) TOTAL(62,50,000 Lakhs)
IP camera and security cameras	500camera	Cp plus 2.5mphd	(1050per) 5,25,000Rs
cctv system	60 server system each floor 6	cp plus 2tb for 1 server floor	2,53,37,160 Rs
ibms software and Internet protocols bio metrics	(IBM)system 10	IBM(D5V4LL)(SEP)	2,80,05,000 (1cost 28,00,500Rs)
lift	2 Lift passenger lift 1 service lift	Schindler groups	(1 service lift)16,00,000 (2lifts)24,00,000 RS 7,30,47,185 Rs
Bio metric	1 bio metric	cp plus(cp-vta-12324-u Schindler groups	2500 rs
Total cost			7,30,47,185 RS

Table 1-EXISTING

PROPOSAL

ibms facilities	Quantity	Brand	investment cost in Rs.
hvac system	40 hvac system	Daikin (8.5ton)1 floor 4 system total 340Ton	1unit cost 1,45,000 40units cost 58,00,000
working space Light manager room board room	850 lights 400 light 180 light	Fos led hanging lights Motion sensors Acco led rectanlge	Rs.33,15,000 (per light.3,900) Rs 22,80,000 (per light 5,700) Rs.13,99,100 (per light 7,495)
Fire safety system			2,92,525Rs
Diesel Generator(DG)set	(750&500 kVA)	cummins diesel generator	22,50,000Rs(500 kva) 40,00,000(750kva) TOTAL(62,50,000Lakhs)
IP camera and security cameras	500camera	Ezviz C8C Full HD 1080P IP65	(4,360per) 21,80,000Rs
cctv system	60 server system each floor 6	Ezviz 5TB for 1 server	5,10,09,600 Rs (8,50,060)1 server
ibms software and Internet protocols bio metrics	(IBM)system 11	IBM(D55V4LL)(SVP)	7,26,00,000rs (1 cost 66,00,000 Rs)
lift	2 Lift passenger lift 1 service lift	Schindler groups	(1 service lift)25,00,000 (2lifts)40,00,000 RS

Bio metric	1 bio metric	REALTIME T502L	21,000RS
ERV	10 ERV SYSTEM	DRI	RS-5,00,00,000 each cost 50,00,000
Total cost			19,99,15,200 Rs

Table2 -PROPOSAL

7. CONCLUSION

To provide effect ion IBMS system the following had been included.IP cameras has been improvised to full HD 1080P category .To provide effect ion for CCTV system the storage was improved to 5 TB.To improve the effect ion of the IBMS and to provide better IBMS system the upgraded of the IBMS shall be improvised .The price value is more higher then the old system .ERV system gives more impact to the area but the cost is higher

8. REFERENCES

[1] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless sensor networks: a survey," *Computer Networks: The International Journal of Computer and Telecommunications Networking*, vol. 38, pp. 393–422, 2002.

[2] J. Stankovic, "When sensor and actuator cover the world," *ETRI Journal*, vol. 30, no. 5, pp. 627–633, 2008.

[3] D. Snoonian, "Control systems: smart buildings," *IEEE Spectrum*, vol. 40, pp. 18–23, 8 2003. [Online]. Available: http://dl.acm.org/ citation.cfm?id=942494.942503

[4] Abdel-Kader, M.G. and Dugdale, D., 2001, 'Evaluating investments in advanced manufacturing technology: a fuzzy set theory approach', British Accounting Review 33, 455–489.

[5] AIIB (The Asian Institute of Intelligent Buildings), 2001, The Intelligent Building Index Manual Version 2.0, October, Hong Kong, City University of Hong Kong.

[6] Baldwin, R., Leach, S.J., Doggart, J.V. and Attenborough, M.P., 1990, 'Building Research Establishment Environmental Assessment Method', (UK BREEAM) Version 1/90 for New Office Designs, Garston, Watford, Building Research Establishment (BRE)

[7] Boman M., Davidsson P., Skarmeas N., Clark K., and Gustavsson R., Energy Saving and Added Customer Value in Intelligent Buildings, PAAM98, Nawana and Ndumu (eds.), pp. 505-517, 1998.

[8] . Davidsson P. and Boman M., Saving Energy and Providing Value Added Services in Intelligent Buildings: A multiagent system approach, HK/R-RES-00/8-SE, University of Karlskrona/Ronneby, 2000. ISSN 1103-1581

[9] Swarnalatha P, "Building Management System Using Windows Communication Foundation And XAML" International Journal of Engineering and Technology Vol.3 (2), 2011, 95-99