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INTELLIGENT BUILDING

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ABSTRACT

The concept of an intelligent building is, and will probably remain, ill-defined. In its most general sense it should mean a building that in some way can sense its environment, reach decisions about the state of that environment and communicate trod those decisions. In practice this should mean that a building can adjust some aspect of the interior or exterior environment in response to a change in some other aspect of that environment. Intelligent building and building automation systems play an essential role in most sophisticated modern buildings. Monitoring and automatic control of building services systems are important to ensure that the design objectives are met in operation. This Research has been an attempt to identify at a very preliminary level advancements in building technology and its implications on buildings so that we can understand how the spaces we live in, work, and even residence or public spaces are being affected by building intelligence and automation. To study System procedure for installing and operation technique of building automation sub systems in the design of the houses, residences,/multi- storied building to make building secure and safe .

KEYWORDS: Building Automation Sub Systems, Definition, Safety, Security, HVAC System, Architectural Method and Organizational Methods

Building Automation is a programmed, computerized, "intelligent" network of electronic devices that monitor and control the mechanical and lighting systems in a building. The intent is to create an intelligent building and reduce energy and maintenance costs. The scope of the study will include the installing and operation technique of building automation sub systems in building as per building code requirements and one case study of residential building with systems installation.

Building Automation System (BAS) is a data acquisition and control system that incorporates various functionalities provided by the control system of a building. Modern BAS is a computerized, intelligent network of electronic devices, designed to monitor and control the Lighting, Internal Climate and other systems in a building for creating optimized energy usage, safety, security, information, communication and entertainment facilities.

BAS maintains the internal climate of building within a specified range by regulating temperature and humidity, regulates lighting based on parameters like occupancy, ambient light and timing schedule, monitors system performance & device failures and generates audio-visual-email and/or text notifications to building O&M staff. The BAS reduces building energy consumption and, thereby, reduces operational and maintenance costs as compared to an uncontrolled building.

A building controlled by a BAS is often referred to as an Intelligent Building. Typically, the functionalities like entertainment, communication and information exchange need high data rates, while the features like automation, safety and security need low data rates but low latency, high network reliability and data security. Moreover, the BAS designs for residential buildings must be cost-effective and affordable to common people and easy to operate without specialized training.

MEN AND INTELLIGENT BUILDING

The starting point of establishing a model of an intelligent building is people, because they determine the mind force of the building against which machines have to act. The effect of an environment at any moment is dependent on one's past experiences. People are not passive recipients of their environment but adapt physiologically and behaviorally. The body has five basic senses -sight, hearing, touch, smell and taste. They are part of the physiological-psychological system which regulates the human response to environmental stimuli. People react individually and any response may be a transient one or one that becomes an experience stored in the long term memory. The building and its environment, the social ambience, the work and its management process all trigger the response system. Senses are to be enjoyed but they are also employed to achieve fulfillment in work hence an intelligent building will be sensitive to this demand.

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The building, its services systems and management of the work process all contribute to the wellbeing of people within an organization. Productivity relies on there being a general sense of high morale and satisfaction with the workplace. Health, wellbeing and comfort are all important. Intelligent buildings have a vital role to play in helping to achieve this by enhancing human resources, by providing environmental systems which support the productive, creative, intellectual and spiritual capacities of people.

NEED OF INTELLIGENT BUILDING

With the increase in world population and the realization of how we pollute the environment with waste products, as well as increasing wealth encouraging the individual to consume more non-renewable resources, concern is now felt for our failure to appreciate the finite and finely balanced nature of the biosphere. Developers, designers and contractors are responsible for the resource demands of the environment they create, whereas owners and occupants are responsible for the waste products they produce. Everyone has to contribute towards evolving a sustainable workplace. Intelligent buildings must stem from a belief in sustainability and the need for social responsibility.

Purpose of Intelligent Building

One of the first attributes in an intelligent design is to carefully evaluate the current and future use of the project. This starts by clearly identifying the purpose and needs of the targeted building occupants. This process will vary depending on whether it will be an owner occupied or a commercial development.

For an owner-occupied building, surveys and focus groups can be held with the building occupants, analyzing and prioritizing their needs to select proper project features.

For a commercial development, the project target market needs to be identified and attributes designed to suit. For example, an office building might target technology companies that would benefit from an urban environment, high-speed network access, and 24/7 availability.

Concept & budget of Intelligent Buildings

When setting initial project budgets, intelligent attributes must be Included. Creating an intelligent building does require an Investment in advanced technology, processes, and solutions. An upfront investment is required to realize a significant return later on. It is unrealistic to expect to make a project intelligent unless there is early buy in on investment. Again, these decisions need to happen prior to the start of design work. One of the challenges is to educate owners on the benefits of an intelligent building design. Waiting until the MEP is brought on to the design team may be too late. This makes the education of both owners and architects about the benefits of intelligent solutions critical for success.

Environmental Design

An intelligent building starts with an environmentally friendly design. Creating a project that is environmentally friendly and energy efficient ties in closely with many of the intelligent attributes. Intelligent buildings are designed for long-term sustainability and minimal environmental impact through the selection of recycled and recyclable materials, construction, maintenance and operations procedures. Providing the ability to integrate building controls, optimize operations, and enterprise level management results in a significant enhancement in energy efficiency, lowering both cost and energy usage compared to non-intelligent projects.

Intelligent buildings are intended to be the preferred environment for occupants. This requires focused attention to environmental factors that affect occupants' perception, comfort, and productivity. An intelligent design finds the balance, providing a superior indoor environment and minimizing energy usage and operating labor. This is where the technology becomes valuable. Using integration and automation we are able to implement solutions that both provide a superior environment and minimize energy.

Source: http://www.fugoolive.com/wp-content

RATIONALE FOR THE SELECTION OF "SAFETY & SECURITY IN INTELLIGENT BUILDING"

As till I studied in the books, Internet, realized that the buildings should be more safe & secure against firefighting safety & security. It should have good heat ventilation & air conditioning system. As in short the services play a very important & major role in every building. As here as I studied I realized that services for intelligent building is a very vast topic so here I will cover the two major aspects of intelligent building safety & security. I think after reading all the details about these topics I can easily understand what are the equipment's used & how do they work in an intelligent building.

Aim

To understand the complexities & technology involved in the safety & security system in intelligent buildings. How do they respond quickly in case of burglary & also what are the new technologies which make intelligent buildings a safer & secure one.

To know about that what are the life safety systems applied to intelligent buildings for access controls, surveillance & intrusion.

Objective

To analyses importance & implementation of safety system in intelligent buildings.

To analyze the present trends & look forward to the future possibilities in the safety system in an intelligent buildings.

To analyse how do we create our building so secure & safe using these technologies.

ASPECTS OF INTELLIGENT BUILDINGS

The Intelligent Building Design has eight different aspects. Every aspect is important for the making a building efficient. The following are the aspects:

1. Security
2. Safety
3. Comfort
4. Energy efficient Building services with proper selection of equipment/ Energy management and conservation
5. Building Automation System
6. Information management
7. System integration
8. Communication wiring system and network design
9. Facility management
10. Technology Maintenance
11. Intelligent Building technology and design

DEFINITIONS

Today's state-of-the-art buildings demand improvements in efficiency from staffing to energy, while providing exceptional value and the maximum utilization of all installed assets. Innovation, integration and integrity are the key to new age buildings. Intelligent buildings can be defined as the

"USE OF TECHNOLOGY AND PROCESS TO CREATE A BUILDING THAT IS SAFER AND MORE PRODUCTIVE FOR ITS OCCUPANTS AND MORE OPERATIONALLY EFFICIENT FOR ITS OWNERS."

The results from implementing these technologies and processes are the buildings that cost less to operate and are worth more to their occupants. For projects that are owner occupied, such as corporate, government, and institutions, the benefits of an intelligent building provide an immediate ROI (Return on investment) in terms of higher employee productivity and reduced operating expenses. For commercial developments, these projects are expected to result in high market rents, improved retention, higher occupancy rates, and lower operating expenses. An intelligent building is one in which the building fabric, space, services and information systems can respond in an efficient manner. It is a system concept that recognizes the true cost of the building is not its cost of construction; it must include the operating and maintenance costs over the structure's life span. Intelligent buildings yield cost reductions over all these areas by optimizing energy use through automated control, communication and management systems. They also guard against repair costs, employee time, productivity loss, revenue loss and the loss of customers to competitors However, the approaches to defining an IB can be grouped into three categories are:

1. Performance- based definitions
2. Services- based definitions
3. System- based definitions

Figure 1: System Integration

Performance- based definitions define IBs by stating what performances a building should have. A typical performance- based intelligent building definition may be that of the European Intelligent Building Group (EIBG). EIBG (located in the United Kingdom) defines an intelligent building as a building created to give its users the most efficient environment; at the same time, the building utilizes and manages resources efficiently and minimizes the life costs of hardware and facilities.

SERVICES- BASED DEFINITIONS

Services- based definitions describe Intelligent Buildings from the viewpoint of services and/or quality of services provided by buildings. The Japanese Intelligent Building Institute (JIBI) provides an example of a services-based definition: an Intelligent Building is a building with the service functions of communication, office automation and building automation, and is convenient for intelligent activities. Services to users are emphasized. The key issues of IBs in Japan focus on the following four services aspects:

1. Serving as a locus for receiving and transmitting information and supporting efficient management
2. Ensuring satisfaction and convenience of persons working inside
3. Rationalization of building management to provide more attractive administrative services at lower cost
4. Fast, flexible and economical responses to the changing sociological environment, diverse and complex working demands and active business strategies

SYSTEM- BASED DEFINITIONS

System- based IB definitions describe IBs by directly addressing the technologies and technology systems that Intelligent Buildings should include. A typical system-based Intelligent Building definition is the one suggested in the Chinese IB Design Standard (GB/T50314–2000), which states that IBs provide building automation, office automation and communication network systems, and an optimal composition integrates the structure, system, service and management, providing the building with high efficiency, comfort, convenience and safety to users. A more straightforward system- based Intelligent Building definition has been used by some professionals and developers in practice. It labels the Intelligent Building s as '3A', which represents Building automation (BA), communication automation (CA) and office automation (OA).

Intelligent buildings mean many things depending on perspective and role. The following list is one summary of these attributes.

PROCESS

Design

• Flexibility – designed to change, Energy efficient design (LEEDs),Building in compliance to Energy conservation building codes (ECBC) , Complete building modeling, Focus on building circulation and common spaces for networking, Integration with transportation and surrounding community.

Construction

• Sustainable construction practices, Electronic project documentation, Modeling extended into construction.

Operations

• Integration of all systems, Remote operations and optimization, Tenant portals, After-hours operation, Maintenance management and dispatch, Energy information and management systems, Real-time energy response, Continuous comfort monitoring and feedback.

Technology

General

• Tenant amenities, Optimized vertical transport,

Personal comfort control

Temperature, Humidity, Lighting, Acoustic.

Networking/Telecom

Common network infrastructure, Structured – maintainable cabling, Wi-Fi, VOIP and Digital signage. **Security/Life Safety:** Digital video monitoring, Access control and monitoring, Automatic fire suppression, Fire detection and alarm, Egress support (lighting, signage, smoke control, etc.), Contaminant monitoring and containment, Proximate security/guard services. **Mechanical**

Energy efficient equipment, Thermal storage, Combined heat and power, Controls optimization, Extensive sensing, Energy efficiency, Comfort monitoring, Internet enabled controls, Enterprise integration; Water and gas metering and sub-metering.

MECHANICAL SYSTEMS

The HVAC system and controls, including the distribution system of air into the workspaces, are the mechanical parts of buildings that affect thermal comfort. These systems must work together to provide building comfort. While not usually a part of the aesthetics of a building, they are critical to its operations and occupant satisfaction.

The number one office complaint is that the workplace is too hot. Number two is that it's too cold.

Many people cope by adding fans, space heaters, covering up vents, complaining, conducting 'thermostat wars' with their co-workers, or simply leaving the office. Occupants can be driven to distraction trying to adjust the comfort in their space. Improper temperature, humidity, ventilation, and indoor air quality can also have significant impacts on productivity and health. When we are thermally comfortable we work better, shop longer, relax, breathe easier, focus our attention better.

In order to provide a comfortable and healthy indoor environment the building mechanical system must:

- Provide an acceptable level of temperature and humidity and safe guard against odors and indoor air pollutants.
- Create a sense of habitability through air movement, ventilation and slight temperature variation.
- Allow the occupant to control and modify conditions to suit individual preferences.

TECHNOLOGY SYSTEMS AND EVOLUTION OF INTELLIGENT BUILDINGS

The evolution of intelligent building systems is illustrated in Figure below, which is modified and updated from the ‘Intelligent Building Pyramids’ developed by the European Intelligent Building Group. The pyramid illustrates the contents and evolution of intelligent building technology over the last few decades. The pyramid is open at the top, emphasizing that the intelligent building systems are not enclosed within buildings any more but instead are merged with intelligent building systems in other buildings as well as other information systems via the global Internet infrastructure. Intelligent buildings began from the automatic intelligent control of typical building services processes and communication devices. Along with the rapid evolution of electronic technology, computer technology and information technology, intelligent building systems are becoming more and more advanced, and the level of integration is being developed progressively from the subsystem level to total building integration and convergence of information systems.

Intelligent building systems after 1980 can be divided into five stages as follows:

1. Integrated single function/dedicated systems (1980–5)
2. Integrated multifunction systems (1985–90)
3. Building level integrated systems (1990–5)
4. Computer integrated building (1995–2002)
5. Enterprise network integrated systems (2002–)

At the stage of integrated single function/dedicated systems (1980–5), all the Building Automation subsystems (including security control; access control; heating, ventilation and air- conditioning [HVAC] control; lighting control; lift control; other electrical systems; fire automation; etc.) and CA subsystems (including electronic data processing [EDP]) and data communication; telefax and text were integrated at the level of a single or individual function subsystem.

communication; voice communication; TV and image communication; etc.)

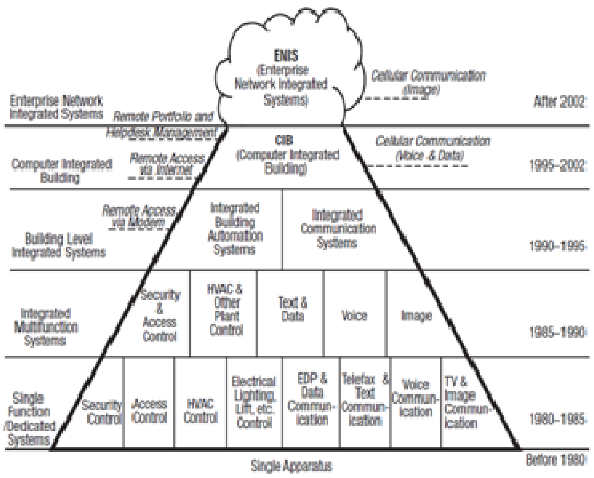

Figure 2: Automation and Technology System in Intelligent Building

Modern IB systems have been becoming very large in terms of system scale and complex in terms of hardware and software system configurations, while their functions and capacities have been increasing progressively. System reliability is an important issue. Utilizing a decentralized network or a decentralized local area network (LAN) is the key to solving the system reliability issue and simplifying IB networks. Distributed intelligence is a major philosophical solution to ensure the reliability of such complex intelligent building and Building Automation systems. 'Integrated but independent' is one of the most essential concerns in the development and configuration of complex intelligent building and Building Automation systems.

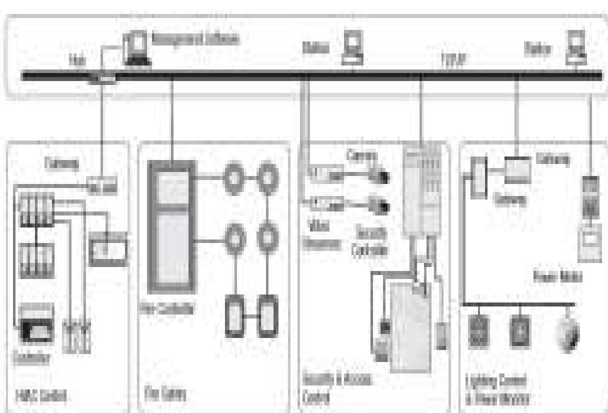

Figure 3: Building Automation systems for Intelligent Building

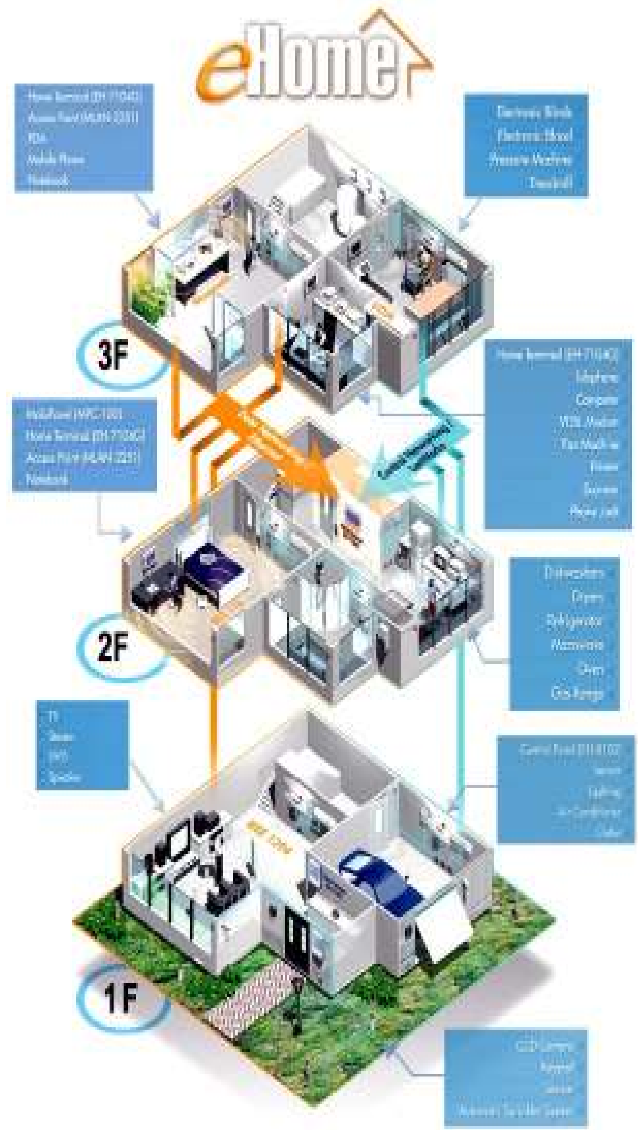

Figure 4 : Building Automation systems in a Home Building

Parts of the System:

a. Controller

b. Occupancy Sensors

c. Lighting

d. Air handlers

i. Constant Volume Air-Handling Units

ii. Variable Volume Air-handling Units

iii. VAV Hybrid Systems

e. Central Plant

i. Chilled water systems

ii. Condenser water system

iii. Hot Water system

f. Alarms and Security

Controller

The controller is normally one or more programmable logic controllers, often with custom programming. PLCs come in a wide range of sizes and capabilities to control devices that are common in buildings. Usually the primary and secondary buses are chosen based on what the PLCs provide. Most PLCs provide general purpose feedback loops, as well as digital circuits.

Occupancy Sensors

Occupancy is usually based on time of day schedules. Override is possible through different means. Some buildings can sense occupancy in their internal spaces by an override switch or sensor.

Lighting

Lighting can be turned on and off with a building automation system based on time of day, or the occupancy sensors and timers. One typical example is to turn the lights in a space on for a half hour since the last motion was sensed. A photocell placed outside a building can sense darkness, and the time of day, and modulate lights in outer offices and the parking lot.

HVAC

An air-conditioning system provides heating, cooling, and ventilation and humidity control for a building. HVAC stands for heating, ventilation and air conditioning and refers to the equipment, distribution network and terminals used either collectively or individually to provide fresh filtered air, heating, cooling and humidity control in a building It is often installed in modern offices and public buildings, but is difficult to retrofit (install in a building that was not designed to receive it) because of the bulky air ducts required. The system must be carefully maintained to prevent the growth of pathogenic bacteria in the ducts.

A dehumidifier is an air-conditioning-like device that controls the humidity of a room or building. They are deployed in basements, which because of their lower temperature have a higher relative humidity. (Conversely humidifiers increase the humidity of buildings.) Air-conditioned buildings often have sealed windows, because open windows would disrupt the attempts of the control system to maintain constant air quality.

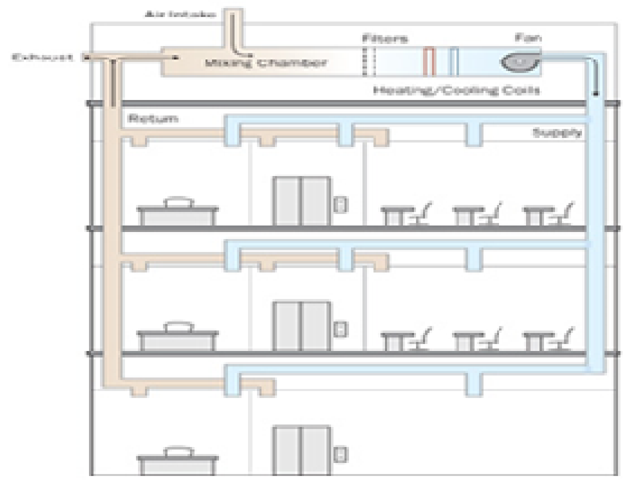

Figure 5 :Diagrammatic representation of a typical HVAC system

The Basic HVAC Design

HVAC systems can vary in design and complexity. Air is taken through an outdoor air intake that is usually a louvered opening on the top or side of the building. Atmospheric pressure pushes the air through a damper, which regulates the amount of outdoor air (OA) taken in by the system. At this point, already conditioned return air (RA) from the system can be mixed with the outdoor air to form “mixed air.” The mixed air goes through a pre-filter where larger dust particles, insects, leaves, etc. are caught. A more efficient filter is usually present to address Small particles. After the filters, the air enters a centrifugal fan. Once exiting the fan outlet, the air is under positive pressure and being pushed towards coils where the air is either heated or cooled, depending on the temperature of the air and the season. Under the coils lies a drain pan to collect any water condensing on the coils. If a humidifier or dehumidifier is needed it is usually incorporated into the cycle at this point. The air travels through ductwork where it reaches a distribution box and may travel through smaller ducts to supply the terminals, registers or diffusers into the workspace. Once the air reaches its destination, it is returned through an air register (usually through a louvered door that opens into a space above the ceiling tiles) in the form of return air that will become mixed air or exit the building.

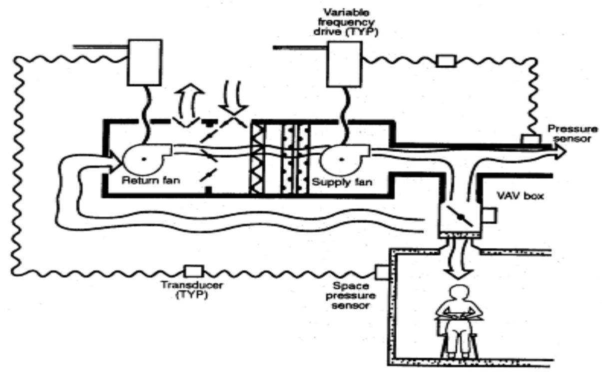

Figure 6: Basic HVAC design

Air Handlers

Most air handlers mix return and outside air so less temperature change is needed. This can save money by using less chilled or heated water (not all AHUs use chilled/hot water circuits). Some external air is needed to keep the building's air healthy. Analog or digital temperature sensors may be placed in the space or room, the return and supply air ducts, and sometimes the external air. Actuators are placed on the hot and chilled water valves, the outside air and return air dampers. The supply fan (and return if applicable) is started and stopped based on either time of day, temperatures, building pressures or a combination.

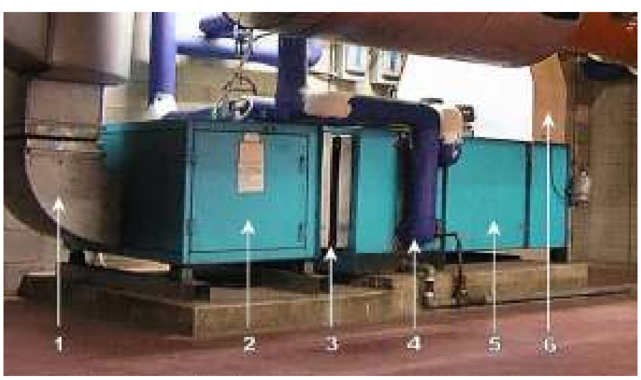

Figure 7: An Air handling unit is used for the heating and cooling of air in a central location

Typical AHU components:
1 - Supply duct
2 - Fan compartment
3 - Flexible connection
4 - Heating and/or cooling coil
5 - Filter compartment
6 - Return and fresh air duct

Alarms and Security

Many building automation systems have alarm capabilities. If an alarm is detected, it can be programmed to notify someone. Notification can be through a computer, pager or audible alarm. Common temperature alarms are Space, Supply Air, Chilled Water Supply and Hot Water Supply. Differential pressure switches can be placed on the filter to determine if it is dirty. Status alarms are common. If a mechanical device like a pump is requested to start, and the status input indicates it is off. This can indicate a mechanical failure. Some valve actuators have end switches to indicate if the valve has opened or not. Carbon monoxide and carbon dioxide sensors can be used to alarm if levels are too high. Refrigerant sensors can be used to indicate a possible refrigerant leak. Security systems can be interlocked to a building automation system. If occupancy sensors are present, they can also be used as burglar alarms.

Fire and smoke alarm systems can be hard-wired to override building automation. For example: if the smoke alarm is activated, all the outside air dampers close to prevent air coming into the building. Life safety applications are normally hard-wired to a mechanical device to override building automation control.

Topology

Most building automation networks consist of a primary and secondary bus which contain programmable logic controllers, input/outputs and a user interface (also known as a human interface device).The primary and secondary bus can be optical fiber, Ethernet, ARCNET, RS-232, RS-485 or a wireless network. Most controllers are proprietary. Each company has its own controllers for specific applications. Some are designed with limited controls: for example, a simple Packaged Roof Top Unit. Others are designed to be flexible. Most have proprietary software that will work with BACnet, Lon Talk and ASHRAE standards.

Inputs and outputs are either analog or digital (some companies say binary). Analog inputs are used to read a variable measurement. Examples are temperature, humidity and pressure sensor which could be thermistor, 4-20 MA, 0-10 Volt or Platinum RTD (resistance temperature detector), or wireless sensors. A digital input indicates if a device is turned on or not. Some examples of a digital input would be a 24VDC relay or air flow switch.

Analog outputs control the speed or position of a device, such as a variable frequency drive, a I-P (current to pneumatics) transducer, or an actuator. An example is a hot water valve opening up 25% to maintain a set point. Digital outputs are used to open and close relays and switches. An example would be to turn on the parking lot lights when a photocell indicates it is dark outside.

Protocols and Industry Standards

ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) is an international organization for people involved in heating, ventilation, air conditioning, or refrigeration (HVAC&R).

BACnet is a network communications protocol for building automation and control systems. *LonTalk is a protocol created by Echelon Corporation for networking devices.

KNX standard, a system for Home and Building Controls (promoted by "Konnex Association") is truly open (no royalties for Konnex members) and platform independent; guarantees multi-vendor and cross-discipline interoperability, ensured via certification and symbolized by the KNX trademark; supports many configuration methods (PC tools, device configurators and plug +play)and media (TP, PL, RF, Ethernet)

Energy Star is program created by the United States government to promote energy efficient consumer products

Heating

Heating systems may be classified as central or local.

Central Heating

Central heating is often used in cold climates to heat private houses and public buildings. Such a system contains a central boiler, furnace or heat pump to heat water, pipe work to distribute the heated water, and heat exchangers or radiators to conduct this heat to the air. The term radiator in this context is misleading, since most heat transfer from the heat exchanger is by convection, not radiation. The heat exchangers may be mounted on walls, or buried in the floor to give under-floor heating. When so mounted it is often referred to as "radiant heating".

All but the simplest systems have a pump to circulate the water and ensure an equal supply of heat to all the radiators. The heated water is often fed through another heat exchanger inside a storage cylinder to provide hot running water. Forced air systems send air through ductwork. The ductwork can be reused for air conditioning and the air can be filtered or put through air cleaners. The heating elements (radiators or vents) should be located in the coldest part of the room, typically next to the windows. Popular retail devices that direct vents away from windows to prevent "wasted" heat defeat this design parameter. Drafts contribute more to the subjective feeling of coldness than actual room temperature. Thus rather than improving the heating of a room/building, it is often more important to control the air leaks.

The invention of central heating is often credited to the ancient Romans, who installed a system of air ducts in walls and floors of public baths and private villas. The ducts were fed with hot air from a central fire. Perhaps there are examples from other early civilizations waiting to be unearthed.

Local Heating

Local heating devices are self-contained heaters that are usually controlled manually. Such devices include:

Wood-burning stove resistive electric heater (colloquially described as an "electric fire") Heat-lamp, Fan-heater (electric heater with forced convection) ,While central systems are more efficient, local systems offer greater flexibility. In sparsely occupied building, the unused rooms can be left unheated in local heating systems.

Thermostats: Thermostats control the operation of HVAC systems, turning on heating or cooling to bring the building to the set temperature (unless there is danger of a rolling blackout). Typically the heating and cooling systems have separate control systems (even though they may share a thermostat) so that the temperature is only controlled "one-way". That is, in winter, the thermostat will not cool a building that is too hot. Thermostats may also be incorporated into facility energy management systems.

Ventilation

Ventilation includes both exchange of air to the outside as well as circulation of air within the building. Methods for ventilating a building may be divided into natural and forced types.

Natural Ventilation

In cold climates natural ventilation is often just a matter of opening a window, but in hot climates it is an important consideration in the design of buildings.

Forced Ventilation

Forced ventilation may be used to control humidity or odors. Kitchens and bathrooms typically have mechanical ventilation to control both. Factors in the design of such systems include the flow rate (which is a function of the fan speed and exhaust vent size) and noise level. If the ducting for the vans traverse unheated space (e.g. an attic), the ducting should be insulated as well to prevent condensation on the ducting. Heat recovery ventilation systems employ heat exchangers to bring the fresh air temperature to room temperature. Ceiling fans and table/floor fans are very effective in circulating the air in the room. Paradoxically, because heat rises ceiling fans may be used to keep a room warmer.

HVAC Control System

Modern computerized HVAC control systems are used for temperature, humidity, and pressure control, and often integrate fire, security, and lighting controls into one system. These systems typically use one or more central controllers to command and monitor the remote terminal unit controllers, and they communicate with one or more personal computers that are used as the operator interface. These control systems are typically used on large commercial and industrial buildings to allow central control of many HVAC units around the building(s). The latest systems use the building Ethernet for communications between central controllers, and allow operator access from a web browser.

Direct Digital Control

Central controllers and most terminal unit controllers are programmable, meaning the direct digital control program code may be customized for the intended use. The program features include time schedules, set points, controllers, logic, timers, trend logs, and alarms. The unit controllers typically have analog and digital inputs, that allow measurement of the variable (temperature, humidity, or pressure)and analog and digital outputs for control of the medium (hot/cold water and/or steam). Digital inputs are typically (dry) contacts from a control device, and analog inputs are typically a voltage or current measurement from a variable (temperature, humidity, velocity, or pressure) sensing device. Digital outputs are typically relay contacts used to start and stop equipment, and analog outputs are typically voltage or current signals to control the movement of the medium (air/water/steam) control devices.

- Buildings should know what is happening inside and immediately outside.
- Building should provide the most effective way of providing a convenient, comfortable and productive environment for its occupants.
- Building should respond as quickly as possible to the occupant's request. These attributes indicates the need for various technology and management systems.

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Lighting Systems

When electric lighting controls are used properly, energy will be saved and the life of lamps and ballasts can be extended. Lighting controls will help reduce energy by:

- Reducing the amount of power used during the peak demand period by automatically dimming lights or turning them off when they are not needed.
- Reducing the number of hours per year that the lights are on Reducing internal heat gains by cutting down lighting use, this allows for reduced HVAC system size and a reduction in the building's cooling needs.
- Allowing occupants to use controls to lower light levels and save energy

Types of Lighting Controls

The most common form of electric lighting control is the on/off "toggle" switch. Other forms of lighting control include occupancy sensors, daylight sensors, clock switches, a variety of manual and automatic dimming devices, and centralized controls.

Standard On/Off Switches and Relays

These can be used to turn groups of lights on and off together.

Occupancy Sensors

Their main functions are:

- To automatically turn lights on when a room becomes occupied
- To keep the lights on without interruption while the controlled space is occupied
- To turn the lights off within a preset time period after the space has been vacated

Passive infrared sensors (PIR) are triggered by the movement of a heat-emitting body through their field of view. Wall-box type PIR occupancy sensors are best suited for small, enclosed spaces such as private offices, where the sensor replaces the light switch on the wall and no extra wiring is required. PIR sensors cannot "see" through opaque walls, partitions, or windows so occupants must be in direct line-of-sight of the sensor. Ultrasonic sensors emit an inaudible sound pattern that is disrupted by any moving object altering the signal returning to the sensor (Doppler shift). They are best suited for spaces where line-of-sight view to the occupant is not always available. This type of sensor detects very minor motion better than most infrared sensors and is often used in restrooms since the hard surfaces will reflect the sound pattern. Dual-technology occupancy sensors use both passive infrared and ultrasonic technologies for less risk of false triggering (lights coming on when the space is unoccupied). Combining the technologies requires a more reliable, yet slightly larger and more expensive device.

Occupancy sensor placement is very important to the successful implementation of the control design intent. Occupancy sensors must be located to ensure that they will not detect movement outside of the desired coverage area, through an open doorway, for example. Ultrasonic devices are sensitive to air movement and should not be placed near an HVAC diffuser, where air movement may cause false tripping. Occupancy controls can be used in conjunction with dimming or daylight controls to keep the lights from turning completely off when a space is unoccupied, or to keep the lights off when daylight is plentiful and the room is occupied. This control scheme may be appropriate when occupancy sensors control separate groups of luminaries, or "zones", in a large space, such as in a laboratory or an open office area. In these situations, the lights can be dimmed to a predetermined level in one specific area when the space is unoccupied.

Additional Occupancy Sensor Information

Manual dimming gives occupants of a space an added degree of control and satisfaction, as well as an opportunity to save energy. It provides users with the flexibility to instantly change the characteristics of a space to make it a more comfortable and productive environment. There are several families of manual preset dimming control.

- Manual hard-wired control
- Preset scene control
- Remote infrared control
- Remote radio frequency control

Manual hard-wired control consists of a dimmer, connected to a single luminary or zone which is operated by the user at the device. Preset scene dimming controls change the light level settings for multiple zones simultaneously at the press of a button.

Remote control dimming is another form of manual dimming that is well suited for retrofit projects to minimize rewiring. Infrared and radio frequency technologies are most successful in these applications. Remote infrared control operates in a similar fashion to other infrared technologies like television, for example. Radio frequency controls are equipped with a sender that "talks" to other dimmer's receivers. This allows multi-zone control from a single-zone device. Personal control systems are now available that allow users to change levels of lighting, sound, heating/cooling, etc., in their own workspaces.

Additional personal control systems information Light-level sensors or photo sensors can be used to Automatically turn lights on or off, or dim them, depending on the available daylight available in the space. Daylight dimming can maintain the desired light level while providing a smooth, barely noticeable transition to or from electric lighting as daylight increases or decreases.

Figure 8: Preset lighting controls

Additional Photo Sensor Information

- Clock switches
- Centralized controls
- Distributed controls
- Wireless Lighting Control System

Figure 9: Wireless Switches

Merit

1. Demonstrates that wireless technology can cost effectively applied to problems of retrofitting integrated

lighting controls into existing buildings. The outcome of the the program will be an advanced lighting control system capable of implementing all lighting control strategies in existing buildings without the need to run additional control wiring.

2. Demonstrates that wireless technology can be cost-effectively embedded into controllable fluorescent lamp ballasts allowing independent control of individual ballasts from an intelligent, wireless environmental sensor.

Photo Sensors

Photo sensors are electronic control units that automatically adjust the output level of electric lights based on the amount of light detected. Photo sensors are a form of automatic control that replaces or accompanies occupant control. The main reason for installing control devices is to conserve energy by switching off or dimming the electric lights when full output is not needed.

Type of Photo Sensor Control

Open loop - the photo sensor does not respond to, or "see" the electric light that it controls.

Closed loop - the photo sensor senses and responds to the electric light that it controls.

Characteristics

As evident from the system diagram, the photo sensor embodies a number of different functional elements of the complete system.

Energy Savings

Nearly all photo sensors are used to decrease the electric power demand for lighting. In addition to lowering the electric power demand, dimming the lights also reduces the thermal load on a building's cooling system when the building is running its chillers, adding to the energy savings. When considering new building designs, the added solar heat gain that occurs when substantial amounts of daylight enters a space must be taken into account for a whole building energy usage analysis.

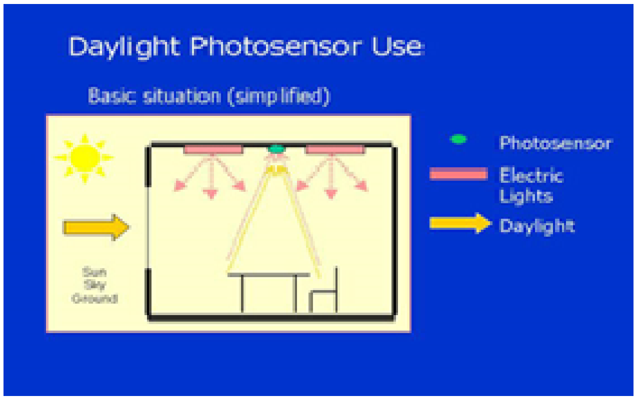

Figure 10: Photo Sensor Control

When considering the energy savings potential from dimming fluorescent lamp luminaries, it is important to realize that fluorescent lamp systems have lower efficacy when dimmed. These losses of efficacy leads to diminished energy savings as lamps are dimmed to lower and lower levels.

Barriers to Using Photo Sensors

a. Added cost of dimming systems in both materials and installation labour.

b. Risk of investing in a newer technology.

c. Belief that occupants dislike automatic lighting control.

d. Perception that automatic dimming controls are unreliable or just don't work properly.

Inference

The intelligent building is today is considered as one which incorporates the best available concepts, materials, systems & technologies, integrating these to achieve or exceed the performance requirements of the buildings stakeholders. These stakeholders include the building's owner, managers & users, as well as local & global community.

More & more buildings have central communication systems & the computer integrated buildings is slowly becoming a reality. In recent years the number of office workers has increased significantly in parallel with global urbanization. The extensive use of technology can be seen as an advantageous aspect but at the same time it also creates a threat to the safety& security of the users or occupants of the buildings.

The general intelligent buildings concepts aims to combine the cabling backbone networks for the systems in order to render the building ready to accommodate any initial future system implementation as building user requirements evolve. This will substantially minimize cost, increase flexibility & enhance the building value over its expected life.

This research will particularly emphasize on the aspect of **building Automation Sub** systems: '**Safety and Security**' in an intelligent buildings in general.

Building Intelligence: The Intelligent Building has the following characteristics as per given below:

A. Dimensions of Building Intelligence:

1. Office Automation
2. Advanced Telecommunication
3. Building Automation: For building management, security, power supply, fire protection, energy conservation.
4. Building to know what happening inside and immediately outside environmental changes.
5. Building to devise a system for a convenient, comfortable, and productive environment for the user.
6. Integrated approach in planning by the Architect , Building services , and Hardware Engineers specialized in office and building automation.
7. System design and performance –temperature ,humidity, illumination, air quality, distribution and circulation and acoustics.
8. Work stations to fulfill human needs in an office – Anthropometric, and other building functions.
9. Effective management of resources, in a co-ordinated mode, to maximize occupant's performance, investment and operating cost savings and flexibility.

B. Building Services for Intelligent Buildings Planning for Productivity:

1. Reduction in the cost of building services, construction and maintenance.
2. Optimum utilization of space
3. Functional efficiency of buildings. trouble free functioning and ease in maintenance.

C. Productivity depends on:

1. Management
2. Job satisfaction
3. Income
4. Status
5. Time spent in buildings
6. Internal Refreshing environment with comforts
7. Trouble free working of men and machine avoiding health hazards
8. Security to data and resource.

D. Comfort Factors

1. Good controlled lighting
2. Comfortable furniture
3. Good circulation of air at the right temperature
4. Reference materials within easy reach

CONCLUSION

As intelligent building in itself is a very huge field. The principle of an Intelligent Building are based on Automation sub systems which are useful in the Architectural Planning, Construction and installation of safety, security and HVAC system for human life as well as created better comfortable work environment for better productivity and profit purpose both . Intelligent planned and constructed for assured performance of the work place based on the tools of information technology.

REFERENCES

www.businessballs.com

website.lineone.net

www.intelligentbuildings.com

www.elclot.com

www.mordernbuildings.com

www.tata.com

www.bsjononline.co.in

Designing for a digital world: Neil leach Energy conservation building codes 2006.