Chapter 17

Intelligent Buildings

The intelligent building is a concept which has received much attention and promotion recently. Networks of sensors and controls collect data about the building environment. Networks of computers and microprocessors use the information to adjust the building to changing conditions. Smart systems aren't brand new but they are coming to play in more and more building types. The broadest new market is likely to be in multi-tenant office buildings, where on-site telecommunications, data-communications and office-automation services can be offered to tenants on a shared basis. But all types of buildings can be enhanced by an electronic infrastructure from libraries and banks to hotels and corporate headquarters.

One of these intelligent buildings is the $640 million headquarters for the Hong Kong and Shanghai Banking Corp. completed in 1986. Its 5,000 sensor point electronic building management system is one of the most comprehensive of its type.

Similar to the US intelligent building phenomenon, the bank's electronics were central to its design. The system minimized building operating costs, ensures fast responses to crises and also makes mechanical and electrical services adaptable to layout changes.

The 43-story building was designed by architect Foster Associates, London, so that internal layouts can be changed easily to suit changing

computer needs. Different types of outlets for air, telecommunications and power are built into an access floor with tiles that can be lifted and moved for different layouts. Four mechanical service modules serve each floor. These boxes stacked on either side of the building that contain toilets, water storage and a local air conditioning plant. The modules are supplied from the central plant in the basement, which draws in seawater for cooling and toilet flushing through a shaft and tunnel from the nearby harbor.

The building management system played a part in commissioning these decentralized mechanical service modules. The system connects each service module and made commissioning easier.

A network of microprocessors, monitors and controls local equipment. They are linked to central computers on the 27th floor and second basement level. The network monitors 23 systems, including lighting, HVAC, water supply, refuse disposal, fire, security and leak detection, and it is programmed to run them economically and with minimum personnel. The system also interfaces extras such as the seawater system and automatic document delivery.

The system emphasizes energy management and will calculate the efficiency of power use and highlight wasteful areas. There are plans to use the system to control window blinds and to track the sun with mirrors, scooping light into the building's 170 ft. high atrium.

The system also features a maintenance component run on a separate minicomputer. The energy management system will drop off pertinent data such as total running time of equipment, and the maintenance system will be programmed to print out preventive maintenance work orders. Work orders will include parts and tools needed, time estimates and costs. If a work order is not acknowledged as completed in a specified time, it will be repeated. The maintenance system will also maintain an inventory of the thousands of spare parts for the building, which will have custom made components from cladding to doorknobs. It will issue restock reminders when stock is running low.

Sophisticated electronics make buildings intelligent. They may not look much different from the outside. But interior design, wiring systems, floor systems, telecommunications systems, lighting, controls and installation techniques are changing. Even structural systems are affected by heavy line loads from additional equipment. Floors may

need reinforcing to handle the approximately 80 psf live load required by computerization.

A new highly regarded player, the telecommunications consultant is being added to the design team. Confused developers, not sure that they need smart systems but afraid of being left with outmoded space, are looking to designers and telecommunications consultants for advice. One answer is flexibility. To avoid obsolescence and costly retrofits, buildings of all types need to be designed so that electronics can be added later, even if no one wants them now.

The physical changes in the building are subtle but elementary to the success of the intelligent building. Simple things, like increasing the size of the telephone closets, can become expensive to work around if overlooked. More important things, such as accommodation for extra live loads, can be dangerous if overlooked. Consultants recommend that clients build for a 100 psf live load throughout the building, instead of the minimum 50 psf typically required by code. Developers are told to bite the bullet and come up with a small added cost premium. If we design according to code, we are designing an obsolete building.

Flexible wiring schemes are also becoming crucial. The first thing a developer planning an intelligent building should do is make sure the designer plans for "a lot of conduit space and a lot of flexibility." Technology is making the need for the old "three pairs of twisted wires" … the three simple two wire connections that in the past were standard on all Bell office phones … obsolete. Current multifunctioning systems take care of most needs with one pair of twisted wire.

Raised floors, designed to offer flexibility, were once as high as 2 ft. They are now available in heights of 2 to 6 in. This saves added floor-to-floor heights and curtain wall costs. Flat wiring, placed under removable carpet tiles, is known for ease of installation, but isn't as easy to bend and install around corners. Electrified decking and underfloor duct systems, both not new, are being used more and more because they offer more outlets, which are required in offices with automated work stations.

Consulting engineers have to take the computer and communication systems into account when sizing the mechanical systems. Main computers give off so much heat that many designs call for recycling it to other parts of the building in the heating months. Even

CRTs give off about three times as much heat as a person, says one designer. Intelligent buildings typically have greater cooling requirements.

Smarter Still

Buildings may get even smarter in the future through integration of processors, voice recognition and more extensive use of fiber-optic networks.

In 1984 a fiber optic network cost about 50 cents per ft. compared to 10 cents per ft for standard wiring. Connection charges, about $12 per strand, were about $50 per strand three years ago. Some say, however, that devices needed to move data on and off the fiber optic network still add to costs. Fiber optic installation costs are coming down and technical wrinkles are being ironed out however. Another frontier is voice recognition. The same type of processors that allow telephones to convert analog voice patterns to digital signals could be used to allow the building's occupants to tell elevators what floor to go to or to turn up the air volume in a room. Should the occupant say please? "It depends how smart the building is."

There are many technological developments that are changing the ways of the HVAC controls industry.

1. Unitary Controllers: Self-contained electronic (remote terminals such as VAV boxes, reheat coils, and heat pumps). These controllers are an extension of DDC on central HVAC systems.

2. Artificial Intelligence: A building that learns from its utility data, which control strategies are most effective.

3. Faster Graphics: If a problem occurs, such as a high temperature alarm, most EMS operators will go directly to the real-time points display. The primary reason is the amount of time it takes to pull up a graphic display. Mouse-driven graphics will continue to improve.

4. Digital Electronics vs. Pneumatic Systems: In the 1990's, even though pneumatic actuators will still be in use, pneumatic control systems will be replaced with electronic sensors and digital controllers.