The Renewable Solutions Provider
Making a World of Difference

The Impact of Control Strategies on Building Energy Performance Using BS EN 15232

Information Guide 53

MITSUBISHI ELECTRIC
LIVING ENVIRONMENTAL SYSTEMS

Air Conditioning | Heating
Ventilation | Controls

CPD CERTIFIED
Construction CPD Certification Service
Collective Mark

The Impact of Control Strategies on Building Energy Performance Using BS EN 15232

The use of energy in our buildings is under scrutiny as never before and legislation is now being used to promote the use of energy efficient technologies. In Europe, EN 15232* is the Standard that has been compiled in conjunction with the implementation of the directive for energy efficiency in buildings (Energy Performance of Buildings Directive - EPBD) 2002/91/EG.

The standard details the methods used to evaluate the influence of building automation and technical building management on the energy consumption of buildings.

Contents

Energy efficiency - a focus for government and business Page **Four**

Understanding controls - at the heart of energy efficiency Page **Six**

Controls strategies - having a plan for efficiency Page **Ten**

This is an independent guide produced by Mitsubishi Electric to enhance the knowledge of its customers and provide a view of the key issues facing our industry today.

This guide accompanies a series of seminars, all of which are CPD certified.

CPD CERTIFIED
Construction CPD Certification Service
Collective Mark

*Energy Performance of Buildings - Impact of Building Automation, Controls & Building Management

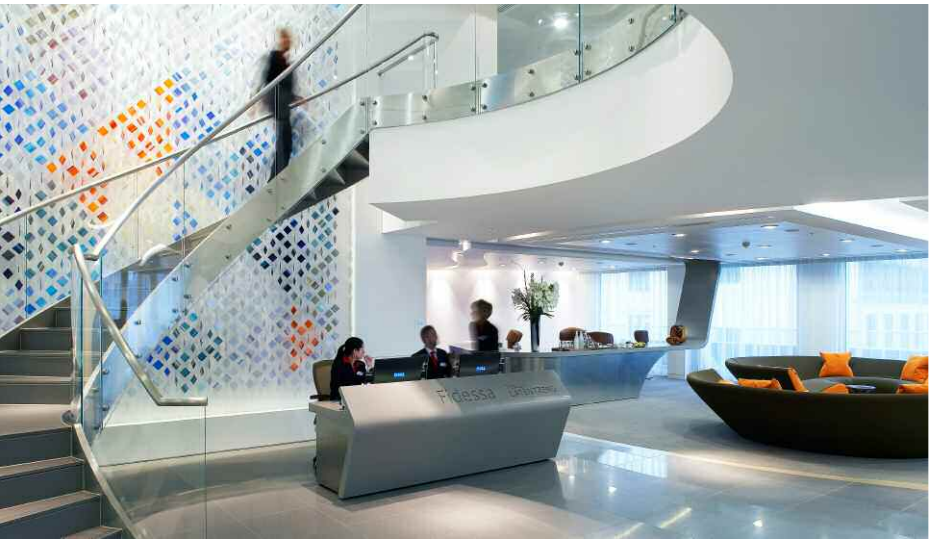
Energy efficiency - a focus for government and business

Energy efficiency is a key target for the European Union, and it is driving legislation on energy use in all member states. In the UK we have already seen requirements for Energy Performance Certificates, as well as regular updates to Part L of the Building Regulations, but these should be regarded as early steps in the process.

As well as legislation, energy prices are also a major incentive for businesses to look carefully at how they use energy. Far from being a small item on the list of business outgoings, energy is now an area of increasing concern. This is particularly true of sectors such as retail and hotels, where energy costs can be the second largest business expense after wages.

Good design of buildings can reduce their lifetime energy use, as can the use of energy efficient building services equipment for air conditioning, ventilation, heating and the other major services.

In fact, 80%[1] of the costs of a building in operation are related to these building services - so it is here that the most potential for long-term savings can be found.



1. Figures from Building and Engineering Services Association (B&ES) and Building Controls Industry Association (BCIA) 2014, www.buildingservicessummit.co.uk

It does not matter how energy efficient a boiler or a fan coil unit might be if they operate in an inefficient way. For example, if they run 24-7; or operate at weekends when not required. This is why leading manufacturers of building services equipment have turned their attention to providing high quality controls for their products.

Controls offer a highly effective solution to the challenge of energy efficiency. They can provide effective automation and control of heating, ventilation, cooling, hot water and lighting systems that lead to better overall building efficiency.

Equally important, today's building controls can provide useful data on energy use around a building. This data gives facilities and energy managers a basis for forward planning, continuous commissioning and a way to track the successes of energy-saving strategies.

As we enter a time when buildings and business will have to pay close attention to energy, it is important to understand how to measure, monitor and control energy in the long-term. This applies equally to small commercial buildings as well as large property estates.

Understanding controls - at the heart of energy efficiency

It is quite common to find that building services equipment is supplied with its own controls. These can have varying levels of sophistication, but generally this type of equipment is referred to as **'smart kit'**.

In many buildings, individual pieces of building services equipment will be connected, via their controls, to a building-wide network known as the building energy management system (BEMS). A BEMS coordinates the operation of various equipment in the building such as boilers, ventilation, lighting and cooling. A BEMS can gather information from sensors that track light, occupancy, temperature or CO_2 and use these to optimise the operation of cooling, lighting, heating etc.

The BEMS can also provide a front-end software interface that allows facilities managers to have a single point of information on how the building services are performing. The front-end software comes in many forms, and the latest BEMS can deliver information to hand-held devices via the Internet. One important aspect of smart kit and BEMS is the concept of **'open protocols'**. These are the most common 'languages' used in programming building controls, and they allow different types of equipment to communicate more easily. There are several open protocols in use, including LonWorks, KNX, BACnet and Modbus. Some of these have been designed to work specifically with certain types of equipment such as energy meters.

If you are thinking of linking your smart kit to the wider BEMS, then it is a good idea to ensure that the equipment is capable of communicating with one (or more) of these protocols.

One recent development from Mitsubishi Electric has been the introduction of MelcoBEMS. This is an air conditioning interface that is compatible with BACnet and Modbus enabled products. This interoperability gives users the flexibility to get the best out of their systems and their buildings - including comprehensive energy monitoring to save energy and therefore running costs, whilst also creating comfortable environments for occupants.

Whether a building has simple or sophisticated controls, understanding their benefits is important because they can have a significant impact on energy use.

There is a Standard that can identify the potential energy savings of a wide range of generic building controls, and their impact on energy use in several different types of building.

BS EN 15232 (2012): Energy Performance of Buildings - Impact of Building Automation, Control and Building Management is the result of research carried out in support of the European Energy Performance of Buildings Directive (EPBD). For anyone trying to calculate the cost-benefits of building controls it is an invaluable tool.

It is a European and British Standard that provides a structured list of controls and building automation technologies which have an impact on the energy performance of buildings. The document introduces four efficiency classes and deals with a range of controls products such as automatic detection devices, demand-based controls such as CO_2 sensors, and also controls-based strategies, for example night cooling.

It also gives a method to define minimum requirements for building controls for buildings of different complexities. Most usefully, the Standard provides detailed methods to assess the impact of building controls on the energy performance of a given building.

IoT - the next step for smart kit

The Internet of Things (IoT) points the way to a future where everything is IT based and we communicate and store things 'in the cloud'. By linking building services equipment to the Internet, the very latest equipment is reaching new levels of intelligence and access. MELCloud from Mitsubishi Electric uses a wi-fi interface to remotely monitor and control a range of its air conditioning and heating equipment.

Users can observe equipment operation, and also receive messages about errors through PCs, Tablets or Smartphones. Mitsubishi Electric supplies a range of controls with its products that can support a range of control strategies including night cooling and limiting setpoints. By the end of 2014, all Mitsubishi Electric air conditioning and heating systems will be IoT compatible (except Classic M Series Inverter).

Understanding controls - at the heart of energy efficiency

The Standard can therefore be used to demonstrate the energy savings of different types of building control, to compare against the costs. For clients and specifiers, BS EN 15232 can be used to identify levels of control required in a new building, or refurbishment project - the Standard identifies four classes A, B, C and D of building control, giving estimates of how much energy is saved at each level. *Table 1* shows the classes in more detail.

In terms of calculating the impact of these different classes of control, BS EN 15232 offers real insight, based on extensive modelling of different types of buildings such as offices, hospitals, schools, lecture halls and retail buildings. With class C controls taken as 'standard', the amount of energy saved compared to this level is shown for each building type. *Table 2* shows the differences in energy consumption for three building types in the energy efficiency classes A, B and D relative to the basis values in rating C. For example, by using class A, 30% of the thermal energy can be saved in offices.

Table 1: Classes of building control from BS EN 15232

Class	Energy efficiency
A	**High energy performance building automation and controls** ■ Networked room automation with automatic demand control ■ Scheduled maintenance ■ Energy monitoring ■ Sustainable energy optimisation
B	**Advanced building automation and some specific controls functions** ■ Networked room automation without automatic demand control ■ Energy monitoring
C	**Corresponds to Standard building automation and control** ■ Networked building automation of primary plants ■ No electric room automation, thermostatic valves for radiators ■ No energy monitoring ■ Recommended minimum level for buildings as per Part L 2013, indicated in the non-domestic building services compliance guide
D	**Corresponds to non-energy efficient building controls** BS EN 15232 recommends that buildings with this type of system should be retrofitted, and that new buildings should avoid this level of control ■ Without networked building automation functions ■ No electronic room automation ■ No energy monitoring

Table 2: Building Automation and Control System (BAC) efficiency classes to BS EN 15232

		Efficiency factor for thermal energy[2]			Efficiency factor for electrical energy[3]		
Building Types[4]		Office	School	Hotel	Office	School	Hotel
A	High energy performance building automation and control system (BACS) and technical building management (TBM)	0.70	0.80	0.68	0.87	0.86	0.90
B	Advanced BACS and TBM	0.80	0.88	0.85	0.93	0.93	0.95
C	Standard BACS	1	1	1	1	1	1
D	Non energy efficient BACS	1.51	1.20	1.31	1.10	1.07	1.07

2. Heating, cooling and ventilation. 3. Fixed services such as lighting, auxiliary, elevators, PCs and printers etc.

4. The building types are for reference only. There are also efficiency factors for lecture halls, hospitals, restaurants, wholesale and retail buildings, sports facilities, storage, industrial facilities and residential dwellings or buildings.

Controls strategies - having a plan for efficiency

The type of control strategy adopted will depend very much on the building, and how it is used. One of the main challenges is to balance occupant comfort with energy efficiency - turning off the heating will reduce energy usage, but could lead to complaints from building users if it happens in winter.

BS EN 15232 can be used at design stage, retrofit or during operation, with real benefits to all those involved. Another important consideration is how to balance the amount of control occupants have over their space against energy efficiency. Many studies have shown that people are more productive in environments where they have a level of control over environmental factors such as temperature. But this needs to be set against a need to optimise energy use.

Furthermore, controls must be usable - easy to understand and operate. Again, this can be challenging in certain types of building such as hotels, where guests are seldom in the building long enough to learn more than the most straightforward control functions.

BS EN 15232 recommends demand control as an important strategy for managing use of building services. As the name implies, controls are set up to run building services only when occupants require it. At the design stage of a building, simple elements can be employed such as presence detection and CO_2 sensors which operate heating, cooling and ventilation, for example, when a space is occupied, or when the controls can automatically increase these elements as more people enter an area of the building.

Demand control is particularly useful for meetings rooms as these are often areas where systems operate unnecessarily, wasting energy.

Another strategy to consider is the auto-off approach. This allows occupants to turn on cooling or heating in a meeting room, but the controls will automatically revert to ‘off’ after a set amount of time, or automatically on non-occupancy. Again, this addresses a common issue of occupants turning on the building services but forgetting to switch them off after they leave a space.

Through retrofit, a well-designed, installed and commissioned BEMS can be invaluable to a building to ensure all building services are integrated and interlocked to operate most effectively.

It is often said you cannot measure what you cannot monitor, so adding in the ability to monitor energy, trend data or create alarms will allow maintenance managers to optimise controls and will highlight areas which need addressing.

A good example of controls that offer a strategy well-suited to the building type is **Melcotel** from Mitsubishi Electric. This is a system designed for hotels which will automatically switch off cooling or heating if the room windows are open. Melcotel also offers a night set-back facility in which cooling or heating are setback in each room under non-occupancy. This control strategy has been specifically designed to reduce energy waste whilst maintaining comfort and user control in the hotel market - reducing operational costs significantly.

The most cost-effective approach that any facilities or energy manager can take is to use their existing building controls as effectively as possible. It is advisable to regard the controls as a tool which can be used regularly, but which also has to be maintained. Regular checking of areas such as sensors and detection devices can identify problems that can easily be rectified, saving energy immediately.

The standard control strategies are split down into 6 key areas - heating, cooling, ventilation with air conditioning, lighting, blinds, home automation and technical home and building management. One can clearly see in each category what is required to achieve for example a level A building controls.

Cooling control example

Low control level (e.g. D):

No automated control of capacity output, temperature, scheduling, interlock with heating

High control level (e.g. A):

Fully automated capacity control, weather compensation, individual room demand control integrated with the building, optimised start / stop scheduling, complete interlock with heating and ventilation system

For indication only

To receive a CPD seminar on The Impact of Control Strategies on Building Energy Performance Using BS EN 15232 you can call your Mitsubishi Electric Regional Sales Office to arrange an in-house presentation of this information.

If you would like to receive invitations to future CPD events, please email **livingenvironmentalsystems@meuk.mee.com**

Further information

Regional Sales Offices, please call one of the numbers below:

Birmingham
Tel: 0121 741 2800 Fax: 0121 741 2801

Bristol
Tel: 01454 202050 Fax: 01454 202900

Wakefield
Tel: 01924 207680 Fax: 01924 207699

Scotland
Tel: 01506 444960 Fax: 01506 444961

Manchester
Tel: 0161 866 6060 Fax: 0161 866 6081

London South Region
Tel: 01737 387170 Fax: 01737 387189

London North Region and East Anglia
Tel: 01707 282480 Fax: 01707 2824810

London Central Region
Tel: 0207 928 6810 Fax: 0207 928 6569

MITSUBISHI ELECTRIC
Changes for the Better

Green Gateway
www.greengateway.mitsubishielectric.co.uk
Mitsubishi Electric UK's commitment to the environment

Telephone: 01707 282880
email: livingenvironmentalsystems@meuk.mee.com
web: livingenvironmentalsystems.mitsubishielectric.co.uk

Follow us @meuk_les
Follow us @green_gateway
Connect with Green Gateway
mitsubishielectric2

UNITED KINGDOM Mitsubishi Electric Europe Living Environmental Systems Division
Travellers Lane, Hatfield, Hertfordshire, AL10 8XB, England
General Enquiries Telephone: 01707 282880 Fax: 01707 278881

IRELAND Mitsubishi Electric Europe Westgate Business Park, Ballymount, Dublin 24, Ireland
Telephone: Dublin (01) 419 8800 Fax: Dublin (01) 419 8890 International code: (003531)

Effective as of July 2014