SECTION 10 OPERATION & MAINTENANCE AND BUILDING MANAGEMENT SYSTEMS

ENERGY EFFICIENCY BUILDING DESIGN GUIDELINES FOR BOTSWANA

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Sections:

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10. OPERATION & MAINTENANCE

10.1. Overview

This Section addresses the subject of operation and maintenance. The different topics that are covered are briefly described below.

10.1.1. Design for Operation and Maintenance.

It is important that a building is designed with the capability and resources of the users and operators in mind to ensure that it is able to function as intended. Different approaches to operation and maintenance are considered.

10.1.2. Operation and Maintenance Manual.

The Operation and Maintenance Manual is an important tool in ensuring the effective and energy efficient functioning of the building. A basic outline of such a document is suggested.

10.1.3. Building Management Systems

Building Management Systems are briefly described, and the conditions under which they are appropriate are considered.

10.2. Design for Operation & Maintenance

10.2.1. Facility Management.

In Botswana until recently there was little awareness of the importance of building operation. Even large and complex buildings in many cases do not have a dedicated 'Facilities Manager' or similar employee who is responsible for the operation and management of the building. As a result, control of air conditioning equipment, lighting, etc is largely left to the individual occupants who generally are not given any training in how to achieve the best performance from the building at minimum cost.

Designing a building with the control systems that can achieve high levels of energy efficiency is pointless if these are not managed to achieve this. It is therefore essential that the building owners understand the human resource structure that will be required to operate and maintain the building, and commit to implementing this in coordination with the building commissioning and handover process.

10.2.2. Resilience.

Maintenance requirements may vary greatly depending on the materials, components and systems that are included in the building. The implications of departures from the ideal maintenance programme may also vary, depending on the resilience of the different elements of the building.

Fig. 1 Modern building in Gaborone, highly dependant on mechanical cooling.

For example, a highly insulated 'active' type of building may become uninhabitable in a very short time if the air conditioning system breaks down. It will therefore require backup power supplies, redundancy in the mechanical equipment and efficient planned maintenance procedures to ensure that the backup kicks in when a fault occurs. In contrast, a climate sensitive building that has a high level of interaction with its surroundings may be more resilient, and merely become less comfortable, but still habitable while breakdowns are being repaired.

Generally there is a strong correlation between effective maintenance and energy efficiency. Poor maintenance of equipment tends to result in lower efficiency, and hence higher cost in relation to performance. In some cases poor maintenance may reduce actual operating cost, but always at the expense of environmental quality. Large numbers of blown fluorescent tubes or air conditioners that are dysfunctional may save money, but at the expense of poor lighting levels, or uncomfortable rooms, which will result in poor productivity and employee morale.

10.2.3. Recommendations.

- Discuss operation and maintenance requirements during client briefing meetings, and include these in the design brief.
- Prepare outline operation and maintenance manual at an early stage, and include information as design and construction proceed.
- Discuss O&M implications with client as design and construction proceed, to ensure that these are understood and accepted.

10.3. Operation & Maintenance Manual

On larger projects it is becoming common for the building design team to be required to prepare an Operation and Maintenance Manual to be handed over to the client on commissioning of the project.

This is an opportunity to ensure that the energy saving concepts that have been designed into the building are formally communicated to the owner and hence to the users of the building.

Ideally the outline of the O&M manual should be prepared at an early stage of the design, and updated as the project develops. In this way, the team will ensure that O&M considerations are addressed at each stage of the design.

The contents of the O&M manual will vary between different projects, depending on the systems that are included in the buildings.

10.3.1. Typical format for an O & M Manual

A typical format would be as follows:

1. GENERAL INFORMATION
1.1. Building Location, Ownership and Tenancy
1.2. Building Physical Data
1.3. Building Construction History
1.4. Utility Providers
1.5. Other Important Contacts

2. O&M OBJECTIVES AND GOALS
2.1. O&M Objectives
2.2. O&M Goals
3. O&M MANAGEMENT
3.1. Organisational chart
3.2. Job descriptions
3.3. External Contracts

4. BUILDING SYSTEMS
4.1. Building Structure
4.2. Building Envelope
4.3. External works and landscaping
4.4. Internal Finishes
4.5. HVAC system
4.6. Electrical system
4.7. Telecommunications
4.8. Water
4.9. Waste water

5. ACTIVITY SCHEDULES
5.1. Operational Task Schedule
5.2. Maintenance Task Schedule

6. O&M PERFORMANCE MEASUREMENT
6.1. Indicators
6.2. Baseline data

7. O&M PROCEDURES AND REPORTING
7.1. Timesheets
7.2. Equipment File
7.3. Activity Schedules
7.4. Work Order File
7.5. Indicator Data File
7.6. Quality Assurance

8. O&M PLANNING AND REVIEW
8.1. Annual plan
8.2. Annual budget
8.3. Monitoring and review

APPENDICES

All relevant documents including title deeds, insurance, drawings, schedules manuals, contracts, etc.

10.4. Maintenance

Maintenance is the client's responsibility, but all too often clients employ poorly qualified staff and only attend to equipment when it stops working. Preventive maintenance consists of weekly and monthly checks on equipment, and early replacement of filters, fan belts etc when they show signs of wear. Fans operating with dirty, partially blocked filters will use more energy and not achieve their design ventilation rates.

In any chilled water or LTHW system, it is essential that the water quality is maintained and that the correct chemical dosing is used. Poor water treatment will drastically reduce the life of the equipment. Checks should also include spotting any water leaks from pipes or equipment. If leaks are not repaired immediately they can lead to damage of the building fabric as well as highly accelerated corrosion due to increased oxygen levels in the pipework systems. In any system with open cooling towers, good maintenance is essential to avoid the risk of Legionella virus and other problems developing.

Good preventive maintenance can both increase the lifetime of equipment and also improve its efficiency thus reducing energy use.

10.5. Building Management Systems

Building Management Systems are electronic controllers linked together via a computer network which are used to control important pieces of plant such as air handling units, chillers, pumps and so on. Variables such as set point control temperatures and hours of operation can be adjusted using software, and the controllers can also be programmed to achieve very sophisticated levels of control such as turning plant on at night when external temperatures are suitable for night cooling.

Typically they are installed in large buildings over about 10,000m^2. While they are principally used to control HVAC equipment, but may also operate lighting, fire control and security systems.

BMS has the potential to provide energy savings of up to about 10% if it is effectively implemented. However many systems have been found to be under performing, resulting in lower energy savings or no savings at all. (EDR Design Brief: Energy Management Systems).

For a BMS to be effective it is essential that it is designed to suit the requirements of the building, correctly installed and commissioned and regularly maintained to ensure that it functions as intended.

BMS has the potential to achieve substantial energy savings. It should however only be considered if the resources are available to design, install, commission, operate and maintain the system.

Fig 10.2 BMS system

10.6. Resource Material

10.6.1. Books and papers

EDR. Design Brief: Energy Management Systems. Energy Design Resources.
http://www.energydesignresources.com/resource/18/

EECOB Project, Dept. of Energy, Botswana. Nov. 2005. 'Guidance on Developing Building O&M Manuals Part II'.

Lechner, N. 1990. 'Heating, Cooling, Lighting – Design Methods for Architects'. USA. John Wiley & Sons.

10.6.2. Websites

ASHRAE American Society of Heating, Refrigerating and Air-conditioning Engineers.
http://www.ashrae.org/

CIBSE Chartered Institute for Building Services Engineers
http://cibse.org

WBDG - Whole Building Design Guide
http://www.wbdg.org/