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Operation and maintenance manuals for buildings

a guide to
procurement
and preparation



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Operation and maintenance manuals for buildings – a guide to procurement and preparation



sharing knowledge ■ building best practice

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Summary

This guide will be of interest to all those involved with buildings, that is construction professionals, clients, maintenance professionals and end-users. It is primarily aimed at those involved in the procurement and preparation of operation and maintenance (O&M) manuals for the fabric of buildings. It complements BSRIA's guidance on the procurement and preparation of O&M manuals for building plant and services installations.

Guidance is given on:

- the preparation and updating of an O&M manual.
- the structure, format, content and style of an O&M manual.
- the use of IT for the development and implementation of an O&M manual.

A format comprising three volumes, "General Records", "Operations" and "Maintenance", is recommended for the O&M manual. O&M manuals for buildings of varying degrees of complexity may comprise one or more documents as deemed necessary by the interested parties.

It is recommended that preparation of the O&M manual should commence as early as possible in the life of the project. The guidance given is applicable during the design, construction and operation of the building; that is from initial brief to final demolition.

Operation and maintenance manuals for buildings: a guide to procurement and preparation

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The PSG comprised the following members:

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	Dr G Alwani-Starr	CIRIA

A draft copy of the guide was issued to volunteer organisations for use in the outline development of an O&M manual for specific projects.

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ABOUT THIS GUIDE

PURPOSE AND SCOPE

Purpose

This guide aims to:

- advise purchasers of an O&M manual for the building fabric on how to specify, procure, use and maintain an O&M manual
- instruct those producing O&M manuals on how to format and prepare a manual.

This guide aims to make the reader aware of the importance of a properly prepared O&M manual for the efficient operation and maintenance of the building fabric. The guide highlights the benefits of an O&M manual to all interested parties, that is construction professionals, clients, maintenance professionals and end users. It also recommends that, to fully achieve these benefits, the manual be kept up-to-date during the life of the building. The guide complements BSRIA's related documents^{1,2} on building services installations and handover information.

Scope

This guide is the output of the first phase of a programme of research being carried out by CIRIA. This phase concentrates on the preparation of O&M manuals for the building fabric. The guide shows how to organise the O&M manual that enables the collection and upkeep of essential records for:

- safe and efficient operation
- scheduling and budgeting maintenance requirements
- safe and efficient renovation and refurbishment work

The topics listed below are included within the scope of this guide:

- structure, format and content of an O&M manual
- benefits to be gained from a well prepared and documented operation and maintenance strategy for the building fabric
- categories of user for whom the O&M manual is being written
- likely sources and type of information.

Guidance is given on the available options of applying IT in the production, maintenance and use of O&M manuals by providing information on:

- operating systems
- on-line documentation storage and retrieval systems
- CAD and other specialist systems
- electronic data interchange.

The guide contains pro-formas in the form of schedules that will act as a series of checklists against which O&M manuals can be developed.

This guide concentrates on the preparation of O&M manuals for the building fabric of new buildings, but much of the information also applies to existing structures.

Related publications

BSRIA has published related documentation with reference to the building services aspect of construction. These include Application Guide 1/87¹, *Operating and Maintenance Manuals for Buildings Services Installations* and Technical Note TN15/95², *Handover Information for Building Services*. In addition, BS 4884 gives guidance on the preparation of technical manuals. BS 4884: Part 1³, *Specification for presentation of essential information*, Part 2⁴, *Guide to content* and Part 3⁵, *Guide to presentation*.

READERSHIP

The guidance offered is primarily directed at those involved in the procurement and preparation of O&M manuals for the fabric of new buildings. Initially it is anticipated that it will be used by those involved in medium or large construction projects. However, many of the principles will, to an equal or lesser extent, apply to smaller projects and existing buildings. This guidance will be of importance to building facilities managers and estate managers, as well as to end-users since all parties will benefit from, and can contribute to, a well-prepared comprehensive O&M manual.

STRUCTURE

This guide is set out in six main sections.

Section 1 describes the benefits of the preparation and use of an O&M manual for the building fabric. It includes consideration of contractual arrangements and economics associated with the procurement or supply of an O&M manual. It also identifies sources of information and the regulations and codes of practice which will influence the preparation of an O&M manual.

Section 2 details the overall concept and the structure, format and content of an O&M manual for the building fabric. It also deals with IT systems which may be utilised in the preparation of O&M information. This section concludes by recommending a three volume format of O&M manuals as follows:

Volume	Primarily for use by building
General Records	owners and facilities managers
Operations	users and occupiers
Maintenance	specialist maintenance contractors

Sections 3, 4 and 5 describe these volumes in greater detail.

Section 6 contains example documents and checklists to assist readers when using this guide.

1.1**WHAT IS AN OPERATIONS AND MAINTENANCE MANUAL?**

The operation and maintenance of buildings and their fabric have assumed a growing importance in recent years, not only because of the need to comply with new health, safety, and environmental legislation but also to limit the costs of using buildings.

An O&M manual should therefore define the requirements and procedures for effective operation, maintenance (which includes replacement of components where necessary), and finally decommissioning and demolition of the building. These include legislative requirements, cost benefit analysis, management procedures, condition monitoring and inspection and details of individual components.

If the needs of the building owners, facilities managers, users and occupiers are to be balanced and satisfied, information must be available on such aspects as:

- construction details, building history, maintenance records and details of guarantees and warranties
- operation requirements for the building
- maintenance instructions and schedules.

These are the essential constituents of an O&M manual. The compilation and presentation of a well-prepared O&M manual should be an essential part of any building construction project.

An O&M manual prepared for an existing building will have similar features. However, the availability of information will be limited and, in many instances, investigative surveys will be necessary.

1.2**WHO BENEFITS FROM AN O&M MANUAL?**

All those who have an interest or investment in a building will benefit from the preparation of an O&M manual. Typical examples are listed below.

- The building owner, who is better able to market a building. The O&M manual should clearly identify the building's features and attributes. It should also provide information to assist the owner's negotiations in providing the basis of a leasing or purchase agreement.
- The landlord, who is better able to identify requirements for the maintenance and repair of the building.
- The tenant or occupier. The O&M manual should provide a source of information and instruction to help effectively and efficiently operate and, where appropriate, maintain the building.
- Those commissioned to carry work on the facility, who benefit from better documented briefs and specifications. These should reduce costs by reducing the amount of reworking.

Generally the benefits would not be restricted to any one party but would be disseminated among all those concerned.

THE BENEFITS OF AN O&M MANUAL

A properly prepared O&M manual will produce significant benefits when it is used:

- as the basis for timely, correct and efficient building maintenance, operation and planning
- as an information base, including handover information, and as a source of reference
- as a basis for ensuring the most economic use of energy
- as a basis for ensuring awareness of health and safety aspects of the building construction, operation, maintenance and decommissioning
- as a basis for staff training
- to assist with facilities management competitive tendering
- as a listing of emergency procedures
- as a reference for use during extension or refurbishment work or changes in use.

Additional derived benefits include:

- better designed and constructed buildings resulting from the project team's improved understanding of:
 - operational requirements
 - maintenance requirements to meet the design life specified for the building
- easier ordering of spares and replacements
- the ready availability of information for components, eg limitations of use, materials and life expectancy
- a proper understanding by the occupants of the purpose and use of the building
- retention of the inherent value of a building as a result of better maintenance
- a reduction in disruptive and potentially costly effects of breakdown or failure.

WHO SHOULD PREPARE AN O&M MANUAL?

Various professionals involved in the design and construction process are well placed to lead the preparation of an O&M manual for a new building, for example a senior member from either the design team or the main contractor. Alternatively, a specialist author can be appointed.

The professional attributes of the lead author should include demonstrable experience in:

- collection, collation, analysis and presentation of information
- preparation of concise and user-friendly documents
- ability and resources to lead a process of information gathering and collation
- ability to work as part of a project team.

BSRIA Application Guide 1/87¹, *Operating and Maintenance Manuals for Building Services Installations*, provides a list of organisations specialising in authorship of O&M manuals.

WHO SHOULD USE, MANAGE AND UPDATE AN O&M MANUAL?

Categories of user would essentially include:

- those responsible for managing the operation and maintenance of the building
- those who use or occupy a building
- specialists who maintain the building.

The level of detail required for each user will vary.

- Those responsible for managing the building will normally need comprehensive information on the building, together with clear statements on the operation and maintenance requirements. This information need not include details of individual components.
- Those who use or occupy the building should be regarded as "non-professional" members of the general public requiring a clear statement concerning the building's general use and limitations.
- Building maintenance specialists will require itemised maintenance and replacement schedules and relevant details related to the construction and to component suppliers.

The professional and personal attributes of those given responsibility for managing and updating an O&M manual should include knowledge of the building and its operation. Good communication skills are essential. Authority to obtain assistance or delegate such work to others, where appropriate, must be given.

Managing the O&M manual can be awarded under separate contract to a design consultant, a specialist in building operation and maintenance or a specialist author.

To optimise the operation and correct maintenance of the building, the O&M manual must be regularly updated to take account of any relevant developments in knowledge and techniques. When changes occur to the building and new information becomes available, the O&M manual should be amended.

It is recommended that a review of the O&M manual is carried out annually.

The responsibility for regular updating lies with the building owner or his assigned agent or facilities manager. Alternatively, the tenant could undertake this task. It is recommended that an appropriate modification procedure is included in the O&M manual along with a facility to allow changes to be recorded as they occur.

Full compliance with health and safety legislation carries a requirement for the issue of up-to-date information.

The responsibility for the management, updating, control and distribution of copies of the O&M manual needs to be clearly defined and allocated (see Section 2.8).

A lead author should be appointed to prepare the O&M manual, with the assistance and co-operation of the rest of the project team, as early as possible during the life of the project. The lead author is normally a member of the project team.

It is essential that the correct contractual arrangement is undertaken, based on clear documents. It should, where appropriate, allow the authoring contractor to price the work realistically and when required on a competitive basis.

Maintenance of the building fabric should start from the point of building handover and should not await the completion of the defects liability period. The building contract will normally cover a warranty period but not maintenance. The O&M manual should therefore be ready at building handover. The lead author for keeping the O&M manual up to date after building handover should be appointed before handover (see Sections 1.5 and 2.8).

All members of the construction team will be required to provide information for compilation into the O&M manual (see Sections 3.2, 4.2 and 5.2). This requirement needs to be part of their contractual arrangement.

Owners of large buildings will often employ a resident operation and maintenance team which will be required to provide the record to keep the O&M manual up to date. Owners of small buildings often rely on maintenance service contractors providing cover when failures occur. In such cases, an owner will provide the lead author with the records to keep the O&M manual up to date.

There is no published form of contract for facilities management, and specialist contractors usually have their own documentation. The British Institute of Facilities Management (BIFM) is preparing a model contract. An arrangement for updating the O&M manual could be included as an additional responsibility.

It is recommended that reference is made to BSRIA Application Guide 4/89², *Maintenance Contracts for Building Engineering Services: A Guide to Management and Documentation*, for use as a guideline for establishing contractual arrangements in regard to maintenance of the building structure and fabric.

Information for inclusion in an O&M manual can be obtained from those who specify, design, build or manufacture the building and its components including contributions from specialists.

Information will therefore generally be subscribed by the following:

- client
- design team
- manufacturers and suppliers
- installation and building contractors
- specialist and subcontract designers.

The following are typical examples of the information normally available from each of the above sources.

- Client – general details and specification for the building; that is, finally agreed client requirements. These details should include the operation and maintenance strategy and requirements as well as procedures for maintaining and updating the O&M manual.
- Design team – design philosophy, design drawings, specification, general construction schedules and details and modification, maintenance, decommissioning and demolition statements. Information obtained from statutory authorities and utility companies must be included.
- Manufacturers and suppliers – information and data concerning proprietary items and factory manufactured components.
- Installation and building contractors – fabrication and working details, material and component sourcing, as-built information, and maintenance requirements.
- Specialist and subcontract designers – ground surveys, soil surveys, specialist reports etc.

The design team will generate the operating philosophy of the building including purpose, design loadings, emergency provisions, safety considerations and design criteria. The building contractor will provide a structure in accordance with the design specification, for example by selecting and installing proprietary components and materials. Information will be available on the chosen manufacturer or supplier products with commissioning results and variations from specified design criteria.

The preparation of the final manual requires integration of the different types of information available from each of the sources. Permission to reproduce information that is protected by copyright must be obtained before the issued.

Modifications are likely to be carried out during the working life of the building. The associated update of the O&M manual will be based on sources of information similar to the above. However, it will be necessary to identify and record the physical boundaries and interfaces that will occur between existing and new elements.

Information will include details of warranties and guarantees provided by suppliers, manufacturers, installers and subcontractors. Useful guidance concerning anticipated life of components may be found in the *HAPM Component Life Manual*⁸ published by E&FN Spon.

REGULATIONS AND CODES OF PRACTICE

Regulations and codes of practice to be observed may be either statutory or generated by the building owner or user.

In the latter cases the requirement is specific and outside the scope of this guide.

Probably the most important statutory requirements comprise the Health and Safety at Work Act 1974⁹, Workplace Health, Safety and Welfare Regulations 1992¹⁰ and the Construction (Design and Management) Regulations 1994 (CDM)¹¹.

It is recommended that the O&M manual contains information that demonstrates that appropriate systems are employed to meet the needs listed below.

- The Health and Safety at Work Act states that employees must be fully informed and instructed on the equipment for which they are responsible.
- The main aim of the Workplace Health, Safety and Welfare Regulations 1992 is to ensure that a suitable working environment is provided that contains adequate welfare facilities for occupants. It requires an appropriate system of maintenance to be employed. Detailed guidance is given in *Workplace Health, Safety and Welfare – Approved Code of Practice*¹⁸, available from HSE.
- The CDM Regulations establish a specific requirement for the creation of a health and safety file. The regulations specifically cover “construction work and cleaning work in or on the structure”, but it may be expedient to include work of any nature. It is advisable to ensure that this file covers all health and safety aspects of the operation and maintenance of the building. Appendix 5 of the HSE document *Managing Construction for Health and Safety – Approved Code of Practice*¹⁸ details the type of information required.

LIFE-CYCLE COSTING

Life-cycle costing involves putting the estimated capital, operational, maintenance (including replacement), decommissioning and demolition costs into a comparable form. These are combined into a single figure to identify the items of expenditure that will take place at different stages in the life of the building. If the client or developer requires life cycle costing, the content of the O&M manual will need to include suitable formats for recording the maintenance, operating and replacement costs to allow comparison with the budgeted figures.

A preferred method of costing includes the application of Royal Institute of Chartered Surveyors¹⁹ multipliers for calculation of forward projections from present-day costs.

The LINK/CMR¹⁶ research project “Building Performance and Costs-in-use” provides guidance on the production and use of capital, maintenance and replacement cost records for life-cycle costing.

A properly prepared O&M manual should produce cost benefits greater than the initial outlay for its preparation. Section 1.3 lists some of the benefits.

Cost of preparation

In estimating the cost of preparing an O&M manual three methods are suggested.

- By estimating the resource required

The precise content of the O&M manual must first be identified. A detailed assessment of the workload in terms of time can then be made; when multiplied by the appropriate cost rate, this will provide an estimate of cost. Added to this should be considerations of disbursements, including print costs and any cost that may arise from third-party sources providing data.

- By scale reference to the building cost

In the same manner that professional associations are able to prepare a fee scale it should be possible when working within the recommendations of this guide to prepare a scale of likely costs by similar method. This has not been undertaken within the scope of this document and may form a basis of a later publication.

- From previous experience

It is likely that specialist authors or those with previous experience in the preparation of O&M manuals will, from records of previous undertakings, be able to provide a reasonably accurate cost forecast.

In estimating the costs of preparing an O&M manual consideration should be given to costs that would normally be incurred in collating information for a building.

There are two main considerations in estimating the costs of preparing an O&M manual:

- costs associated with the provision of any new control documentation for rebuilding
- the provision of information detailing operation and maintenance requirements and procedures.

The first consideration should not have a significant cost implication, as the control procedures will be required to be in place when compiling new information.

The latter consideration will be determined by the operation and maintenance strategy, which needs to be discussed and agreed between the interested parties.

As a general rule, each page will add a minimum of an hour to the time cost of preparing a manual. A full page of text which requires to be composed, edited and agreed by other parties will typically add five, but perhaps up to ten, hours, depending on its complexity and importance.

2

Concept of an O&M manual

2.1

INTRODUCTION

2.1.1

The industry

The traditional approach to construction procurement within the building industry is for the client to commission a project design team and then to select a contractor on a competitive basis. During this process the emphasis has been to minimise capital expenditure within cost limitations. Life cycle costs have not generally been included in the process. These costs are significant, normally several times the original capital costs. This factor is usually 3, but may be up to 10 times the capital costs.

Recent legislation has prompted greater awareness of the importance of correct building operation and maintenance systems. This has led to growth in the specialist field of facilities management, a trend enhanced by the need to minimise running costs in response to commercial pressures. Building owners have, therefore, focused upon the efficiency and flexibility of property assets, encouraging conservation and reuse of existing structures and increasing an awareness of the need to reduce maintenance and operating costs. The effect of this is to shift emphasis to greater consideration, during design, of optimum performance requirements. To carry out this optimisation, it is necessary to make financial projections associated with the proposed operating and maintenance regime. These moves have been further encouraged by government legislation on energy usage, safety and environmental considerations.

The building industry has recognised these changes in requirements for buildings. It has also recognised the need to prepare and issue information with instructions for the benefit of, and use by, the building owner, manager and occupier.

2.1.2

The need

The efficient operation of a facility – which includes design, maintenance, repair and renovation work – is most likely to be achieved through good communication. It is important for good communication to be established between client and project team from the start of a project and be maintained, especially when changes occur, during the life of the building. At present, communication links established before handover tend to lapse during the operational life of the facility. This has many implications, particularly when a building changes ownership or use, the most serious being for safety. This was recognised by the Health & Safety Executive while drafting the CDM Regulations. These regulations make it a duty of the planning supervisor to ensure that a health and safety file is prepared. The file should contain all reasonably foreseeable information necessary to ensure the health and safety of any person carrying out any construction and cleaning work in or on any part of the structure at any time. The planning supervisor must also ensure that this file is delivered to the client at handover. The client is then responsible for making the information available for statutory purposes and to any leaseholder or new owner of the structure.

Maintenance of a building should start at handover and continue until demolition, even if the building is out of use or mothballed for any period. The availability of an up-to-date O&M manual would assist in improving the management of lifetime costs. Such a manual would enable consideration of lifetime costs at the design stage and, once reviewed, would enable forward planning and budgeting for maintenance and repairs.

Prior to compiling an O&M manual consideration needs to be given to the following:

Consideration	Section
• strategy for operation and maintenance	2.3.1
• categories of user of the O&M manual	2.3.2
• information to be included	2.3.3
• level of detail required	2.3.4
• procedures for producing and maintaining the O&M manual	2.6, 2.7
• likely sources of information	3.2, 4.2, 5.2

These are further expanded in the sections listed.

2.2

WHEN TO START PREPARING THE MANUAL

Because the O&M manual ought to be integral to a building project, it should be prepared from the inception of the project. (see BS 4884: Part 1⁵ *Specification for presentation of essential information*). It is also important that it should continue to be updated until the building is demolished. There should be an identifiable person responsible for maintaining, modifying or extending the O&M manual at all times, particularly during changes in use or ownership.

The client should recognise there will be a cost benefit of starting the preparation of the O&M manual at the earliest opportunity to minimise the costs of gathering information. The lead author for the initial preparation of the O&M manual, at least up to the time of building handover, should be identified and commissioned to carry out this task when the design is commissioned.

2.3

HOW TO DECIDE ON THE MANUAL'S CONTENTS

General guidance on the content of technical manuals is given in BS 4884: Part 2⁶.

2.3.1

Operation and maintenance strategy

Much of the detailed content of the O&M manual will be identifiable from the operation and maintenance strategy for the building. This strategy should be planned and organised to achieve the overall objectives of the building owner and occupier.

These objectives provide an overview of the conditions to be met and the limitations imposed. They should include details of:

- resources available together with allocation and priority
- building function and envisaged design life
- occupancy times
- the implication of failure of any of the main building components
- level of maintenance required (essential/preferable)
- requirements for life cycle costing.

The operation and maintenance plan developed on the basis of these broad objectives should identify:

- aims and responsibilities
- the details of the content and amount of information needed (perhaps most important in this context)
- those responsible for providing information
- by whom and in what form this information should be processed and presented.

A more detailed maintenance plan, describing how the set objectives will be achieved, needs to take account of:

- cost limitations
- the planned life of the various components
- risk analysis
- component failure policy
- the availability of and access to spares
- accessibility for maintenance
- specialist support.

The detailed maintenance plan will also be influenced by the building owner and occupier arrangement. This will mainly affect the allocation of, and priority given to, the available resources. Three alternative arrangements can be identified.

1. The owner occupies his own property and has responsibility for management, operation, maintenance and repair.
2. The owner leases his property to tenants, but retains responsibility for its maintenance and repair and, possibly, for its operation too.
3. The owner makes the tenant entirely responsible for the property's operation, maintenance and repair.

Such detailed planning is crucial when determining the content and presentation of the O&M manual.

2.3.2

Categories of user

The users of O&M manuals can be divided into three broad categories:

- those responsible for managing the operation and general maintenance of the building
- those who use or occupy the building
- specialists who carry out maintenance of the building.

These groups will each have specific interests, abilities and expertise. They will each require something different of the O&M manual.

The management team needs details of the design concept, the operational features of the building and the maintenance programme. The users and occupiers probably only require a general overview of the building performance capability, while the maintenance staff need technical details of the building and its operational and maintenance requirements. These varying requirements affect both the content and presentation. This is the main reason for recommending the O&M manual be divided into three volumes as follows:

Volume	Primarily for use by building	Section
General Records	owners and facilities managers	3
Operations	users and occupiers	4
Maintenance	specialist maintenance contractors	5

The listed section gives specific recommendations for each volume.

2.3.3

Information to be included

The amount and type of information in the O&M manual will vary less with the size of a project than with its nature and complexity. Each of the interested parties will have different and sometimes conflicting requirements of the O&M manual. In order to define the content clearly it is essential to establish good communication links and to define responsibilities for all parties involved in the project. These links and responsibilities should be set up at the start of the project and maintained as the project develops and the project team changes.

It is recommended that, although the degree of detail will vary, all O&M manuals for the building fabric should include the following types of information:

- the purpose or function of the building
- construction records
- description of the building
- operational constraints
- maintenance requirements
- maintenance schedules
- considerations relating to building modification
- considerations relating to building demolition.

2.3.4

Level of detail required

All O&M manuals should contain basic building details, for example the final agreed client requirements, design statement, and health and safety considerations covering operation, maintenance, modification, decommissioning and demolition. In addition, three possible levels of detail for an O&M manual, in increasing scope, include the following:

- (i) Basic record drawings and manufacturers' literature or manuals.
- (ii) Record drawings, manufacturers' operating instructions and manuals, test certificates, parts list and specifications.
- (iii) Functional information; technical documentation, including record drawings; operation instructions for each component; detailed maintenance instructions and schedules; parts list; detailed modification, decommissioning and demolition statements; and detailed requirements for life cycle costing, including schedules and proforma.

The level selected should relate to the building complexity, materials used and the sensitivity of the function of the building. An O&M manual prepared for either level (i) or (ii) above provides adequate information for the relatively small, simple installations that comprise the majority of buildings.

If the project warrants establishing computer records with details for individual components or groups of components, it requires little further effort to add cost and performance data with each entry. This data can be used to provide information on life cycle costing for the building and components. It can also be used to highlight the optimum solutions for future building works.

2.3.5

Arrangement of content

There are at least two industry-recognised approaches to the way in which building or building works can be sectioned. These are as suggested in the *Common arrangement of works sections for building works* (CAWS)¹³ (see Section 3.3) and as adopted by BS 7543: 1992¹⁴ *Durability of buildings and building elements, products and components* (see Sections 4.3 and 5.3). Neither of these arrangements was specifically developed to accommodate the production of O&M manuals. Both, however, can be used to form headings for the contents of an O&M manual.

During the design and construction phase of the building life, the project team will be using CAWS¹³ as the basis for organising documentation. The General Records volume of the O&M manual will be mainly developed from information generated during this phase. Therefore, for this volume of the O&M manual, data recording will require the minimum of reworking if this arrangement is used (see Section 3.3).

During the building's operation and maintenance phase, the interested parties will be using the building and will rarely be concerned with the construction process. BS 7543¹⁴ was developed to facilitate the systematic assessment and recording of service and design life. The compiled records are fundamental to the development of effective maintenance schedules. BS 7543¹⁴ recommends sectioning these records into building elements (see Sections 4.3 and 5.3). This is considered the best arrangement for the two O&M manual volumes Operations and Maintenance. Section 5.3 gives details on the interpretation of headings within the design and service life records from BS 7543¹⁴.

For existing buildings, examination of the available information may lead the project team to conclude that the BS 7543¹⁴ grouping is most suitable for all three volumes.

2.4

FORMAT AND STRUCTURE

BS 4884: Part 1⁵ gives guidance on the "Specification for presentation of essential information".

It is recommended that the O&M manual title page(s) fully identifies the following:

- manual title
- project name
- document issue reference
- date of issue
- identification of the particular copy
- building owner including address, telephone and fax numbers and contact name
- manual author, including address, telephone and fax numbers and contact name.

All changes should be recorded within the O&M manual so that the full building history is easily traceable. For example, during the life of the building the contents for the title page may change due to a change of ownership.

It is recommended that the O&M manual title page(s) be followed by:

- a full contents listing identifying the number of volumes and documents
- emergency contacts including address, telephone and fax numbers and contact name
- a listing and cross-reference to all identified health and safety hazards. While this may be a simple reference to the health and safety file, it is advisable to incorporate the H&S file in the O&M manual to ensure conformity and compatibility of documents
- a note on the issue and revision control of the O&M manual
- a note on the importance of, and procedures for, keeping the manual up to date.

The format selected should be such that information is easy to access, understand and use. It should be suitable for receiving information generated during the building design, procurement, construction and working life through to demolition. The O&M manual therefore needs to accommodate continual development and addition. The preparation costs and choice of medium (ie paper or IT-based systems – see Section 2.7) will be substantially influenced by the size and complexity of the building and also by the client's requirements. For paper-based manuals a loose-leaf format is likely to be the most economical way of ensuring flexibility. It is recommended that:

- all pages are uniquely referenced so that any pages removed or lost can be identified
- all sources of information referred to in the O&M manual are referenced.

2.5

RECOMMENDED FORMAT

BS 4884: Part 3⁷ gives guidance on the presentation of technical manuals.

Since the O&M manual will be continually developed and amended a loose-leaf format is recommended, each page having header and footer in a common style. It is recommended that the header contain:

- project and volume name
- section title
- volume, section and subsection reference
- subsection title if applicable
- page number of total number of pages in subsection.

These items allow any subsection to be revised without the need to update the entire manual and for each subsection to be physically checked for completeness. A typical page header might be set out as follows:

Project name	General records volume
Section title	Vol 1 – Section A
Subsection title	Page 3 of 5

It is recommended that the footer contain:

- revision number
- date of revision
- name of originator of subsection
- name approving subsection
- document name
- document location eg a reference to the IT storage medium. The storage location of all source material should be identified within the O&M manual.

These items allow the current documents for each subsection to be located. They also identify the persons responsible for maintaining each subsection. A typical page footer might be set out as follows:

Rev: 1	Originator:	Approved:	Doc.: GRV A
Date: 8/8/1996			Disk: GRVA

Section 6.1 illustrates an example blank page.

2.6

DOCUMENT DEVELOPMENT

Loose-leaf binding provides the flexibility to integrate information from a range of sources and allows frequent updating. However, it also demands a robust document control system to prevent lost or outdated pages eroding the value of the manual. On the following page is illustrated a blank contents template that forms the basis of the recommended approach for compilers developing an O&M manual. The completed contents page also forms the basis of a document control system – a partially completed example for a typical project is shown in Section 6.2.

It is recommended that the first page of each section of the O&M manual contains a contents matrix table (see Section 6.2). This table identifies the reference number and title of each subsection: Sections 3.3, 4.3 and 5.3 identify the recommended main section and subsection headings for each volume of the manual. Each subsection should be allocated standard headings; the tables illustrated throughout this guide have ten headings that should provide adequate division of the information likely to be required. If a large volume of information is anticipated and sub-subsections are needed, each subsection should start with its own matrix table that identifies the sub-subsections and uses the same standard headings. Subsections or headings can be omitted if no information is to be generated under these labels in the completed O&M manual.

On the contents page, shaded or annotated cells identify those parts that:

- have been compiled
- require compilation
- are not applicable.

When starting to compile an O&M manual it is recommended that a contents page for each main section is prepared. For each subsection (or sub-subsection) the compiler should write under the first standard heading an introduction that lists the information to be collated. These lists should be annotated to indicate the information as being:

- essential
- desirable
- potentially useful.

USING IT SYSTEMS TO PREPARE AN O&M MANUAL

Within the context of an O&M manual, IT systems should include any computer-based software that makes the task of accessing and updating information easier and more cost-effective. Due to the dramatic reduction in costs, availability and increase in memory and storage capacity of computer systems, IT systems will be used in some form in the preparation of most O&M manuals. In its simplest form, a word-processing package (WP) can be used in the production of an essentially paper-based manual. The most commonly available WP packages have the facility to read and convert documents from other packages. The adoption of a common WP package will have cost benefits and minimise the reworking time by the manual compiler in the production of a unified document. The computer files generated should be used as backup and the basis for updating and maintaining the O&M manual. Managing these files within an on-line database system is a step towards a more dynamic computer-based O&M manual.

2.7.1

On-line documentation systems

On-line documentation systems have been developed to manage large volumes of information, eg library cataloguing and authoring systems. These systems allow:

- searches to be made through the documentation on the system and to establish links between related information
- effective reduction of the volume of information held
- direct access to the required information
- missing information to be highlighted
- archived and out-of-date records to be tracked.

This would particularly benefit the production and use of an O&M manual for larger, more complex buildings. Using a network system, all parties involved in the project can be given direct access to the O&M manual for varying levels of activity depending on their requirement. Advantages are that everyone has access to the same information, it is easier to keep the information up to date and the production of the O&M manual can be significantly speeded up. To maximise the benefits it is recommended that:

- all parties agree and use a common system
- working practices and protocols are agreed and followed
- responsibilities for changing information are established, that is users will be allowed to read and write to some files but only read other files.
- the network is robust. This should minimise the time users are not able to access the system, that is due to system failure or maintenance requirements.
- the information held is secure and backed-up to prevent loss or corruption.

2.7.2

CAD systems

The drawings required for construction are commonly generated using computer-aided design (CAD) systems. The major CAD software users within the UK have adopted the recommendations given in the *European Quality Manual for Building Data Exchange*¹⁵ for the following reasons:

- to rationalise information transfer
- to create a common user environment
- to give users guidance in structuring their drawing file
- to provide a structure for quality control over user's drawings.

Providing the parties involved in the construction process adopt these recommendations, all other parties can easily access information through electronic data interchange. The designer can incorporate a manufacturer's standard components onto the building drawing, while the contractor can transmit to the manufacturer the site requirements for non-standard components so that they can be incorporated into the production process.

From the project team viewpoint, CAD systems provide a very convenient way of storing, viewing and keeping up-to-date drawings of the building and its components. Many companies use CAWS¹³ (see Sections 2.3.5 and 3.3) in the compilation and annotation of drawings. Software to operate with the CAD system has been developed to manage the production and revision of the drawings and to track their issue. Recent developments allow the attachment of key information files with any item on the drawing, such as the operation and maintenance requirements. Although this information would not appear on the printed drawing it can be viewed on-line. Additionally, the selection from the attached key information files can be made operator-sensitive: ie it can give the required information file or allow selection from all or pre-determined file types.

By being linked to integrated databases, CAD has been developed into computer-aided facilities management (CAFM), which can provide cost control and service management functions. Sections 6.3.4 and 6.3.5 illustrate example proforma of maintenance cost records modelled on data in the LINK/CMR¹⁶ research project "Building Performance and Costs-in-Use". It is recommended that if a CAFM system is proposed, that any potential conflict between using CAWS¹³ for the construction phase CAD drawings and the BS 7543¹⁴ arrangement for Operation and Maintenance volumes be resolved.

2.7.3

Specialist systems

Facilities to scan paper-based documents and drawings to produce computer files are commonly available. The scanned files may be read-only – ie images that the operator can read but which have no computer-based search and find facility. An image can also be scanned to produce a computer text file, which overcomes this drawback; nevertheless, this is still not as cost-effective as the direct transfer of a computer-based file especially from within the same software package. These facilities enable the author to link all relevant information for an O&M manual within one system. Geographic information systems (GIS) have the facility to integrate maps, drawings, documents and photographs, but at a cost that would exclude most procurers of O&M manuals.

Recent advances have seen the use of barcoding move from simple identification of products to the production of the contents of an A4 page within a barcode no larger than a credit card. These barcodes have error-checking features that permit most of the information to be recovered from damaged labels. Consideration is being given to the methods and uses of barcode labels fixed directly onto building products. The labels can be used to identify the product, manufacturer, and operation and maintenance details. Barcodes can also be added to the drawing to provide further detailed information. The next step will be to reproduce drawings to a similar scale – an alternative long-life method to storing drawings for a building in a paper-based manual.

Specialist software, facilities and maintenance management systems are available to manage the life-cycle operation and maintenance requirements generally for the larger, more complex buildings. These can be linked to building control and data collection systems – for example building energy management systems – to provide a dynamic method of identifying and implementing operation and maintenance scheduling. This software should be used to enhance rather than replace the O&M manual. Where the building owner/occupier has an established facilities management IT strategy,

development of the O&M manual should be linked within this strategy at an early stage. As with all IT systems this is a dynamic and fast-growing field both in software development and the equipment and sensors that form these systems.

2.7.4

Guidance on the use of IT systems

Recent developments in data storage and transmission allow large volumes of information to be easily transferred in electronic form worldwide. Trade literature is distributed on diskette or CD-ROM in addition to the traditional printed catalogue. A wide range of goods and services can be purchased through a PC by on-line selection direct to the manufacturer or supplier using telephone and satellite network systems. These procedures could be used by the lead author to produce the O&M manual for distribution on CD-ROM or networked to local PCs at various locations in the building complex (see Section 2.8). The latter could be used as information displays to assist the building operation or maintenance, for example to provide procedures and relevant drawings for key processes.

The BSRIA publication *Handover Information for Building Services*² identifies the following key requirements for a successful computer-based system:

- clear identification of requirements
 - careful evaluation of relevant software packages
 - appropriate training of personnel responsible for the system
 - establishment of appropriate system management protocols
 - establishment of a system for “change control” to incorporate updates to the master file(s). This system must avoid the unauthorised alteration and copying of information, perhaps by barcoding
 - establishment of a robust system for backing-up data
 - provision of adequate resources to operate the system
 - provision of adequate technical support from the software supplier;
- plus the additional requirement that:
- the complete system should be Year 2000-compliant.

This BSRIA publication² also has a section on “Information Considerations and Planning”, from which the following table was compiled:

Hard-copy documentation and drawings	
Advantages	Disadvantages
• Selected data can be removed for ease of use for reference purposes, revisions etc • Tried and tested approach with low risk factor • For small projects hard-copy documentation and drawings are likely to be the cheapest and most practical option • Proven long term storage medium	• Manuals cannot be updated easily (unless copy of original word-processed documents is kept on disk) • Working copies of manuals and drawings can become unreadable • Documents and drawings can be misplaced • Limited flexibility in use
Computer-based systems	
Advantages	Disadvantages
• Text-based information and CAD drawings can be accessed and updated easily • On-line systems should eliminate working with or on out-of-date drawings • Well suited for recording breakdowns and scheduling maintenance work etc • Multi-user network can be set up, with the option to interface with a building management system • Interested parties can be kept up to date and hence improve communication links and reduce delays and misunderstanding • Relevant information can be made available both at the right time and at the right location • All users have access to the same information • Provides mechanism for operational support, for example space allocation • Provides mechanism for asset control	• Initial expense of hardware, software and training • System management required • The scanning of drawings, manufacturers' literature etc can represent a significant cost • Scanned drawings and text may be read-only. The image might need to be converted into a vector-based format suitable for CAD systems or a text file • The cost of updating CAD drawings can be relatively high, compared to a hand-written note on the working drawing, especially when only minor works have been carried out • Magnetic storage media can decay, causing loss of information • Hard-copy prints will normally be required for specific purposes, for example maintenance contractors. These include instructions, schedules and working drawings

2.8

RECOMMENDATIONS FOR DOCUMENT CONTROL

The recommended contents page matrix (Section 2.6) provides a control regime for the compiled O&M manual. The manual should only contain the information that has been annotated as being compiled; there is no need to add blank pages for the parts yet to be compiled or that are not applicable.

The recommended checklists generated from these contents matrices provide the manual user with information indicating those responsible for any new material. This may be in parts yet to be compiled or when compiled sections are known to require updating, for example during the development of the manual. These checklists also provide the required date for the issue of these additions.

The recommended page format (Section 2.5) provides document control for each section, subsection or (if required) sub-subsection. It is recommended that the O&M manual clearly states the section referencing adopted. To assist users to initiate changes to the manual, those responsible for compiling and maintaining the information are identified.

It is recommended that the majority of O&M manuals should follow a loose-leaf format as this enables printed copies to be produced easily and can also be incorporated into on-line documentation systems. It is recommended, too, that the text be prepared using a word-processing package (as used in the compilation of this guide). These procedures will generally be found to be the most cost-effective method of production. If well managed, this system will accommodate all of the production stages of the O&M manual and allow full records to be maintained conveniently.

In order to safeguard the investment in any computer-based software system all the files, software systems and data files should be backed-up to a suitable medium at regular intervals. This medium should be stored in a fireproof location in a separate building to the main computer storage medium. Adequate schedules and records should be maintained within the O&M manual to enable every file to be traced.

It is recommended that the lead author records the issue of each copy of the O&M manual in a register. Each document should be identified by a copy number on the title page. Where authorised, uncontrolled copies may be issued for information purposes only. These copies should be recorded and both register and title page(s) marked "Uncontrolled Document". It is recommended that the lead author is responsible for ensuring that all controlled documents are kept up to date. When using paper copies one method of demonstrating compliance is to request the return of all superseded material together with a signed receipt form.

It is recommended that all companies involved in the production of the O&M manual should have, and be actively operating, a reliable quality management system to the requirements of BS EN ISO 9000: 1994 *Quality management and quality assurance standards*¹⁷.

These procedures are equally applicable to all methods used in the production of O&M manuals: the investment warrants adequate protection.

Contents and format of the General Records volume

3.1

INTRODUCTION

A General Records volume (GRV) provides the building owner with records of essential information for the building to be legally and safely planned, constructed, commissioned, operated, maintained and demolished; ie the manual should relate to the full life-cycle of the building. It should also contain the procedures and safeguards for producing and maintaining the O&M manual over the full life-cycle of the building. The GRV should contain the information to determine the content and style of the other two O&M manual volumes: the Operations volume (OV) and the Maintenance volume (MV).

The Workplace Health, Safety and Welfare Regulations 1992¹⁰ place duties of compliance on persons who are to any extent in control of a workplace with an obligation to ensure that these regulations are met and maintained. These regulations cover the building services and the building fabric. The information for the building services installations should be developed into manuals with reference to BSRIA Guidance Documentation^{1,2}. It is recommended that the GRV contain, as a minimum, appropriate cross-referencing to these manuals. Consideration should be given whether it is in the best interests of the parties to combine these manuals into one document.

It is recommended that the GRV contain the relevant information for the building fabric covering, for example:

- foundations, frames, floors, walls, ceilings and roofs
- doors, gates, stairs, windows and skylights
- workspace, sanitary facilities and rest rooms
- pedestrian and traffic access
- physical safeguards for persons working in or on the building
- emergency routes and exits
- loading bays and ramps.

The preparation of the GRV will benefit the building owner by:

- providing the mechanism for ensuring the building and services comply with the regulations
- providing the mechanism to demonstrate the retained building value derived from efficient usage and proper maintenance during the building lifecycle
- providing the impetus to form the required links between the project team comprising the client, design team, building contractor, maintenance organisation and lead author of the O&M manual (includes GRV)
- maximising the effectiveness of the project team early in the building contract
- providing a nucleus of information developed during the building contract that should minimise reworking, avoid delays, reduce last-minute decision-making and resolve problems of ill-defined briefs that might otherwise go unnoticed

- providing a source of information when:
 - commissioning the building
 - investigating accidents and functional failures
 - carrying out and recording inspections
 - planning and implementing changes of use
 - planning and implementing alterations to the building
 - effecting the disposal or demolition of the building.

3.2

SOURCES OF INFORMATION AND CONTENT

The building owner or client is the most likely source of information for:

- the general details and specification for the building, including:
 - client requirements
 - matters relating to the site and any building:
 - ownership and interests
 - boundaries
 - easements and restrictive and other covenants
 - other legal constraints
 - planning consents applied for, obtained and rejected
 - measured surveys
 - explorations
 - any relevant environmental factors
 - any requirement to conform to client systems or working methods including details relating to operation, maintenance and service life
 - previous uses
 - further matters relating to client's requirements, including:
 - schedule of accommodation
 - general level of quality of specification
 - any proposed or previous uses likely to have an adverse affect relating to health and safety considerations or the durability of the structure
- the requirements and procedures for maintaining and updating the O&M manual.

The design team is the most likely source of information for:

- a design statement for the building indicating
 - principles of design
 - means of escape philosophy
 - fire strategy including compartmentation and rating
 - built-in security arrangements
 - building considerations for those with special needs
 - British Standard codes and other technical documents used in the design
 - material strengths
 - foundation design parameters (ground bearing pressures, range of pile loads etc)
 - loading capacity
 - water table levels
 - statutory drawings provided for planning permission and building regulations
 - as-built drawings identifying critical dimensions
 - project specification
 - block and space planning concepts
- principles of design by each subcontractor, for example:
 - foundations, piling
 - structural concrete, steelwork, timber
 - precast concrete
 - masonry support systems

- cladding
- ceilings
- partitions
- grilles
- platforms
- room schedules indicating surface finishes including:
 - required function (cleanability, electrostatic, moisture resistant, etc.)
 - material
 - supplier and manufacturer details and product brochures
- door schedules indicating:
 - fire doors and rating
 - ironmongery
 - door type
 including for all:
 - detailed specification
 - sizes
 - supplier and manufacturer details and product brochures
- window and glazed screen schedules indicating:
 - supplier and manufacturer details and brochures
 - ironmongery, including a detailed specification
 - sealants used
- brickwork, blockwork, stone used including supplier and manufacturer details
- external (hard and soft) and internal landscaping
- names of planted items and notes on their upkeep if not covered by the design life summary.

The contractor is the most likely source of information for:

- the as-built information where not supplied by the design team.
- the relevant information from suppliers, manufacturers, installers and subcontractor relating to:
 - product data
 - requirements and procedures for operation and maintenance
 - proof or load test certificates
- all warranties and guarantees.

The building occupier or facilities manager is the most likely source of information for:

- the information required by the building owner to produce life-cycle records including for example:
 - historical
 - operation and maintenance
 - breakdown and failure
 - costs

and in the case of an existing building for:

- building user guides and information
- building policies and practices
- emergency procedures, disaster recovery etc.

RECOMMENDED SECTIONING OF CONTENT

Section 2.3 recommended that the GRV contents be organised to follow the *Common Arrangement of Work Sections for Building Works (CAWS)*¹³, so as to minimise reworking of data. The section headings and sub-headings are given below.

Section

0 EMERGENCY CONTACTS		
Emergency contacts		Contents
Health and safety hazards		Checklists
Manual concept		
A PRELIMINARIES/GENERAL CONDITIONS		
The project generally		Contractor's general cost items
The contract		Work by others or subject to instruction
Employer's requirements		
B COMPLETE BUILDINGS		
Proprietary buildings		
C DEMOLITION/ALTERATION/RENOVATION		
Demolition		Repairing/renovating
Alteration – composite items		concrete/masonry
Alteration – support		Repairing/renovating metal/timber
D GROUNDWORK		
Ground investigation/stabilisation/ dewatering		Piling Diaphragm walling
Excavation/filling		Underpinning
E IN-SITU CONCRETE/LARGE PRECAST CONCRETE		
In-situ concrete		In situ concrete sundries
Formwork		Precast concrete large units
Reinforcement		Composite construction
F MASONRY		
Brick/block walling		Masonry accessories
Stone walling		
G STRUCTURAL/CARCASSING METAL/TIMBER		
Structural/carcassing metal		Metal/timber decking
Structural/carcassing timber		
H CLADDING/COVERING		
Glazed cladding/covering		Slab cladding
Sheet/board cladding		Slate/tile cladding/covering
Profiled sheet cladding/covering/siding		Malleable sheet coverings/cladding
Profiled panel cladding		
J WATERPROOFING		
Cementitious coatings		Liquid applied coatings
Asphalt coatings		Felt/flexible sheets
K LININGS/SHEATHING/DRY PARTITIONING		
Rigid sheet sheathing/linings		Dry partitions/linings
Board/strip sheathing/linings		False ceilings/floors
L WINDOWS/DOORS/STAIRS		
Windows/rooflights/screens/louvres		Stairs/galleries/balustrades
Doors/shutters/hatches		Glazing
M SURFACE FINISHES		
Screeds/trowelled flooring		Rigid tiles
Plastered coatings		Flexible sheet/tile coverings
Work related to plastered coatings		Painting

N FURNITURE/EQUIPMENT	
General purpose fixtures/furnishings/ equipment	Special purpose fixtures/furnishings/ equipment
P BUILDING FABRIC SUNDRIES	
Sundry proofing/insulation	Sundry work in connection with engineering services
Sundry finishes/fitings	
Q PAVING/PLANTING/FENCING/SITE FURNITURE	
Edgings for pavings	Fencing
Pavings	Site furniture
Site planting	
R DISPOSAL SYSTEMS	
Drainage	Refuse disposal
Sewerage	
S PIPED SUPPLY SYSTEMS	
Water supply	Other supply systems
Treated water supply	Fire-fighting – water
Gas supply	Fire-fighting – gas/foam
Petrol/oil storage	
T MECHANICAL HEATING/ COOLING/REFRIGERATION SYSTEMS	
Heat source	Heat recovery
Primary heat distribution	Central refrigeration/ Distribution
Heat distribution/utilisation – water	Local cooling/refrigeration
Heat distribution/utilisation – air	
U VENTILATION/AIR CONDITIONING SYSTEMS	
Ventilation/fume extract	Air conditioning – hybrid
Industrial extract	Air conditioning – local
Air conditioning – all-air	Other air systems
V ELECTRICAL SUPPLY/POWER/LIGHTING SYSTEMS	
Generation/supply/HV distribution	Special lighting
General LV distribution/lighting/power	Electric heating
Special types of supply/distribution	General/other electrical work
W COMMUNICATIONS/SECURITY/CONTROL SYSTEMS	
Communications – speech/audio	Protection
Communications – audio-visual	Control
Communications – data	Security
X TRANSPORT SYSTEMS	
People/goods	Documents
Goods/maintenance	
Y SERVICES REFERENCE SPECIFICATION	
Pipelines and ancillaries	Cables and wiring
General pipeline equipment	General electrical equipment
Air ductlines and ancillaries	Other common electrical items
General air ductline equipment	Other common mechanical and/or electrical items
Other common mechanical items	
Z BUILDING FABRIC REFERENCE SPECIFICATION	
Fabricating	Finishing
Fixing/jointing	

Note: The table has been given as guidance to the compiler of the O&M manual. Section and subsection headings may be omitted, or others added, as required to suit the particular project.

3.4

RECOMMENDED FORMAT

The recommendations for the structure, format and content of the GRV are given in Sections 2.4, 2.5 and 3.3 respectively. Following the document control procedure outlined in Section 2.6, an example skeleton contents page for the GRV Section A, Preliminaries/General conditions, should contain:

- a header, all pages, identifying the page within the O&M manual:

Project name	General Records volume
Preliminaries/general conditions	Vol 1 – Section A
	Page 1 of 10

- a table, on the first page of each section, identifying the section contents:

		STANDARD HEADING									
		0	1	2	3	4	5	6	7	8	9
A Preliminaries/general conditions		Contents	Introduction	Design life	Design and technical information	Operating instructions	Health and safety information	Environmental considerations	Drawings	Maintenance	Cost records
SUBSECTION											
A1	The project generally	n/a		•	•	•	•	•	•	•	•
A2	The contract	n/a		n/a	n/a	n/a	•	•	n/a	n/a	n/a
A3	Employer's requirements	n/a									
A4	Contractor's general cost	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
A5	Work by others	n/a		•	•	•	•	•	•	•	•

	Compiled
•	not yet compiled
n/a	not applicable

- and a footer, all pages, identifying the document:

Rev: 0	Originator:	Approved:	Doc: GRV1_r00
Date: 15/10/1996			Disk: GRV01

3.5

CHECKLISTS

The contents tables should be converted to a series of checklists. A typical checklist for the GRV Section A, Preliminaries/general conditions, with the contents table as illustrated above, has been developed in outline as follows:

CHECKLIST FOR THE COMPILER						
Section A		Preliminaries/general conditions				
Subsection	Building element/heading	Responsibility for preparation or updating	Revision no	Actioned/ submitted by date	Accepted/ approved by date	Comment
A1 The project generally	1	lead author	0	lead author dd/mm/yy		Skeleton
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
A2 The contract	1	lead author	0	lead author dd/mm/yy		Skeleton
	5					
	6					
A3 Employers requirements	1	lead author	0	lead author dd/mm/yy		Skeleton
	2	lead author	0	lead author dd/mm/yy		Skeleton
	3	lead author	0	lead author dd/mm/yy		Skeleton
	4	lead author	0	lead author dd/mm/yy		Skeleton
	5	lead author	0	lead author dd/mm/yy		Skeleton
	6	lead author	0	lead author dd/mm/yy		Skeleton
	7	lead author	0	lead author dd/mm/yy		Skeleton
	8	lead author	0	lead author dd/mm/yy		Skeleton
	9	lead author	0	lead author dd/mm/yy		Skeleton
A5 Work by others	1	lead author	0	lead author dd/mm/yy		Skeleton
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					

The checklist includes only the sections requiring compilation. Contents pages, checklists and preliminary information (see Section 2.6) should be compiled into an skeleton O&M manual for distribution to the project's interested parties. Agreement should be gained on:

- the basis for the management of the initial production of the manual
- the required content of the proposed manual
- the format of the manual
- IT systems to be used (if required)
- responsibility for the preparation of each section
- responsibility for the provision of material for each section
- timescales for the preparation of each section
- basis for keeping the manual up to date.

These checklists have the potential to provide an effective way to manage and demonstrate that the requirements of the CDM Regulations have been satisfied. In conjunction with the document control procedures needed for the O&M manual (see Section 2.8), they can also be used in the production of the health and safety file.

Contents and format of the Operations volume

4.1

INTRODUCTION

The Operations volume (OV) provides essential information to enable building users and occupiers to cost-effectively, safely and legally utilise the building during its planned life-cycle. The document, commissioned by the building owner, should give clear instructions to users and occupiers on the use of the building. It should comply with UK and EU legal requirements, in particular the Workplace Health, Safety and Welfare Regulations 1992¹⁰.

The preparation of the OV will benefit the building owner by:

- providing the impetus to form communication links between the project team members, comprising the client, design team, installation contractor, maintenance organisation and the lead author of the O&M manual (including the OV)
- maximising the effectiveness of the project team, thereby reducing costs by minimising reworking, avoiding delays and reducing last-minute decision-making
- providing the mechanism for ensuring the building and services are operated in a way that ensures they best retain their value through:
 - efficient usage
 - minimal risk of misuse and misunderstanding
 - proper maintenance during the building life-cycle.

The OV will benefit the building user and occupiers by providing:

- a list of emergency procedures
- a means of creating safety awareness
- the basis for correct and efficient building operation
- a reduction in disruptive and costly effects of breakdown or failure that might force unplanned closure of parts of the building
- the most economic use of energy
- maximum utilisation and minimum costs
- a comprehensive source of reference, for example:
 - as a basis for staff training
 - for use during modifications or changes in use
 - when ordering spares/replacements
 - commissioning information
 - for effective operation and maintenance
 - a basis for maintenance tendering
 - information on components, their limitations and usage.

The OV will also provide data of use to facilities management and maintenance teams when carrying out their tasks. It should provide details on the operation of the building with appropriate cross-references to the building services manuals that should be developed with reference to BSRIA guidance documentation^{1,2}. The content and style of the OV will be determined by information collated in the GRV. Depending on the size and specific operational requirements for the building, the OV and building services manuals may be incorporated into one document or kept as separate volumes.

BSRIA Technical Note TN 1/84⁴ identifies four classes of O&M manual in increasing scope, as below.

- **Class A** basic record drawings and as-received literature or manuals
- **Class B** record drawings, operating instructions and manuals, test certificates and lists of components
- **Class C** purpose and planning information, technical documentation including record drawings, full operating instruction for all systems, detailed maintenance instructions and schedules, components lists, modification instructions, disposal instructions
- **Class D** as Class C, plus procedures and results of all tests undertaken during the commissioning period and after changes in use or modifications.

For relatively small buildings using simple control systems where Class A or B documentation is considered sufficient, a single volume should prove adequate. For the larger, more complex buildings, where the extra costs in producing documentation to BSRIA Class C or D is justified, it should be decided early in the contract whether all parties would benefit from the production of one or more volumes.

The OV should be updated to provide a comprehensive historic record of any changes to the volume and, when deemed necessary, the actual operational costs of the building.

4.2

SOURCES OF INFORMATION AND CONTENT

The other volumes of the O&M manual will contain information relevant to the compilation of OV. In addition:

The building owner is the most likely source of information for:

- the general details, specification and overall objectives for the operation of the building and the procedures for updating and maintaining the OV. These should include, but not necessarily be limited to, details of:
 - security arrangements
 - procedures and methods in dealing with fire, flooding, bomb threats etc
 - consideration for those with special needs
 - the environmental conditions provided
 - occupancy times
 - the implications on operations of failure of any component
 - responsibility for maintaining the OV.

The design team is the most likely source of information for:

- listing of the imposed design loading for the project.
- details of any special design requirements, for example:
 - due to high or low temperature processes, eg ice rinks
 - vibration
 - occasional events
- instructions if parts of the structure are removable, for example:
 - large removable plant accesses
 - knock-out panels for future alterations
- general details of operational requirements, for example:
 - fire strategy, including escape routes
 - heating and air-conditioning
 - lighting
 - plumbing and toilet facilities

- acoustic properties and noise control
- general details for operating architectural items, such as:
 - windows and doors
 - sliding and folding partitions
 - blinds and curtains (if major items)
- method for cleaning windows, for example:
 - cradle from roof
 - safety eyes within building
 - fully reversible windows.

In conjunction with suppliers or manufacturers:

- advice on cleaning materials, to be and not to be used.

4.3

RECOMMENDED SECTIONING OF CONTENT

Section 2.3 recommended that, to facilitate the systematic assessment and recording of service and design life, the content of the OV should be organised under the section headings given in BS 7543¹⁴. The section and subsection headings are given below.

Section

0	EMERGENCY CONTACTS	
	Emergency contacts	Contents
	Health and safety hazards	Checklists
	Manual concept	
1	GENERAL PROJECT DESCRIPTION	
	Project description	Contract team
	Site information	Statutory approvals
2	SUBSTRUCTURE	
	Foundations	Solid floors
	Retaining walls	
3	PRIMARY ELEMENTS	
	External wall	Roof structure
	Internal walls (fixed partitions)	Structural frame
	Suspended floors (stair)	Stair
4	SECONDARY EXTERNAL ELEMENTS	
	Doors and shutters	Balconies
	Windows	Balustrades and railings
	Roof lights	Fire escape
5	SECONDARY INTERNAL ELEMENTS	
	Doors and screens	Suspended ceilings
	Demountable partitions	Access floors
6	EXTERNAL FINISHES	
	Walls, windows and doors	Stairs and steps
	Roof claddings and membranes	Sealants
7	INTERNAL FINISHES	
	Walls and doors	Floors (and skirtings)
	Ceilings	Stairs
8	SERVICE INSTALLATION	
	Underground drainage	Mechanical ventilation
	Rainwater gutters and downpipes	Electrical installation
	Hot and cold water supply	Transport (lifts)
	Space heating	Communications, security
9	FITTINGS	
	Fixed/built-in fittings or features	Light fittings
	Storage, kitchen fittings	Signs
	Sanitary appliances	

10 EXTERNAL WORKS

Roads and drives, footpaths
Hardstandings
Walls and fences

Planting
Site services
Lighting and security

Note: The table has been given as guidance to the compiler of the O&M manual. Section and subsection headings may be omitted, or others added, as required to suit the particular project.

4.4

RECOMMENDED FORMAT

Sections 2.4, 2.5 and 4.3 give recommendations for the structure, format and content of the OV. A typical contents page for OV Section 1, General project description, should contain:

- a header, all pages, identifying the page within the O&M manual:

Project name	Operations volume
General project description	Vol 2 – Section 1
	Page 1 of 15

- a table, on the first page of each section, identifying the section contents:

STANDARD HEADING										
	0	1	2	3	4	5	6	7	8	9
1 General project description	Contents	Introduction	Design life	Design and technical information	Operating instructions	Health and safety information	Environmental considerations	Drawings	Maintenance	Cost records
SUBSECTION										
1.1 Project description	n/a	•	•	•	•	•	•	•	•	•
1.2 Site information	n/a	•	•	•	•	•	•	•	•	•
1.3 Contract team	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1.4 Statutory approvals	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

•	Compiled
•	not yet compiled
n/a	not applicable

- and a footer, all pages, identifying the document:

Rev: 0	Originator:	Approved:	Doc: OV1_r00
Date: 15/10/1996			Disk: OV01

CHECKLIST

The contents tables for each section of the OV should be drawn up during the development of the O&M manual for the building. These tables should be compiled to meet the requirements of the interested parties to the project based on the recommendations in Section 2.6. They should then be converted to a series of checklists. These checklists can provide an effective way to manage and demonstrate that the requirements of the CDM regulations have been satisfied. In conjunction with the document control procedures needed for the O&M manual (Section 2.8), they can also be used in the production of the health and safety file. A typical checklist for the OV Section 1, General project description, with the contents table as illustrated above has been developed in outline as below.

CHECKLIST FOR THE COMPILER						
Section 1		General project description				
Subsection	Building element/section	Responsibility for preparation or updating	Revision no	Actioned/ submitted by date	Accepted/ approved by date	Comment
1.1 Project description	1	lead author	0	lead author dd/mm/yy		Skeleton
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
1.2 Site information	1	lead author	0	lead author dd/mm/yy		Skeleton
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
1.3 Contract team	1	lead author	0	lead author dd/mm/yy		Skeleton
1.4 Statutory approvals	1	lead author	0	lead author dd/mm/yy		Skeleton

Contents and format of the Maintenance volume

5.1

INTRODUCTION

The Maintenance volume (MV) of the O&M manual provides the essential information that enables the building owner and facilities management to maintain the building safely. It also provides a comprehensive historic record of the actual maintenance activity and cost: that is, the MV should record the full life-cycle maintenance requirements of the building fabric. The preparation of the MV will benefit the building owner by:

- providing the impetus to form the required links between the project team comprising the client, design team, building contractor, maintenance organisation and lead author of the O&M manual (including the MV)
- maximising the effectiveness of the project team, thereby reducing actual building maintenance costs
- providing a mechanism to satisfy conditions attached to warranties and guarantees
- providing a mechanism to satisfy health and safety regulations
- providing a mechanism for ensuring the building fabric and services are maintained and operated in a way that ensures they best retain their value through proper maintenance and efficient usage during the complete building life-cycle
- minimising costs of unplanned maintenance, ie failures or other functional problems
- providing a mechanism to record costs over the whole life of the building that permits comparison within and between facilities and between design and actual building maintenance performance.

The MV will benefit the building facilities management and users by providing:

- a list of emergency procedures
- a means of creating safety awareness
- the basis for correct and efficient building fabric maintenance
- the most economic use of energy
- maximum utilisation and minimum costs
- a comprehensive source of reference, for example:
 - as a basis for staff training
 - for use during modifications or changes in use
 - when ordering spares/replacements
 - commissioning information
 - for effective maintenance
 - a basis for maintenance tendering
 - information on components, their limitations and usage.

The MV, with appropriate cross-referencing to the building services manuals, developed with reference to BSRIA Guidance Documentation^{1,2}, will provide data on the whole-life cost of operating the building and its maintenance. It thus provides records that are essential for efficient facilities management and the development of more effective environmental cost management.

The content and style of the MV will be determined by information collated in the GRV of the O&M manual.

The MV should be updated to provide a comprehensive historic record of any changes to the volume and, when deemed necessary, the actual maintenance costs of the building.

5.2

SOURCES OF INFORMATION AND CONTENT

The other volumes of the O&M manual will contain information relevant to the compilation of MV. In particular, it is recommended that the agreed client's maintenance strategy be restated in the MV.

The design team is the most likely source of information for:

- design life record and design life summary sheets that conform to the format given in BS 7543 1992¹⁴. They are summarised below and detailed, with notes for compilers, in Sections 5.3.1 and 5.3.2. Section 6, Specimen documents, gives example proforma for the design life record (Section 6.3) and the design life summary (Section 6.3.1).

The design life record contains:

- general details
- details of the required service life of the building
- the design life of building
- basic data.

The design life summary contains details for each construction element details of:

- material or type
- category of design life:
 - replaceable
 - maintainable
 - lifelong
- maintenance requirement
- method of maintenance
- category of failure, ranging from:
 - danger to life, for example sudden collapse
 - to
 - no exceptional problem, for example replacement of fitting.

RECOMMENDED SECTIONING OF CONTENT

To facilitate the systematic assessment and recording of service and design life, Section 2.3 recommended that the content of the MV should be organised under the headings given in BS 7543¹⁴. The section and subsection headings are shown below.

Section

0	EMERGENCY CONTACTS Emergency contacts Health and safety hazards Manual concept	Contents Checklists
1	GENERAL PROJECT DESCRIPTION Project description Site information	Contract team Statutory approvals
2	SUBSTRUCTURE Foundations Retaining walls	Solid floors
3	PRIMARY ELEMENTS External wall Internal walls (fixed partitions) Suspended floors (stair)	Roof structure Structural frame Stair
4	SECONDARY EXTERNAL ELEMENTS Doors and shutters Windows Roof lights	Balconies Balustrades and bailings Fire escape
5	SECONDARY INTERNAL ELEMENTS Doors and screens Demountable partitions	Suspended ceilings Access floors
6	EXTERNAL FINISHES Walls, windows and doors Roof claddings and membranes	Stairs and steps Sealants
7	INTERNAL FINISHES Walls and doors Ceilings	Floors (and skirtings) Stairs
8	SERVICE INSTALLATION Underground drainage Rainwater gutters and downpipes Hot and cold water supply Space heating	Mechanical ventilation Electrical installation Transport (lifts) Communications, security
9	FITTINGS Fixed/built-in fittings or features Storage, kitchen fittings Sanitary appliances	Light fittings Signs
10	EXTERNAL WORKS Roads and drives, footpaths Hardstandings Walls and fences	Planting Site services Lighting and security

Note: The table has been given as guidance to the compiler of the O&M manual. Section and subsection headings may be omitted, or others added, as required to suit the particular project.

BS 7543¹⁴ was drafted to “assist the communication of information on durability between the parties involved in a building project”. It is “intended to discourage unrealistic expectations of service life of buildings and parts of buildings”. The data is presented in total as a project design life summary and selected elements repeated as the initial design statement for each section of the MV Guidance notes for the compiler of these records are given in Sections 5.3.1 and 5.3.2.

Design life record

Section 6.3 shows, in outline, a design life record that conforms to the format given in BS 7543¹⁴. The BS 7543¹⁴ definitions of terms applies to the following notes for compilers that give details the content for these records:

- Item 1 General details
 - 1(a) Name:
 - this should be name by which the building will be known during its life; where this is different from that used in the design, cross-referencing should be made here
 - 1(A) and location:
 - postal address
 - 1(b) Designer:
 - name of principal designer or design organisation
 - 1(c) Date:
 - of practical completion
 - 1(d) Related documents, including:
 - client's brief or employer requirements
 - contractors proposal
 - employer variations together with date of issue of each
 - 1(E) Preliminary design, including:
 - the drawings from which the final design was developed
- Item 2 Required service life of building:
 - 2(a) Category of building life as specified by the client in the client's brief or performance specification and should be one of the following:
 - Temporary up to 10 years
 - Short 10 years
 - Medium 30 years
 - Normal 60 years
 - Long 120 years

The absence of any specific definition would imply the Normal category unless otherwise agreed with the client
- Item 3 Design life of building
 - 3(a) Design life in years
 - at least the required service life, but less than the minimum predicted service life of any of the non-replaceable building components. The value is highly dependent on factors, such as maintenance, which are beyond the designers' direct control. A margin of safety should therefore be applied to the predicted life or default to the required service life
 - 3(b) Basis for choice of design life:
 - client's or funding authority's requirement
 - normal for building type
 - 3(c) Designers' recommended maintenance level, one of the following:
 - Level 1 – repair only
 - Level 2 – scheduled maintenance plus repair
 - Level 3 – condition based maintenance plus repair

together with the frequency of inspection
- Item 4 Basic data:
 - 4(a) Basic wind speed:
 - as used by the designers and agreed with Building Control
 - 4(b) Driving rain index:
 - as used by cladding designers

- 4(c) Height above sea level:
 - Ordnance Datum level; give ground level to nearest 5 metres, or, if there is a great variation, give maximum and minimum
- 4(d) Other relevant environmental factors, for example:
 - give proximity of pollutants especially if contaminated site beneath or adjacent to contract
 - risk of flooding or subsidence
 - natural risks (trees, wind-blown sand, animals or birds)
- 4(e) Proposed uses likely to have adverse affect on durability, for example:
 - rough use by adults or children
 - presence of large and/or surging crowds
 - toxic or other industrial processes
 - vibration

and note if the effect is general or limited to parts of the contract.

5.3.2

Design life summary

Sections 6.3.1, 6.3.2 and 6.3.3 give outline specimen documents of the design life summary records using each of the listed construction elements from Appendix A of BS 7543¹⁴. When compiling the records the following conventions are recommended:

- Column 1, Construction elements:
 - the given items should be used as a checklist but should be extended where construction features have specific maintenance requirements or if a building has a mixture of construction forms
- Column 2, Material or type:
 - indicate the material or type of construction used. Where several materials or types are used they must be listed separately to enable requirements specific to each to be indicated
- Column 3, Category of design life for components:
 - tick appropriate box in column 3 according to BS 7543¹⁴: Table 2 as below:

Category	Description	Life	Typical examples
1	Replaceable	Shorter life than the building and replacement can be envisaged at design stage	Most floor finishes and service installation components
2	Maintainable	Will last, with periodic treatment, for the life of the building	Most external cladding, doors and windows
3	Lifelong	Will last for the life of the building	Foundations and main structural elements

- Column 4, Frequency of maintenance, repair or replacement:
 - an entry is required for all elements *except* those needing no attention during the building life, that is items marked as lifelong in the previous entry
 - where periodic replacement is assumed, this will need to be confirmed by inspection
- Column 5, Methods of maintenance and repair
 - indicate the type of maintenance and or repair including any special techniques or specialists
 - indicate form of access needed – for example, cherry-picker, scaffold, ladder – and whether cladding has to be removed or areas of building vacated
 - as described in BS 7543¹⁴: Table 4 as follows:

Level	Description	Scope	Examples
1	Repair only	Maintenance restricted to restoring items to their original function after failure	Replacement of jammed valves; reglazing of broken windows
2	Scheduled maintenance plus repair	Maintenance work carried out to a predetermined interval of time, number of operations, regular cycles etc (see note)	Five-yearly external joinery painting cycle. Five-yearly recoating of roof membrane with solar reflective paint
3	Condition-based maintenance plus repair	Maintenance carried out as a result of knowledge of an item's condition (the condition having been reported through a systematic inspection procedure)	Five-yearly inspections of historic churches etc, leading to planned maintenance

NOTE: The length of the regular maintenance cycle is an important factor. It may be stated in the brief or agreed while the design is being developed.

- BS 8210²⁰ recommends systematic inspections as follows:
 - (a) continuous, regular observation by the building user as part of the occupancy of the building
 - (b) annual visual inspection of the main elements under supervision of suitability qualified personnel
 - (c) full inspection of the building fabric by suitably qualified personnel at least every five years
 there may be statutory requirements for more frequent inspections
- Column 6, Category of failure
 - indicate category letter as described in the following Table 5 of BS 7543¹⁴:

Category	Effect	Example
A	Danger to life (or of injury)	Sudden collapse of structure
B	Risk of injury	Loose stair nosing
C	Danger to health	Serious damp penetration
D	Costly repair	Extensive scaffolding required
E	Costly because repeated	Window fastening replacement
F	Interruption of building use	Heating failure
G	Security compromised	Broken door latch
H	No exceptional problems	Replacement of light fittings

NOTE: Individual failures can be in two or more categories

5.3.3

Maintenance cost records

If the project warrants establishing records on a computer database with details for individual or groups of components, it requires little further effort to add cost and performance data with each entry. This data can be used to provide information on life-cycle costing for the building and components. It can also be used to:

- highlight the optimum solutions for future building works
- provide information on the attributes of materials or components
- provide lists of materials or components that have given attributes.

Sections 6.3.4 and 6.3.5 illustrate example proforma of maintenance cost records modelled on information from the LINK/CMR¹⁶ research project "Building Performance and Costs-in-Use".

RECOMMENDED FORMAT

Sections 2.4, 2.5 and 5.3 give recommendations for the structure, format and content of the MV. A typical contents page for MV Section 7, Internal finishes, should contain:

- a header, all pages, identifying the page within the O&M manual:

Project name	Maintenance volume
Internal finishes	Vol 3 – Section 7
	Page 1 of 12

- a table, on the first page of each section, identifying the section contents:

STANDARD HEADING										
	0	1	2	3	4	5	6	7	8	9
7 Internal finishes	Contents	Introduction	Design life	Design and technical information	Operating instructions	Health and safety information	Environmental considerations	Drawings	Maintenance	Cost records
SUBSECTION										
7.1 Walls and doors	n/a		•	•	•	•	•	•	•	•
7.2 Ceilings	n/a		•	•	•	•	•	•	•	•
7.3 Floors (and skirtings)	n/a		•	•	•	•	•	•	•	•
7.4 Stairs	n/a		•	•	•	•	•	•	•	•

Compiled

•

not yet compiled

n/a

not applicable

- and a footer, all pages, identifying the document:

Rev: 0	Originator:	Approved:	Doc: MV1_r00
Date: 15/10/1996			Disk: MV01

The MV document record contents tables should be drawn up during the concept development stage for the proposed building, adapted to suit the project from the recommendations in Section 2.6. This table should then be converted to a series of checklists for each section of the MV. These checklists can provide an effective way to manage and demonstrate that the requirements of the CDM regulations have been satisfied. In conjunction with the document control procedures needed for the O&M manual, see Section 2.8, they can also be used in the production of the health and safety file. They can also be used to record maintenance costs throughout the life of the building thereby allowing facilities management of whole-life cost. See Section 6 Specimen documents, 6.3.4 and Maintenance cost records, 6.3.5. A typical checklist for the MV Section 7, Internal finishes, with the contents page as illustrated above has been developed in outline as follows:

CHECKLIST FOR THE COMPILER						
Section 7		Internal finishes				
Subsection	Building element/section	Responsibility for preparation or updating	Revision no	Actioned/ submitted by date	Accepted/ approved by date	Comment
7.1 Walls and doors	1	lead author	0	lead author dd/mm/yy		Skeleton
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
7.2 Ceilings	1	lead author	0	lead author dd/mm/yy		Skeleton
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
7.3 Floors (and skirtings)	1	lead author	0	lead author dd/mm/yy		Skeleton
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
7.4 Stairs	1	lead author	0	lead author dd/mm/yy		Skeleton
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					

6

Specimen documents

This section provides examples of specimen documents in the formats recommended for the O&M manual elsewhere in the text of this guide. To assist compilers, examples of blank and partially developed proforma are given together with notes in italics and reference to the relevant main section of this guide. The partially developed proforma illustrate the level of detail required in the records for a typical project. The following proforma have been included:

Section	Heading	Comment
6.1	Loose-leaf format	Blank page with header and footer
6.2	Document record	Partially developed contents table for Section A of the GRV
6.2.1	Checklist	Partially developed checklist from the contents table matrix in Section 6.2
6.3	Design life record	Proforma based on BS 7543 ¹⁴ model with references to sections for explanatory notes.
6.3.1	Design life summary	Proforma based on BS 7543 ¹⁴ model including section headings and sub-headings as recommended for the OV and MV
6.3.2	Design life summary – continued	Continuation from above
6.3.3	Design life summary – expanded	Expanded version of above for one section heading showing increased level of detail down to group or individual elements
6.3.4	Maintenance cost record by element	Proposed proforma for individual elements to facilitate life-cycle costing to be developed
6.3.5	Maintenance cost record by product	Proposed proforma for individual products to facilitate life-cycle costing to be developed

6.1

LOOSE-LEAF FORMAT

Example of blank page for the O&M manual with recommended header and footer.

Project name		Volume name	
Section title		Vol no Section ref	
Subsection title		Page no of no	

Rev:	Originator:	Approved:	Doc:
Date:			Disk:

Compiler's note: see Section 2.5 for commentary on document format

6.2

DOCUMENT RECORD

Example of a partially developed contents table for Section A of the GRV.

Project name	General records volume
Preliminaries/general conditions	Vol 1 – Section A
	Page 1 of

		STANDARD HEADING									
		0	1	2	3	4	5	6	7	8	9
A Preliminaries/General Conditions		Contents	Introduction	Design life	Design and technical information	Operating instructions	Health and safety information	Environmental considerations	Drawings	Maintenance	Cost records
	SUBSECTION										
	A1 The project generally	n/a		•	•	•	•	•	•	•	•
	A2 The contract	n/a		n/a	n/a	n/a	•	•	n/a	n/a	n/a
	A3 Employer's requirements	n/a									
	A4 Contractor's general cost items	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	A5 Work by others	n/a		•	•	•	•	•	•	•	•

	Compiled
•	not yet compiled
n/a	not applicable

Rev: 0	Originator:	Approved:	Doc: GRV1_r00
Date: 15/10/1996			Disk: GRV01

Compiler's note: see Section 2.6 for commentary on document development, Section 2.8 recommendations for document control and Sections 3.3, 4.3 and 5.3 for listings of the section and subsections headings for the GRV, OV and MV.

6.2.1

Checklist

Example of a partially developed checklist from the contents table matrix in Section 6.2

Project name

General Records volume

Preliminaries/general conditions	Vol 1 – Section A
	Page 2 of

CHECKLIST FOR THE COMPILER						
Section 1			General project description			
Subsection	Building element/section	Responsibility for preparation or updating	Revision no	Actioned/ submitted by date	Accepted/ approved by date	Comment
1.1 Project description	1	lead author	0	lead author dd/mm/yy		Skeleton
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
1.2 Site information	1	lead author	0	lead author dd/mm/yy		Skeleton
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
1.3 Contract team	1	lead author	0	lead author dd/mm/yy		Skeleton
1.4 Statutory approvals	1	lead author	0	lead author dd/mm/yy		Skeleton

Rev: 0	Originator:	Approved:	Doc: GRV1_r00
Date: 15/10/1996			Disk: GRV01

Compiler's note: see Section 3.5 for commentary on the use of these checklists, Section 2.6 document development, Section 2.8 recommendations for document control and Sections 3.3, 4.3 and 5.3 for listings of the section and subsection headings for the GRV, OV and MV.

Example of proforma based on BS 7543¹⁴ model with references to sections for explanatory notes for the compiler.

Design life data sheet		
Designer's proposals for durability		
1	General details (complete in all cases)	
	Name and location of building	<i>see Section 5.3.1 Item 1(a)</i>
	Designer (or design organisation)	<i>see Section 5.3.1 Item 1(b)</i>
	Date	<i>see Section 5.3.1 Item 1(c)</i>
	Related documents	<i>see Section 5.3.1 Item 1(d)</i>
	Preliminary design	<i>see Section 5.3.1 Item 1(e)</i>
2	Required service life of building (complete in all cases)	
	Category of building life	<i>see Section 5.3.1 Item 2(a)</i>
3	Design life of building	
	Design life in years (if different from minimum period for the category)	<i>see Section 5.3.1 Item 3(a)</i>
	Basis for choice of design life	<i>see Section 5.3.1 Item 3(b)</i>
	Maintenance level, designer's recommendations	<i>see Section 5.3.1 Item 3(c)</i>
4	Basic data (complete if required)	
	Basic wind speed (BS 6399: Part 2: 1995)	<i>see Section 5.3.1 Item 4(a)</i>
	Driving rain index (see DD 93)	<i>see Section 5.3.1 Item 4(b)</i>
	Height above sea level	<i>see Section 5.3.1 Item 4(c)</i>
	Other relevant environmental factors	<i>see Section 5.3.1 Item 4(d)</i>
	Proposed uses likely to have an adverse effect on durability	<i>see Section 5.3.1 Item 4(e)</i>

Compiler's note: see Section 5.3.1 for commentary on design life record

6.3.1

Design life summary

Example of proforma based on BS 7543¹⁴ model including section headings and sub-headings as recommended for the OV and MV, see Sections 2.3, 4.3 and 5.3.

Section	1 <i>see Section 5.3.2</i> <i>Column 1</i> Construction elements	2 <i>Column 2</i> Material or type	3 <i>Column 3</i> Category of design life for components			4 <i>Column 4</i> Maintenance, repair and planned replacements (1) plus frequency	5 <i>Column 5</i> Means of maintenance and repair level of maintenance plus access method	6 <i>Column 6</i> Category of failure
			1	2	3			
2 SUBSTRUCTURE 2.1 Foundations 2.2 Retaining walls 2.3 Solid floors	<i>see Section 5.3</i>							
3 PRIMARY ELEMENTS 3.1 External wall 3.2 Internal walls (fixed partitions) 3.3 Suspended floors (stair) 3.4 Roof structure 3.5 Structural frame 3.6 Stair								
4 SECONDARY EXTERNAL ELEMENTS 4.1 Doors and shutters 4.2 Windows 4.3 Roof lights 4.4 Balconies 4.5 Balustrades and railings 4.6 Fire escape								
5 SECONDARY INTERNAL ELEMENTS 5.1 Doors and screens 5.2 Demountable partitions 5.3 Suspended ceilings 5.4 Access floors								
6 EXTERNAL FINISHES 6.1 Walls, windows and doors 6.2 Roof claddings and membranes 6.3 Stairs and steps 6.4 Sealants								
Note (1) The need for replacement should be confirmed by inspection								

Compiler's notes: see Section 5.3.2 for commentary on the completion of each column and Section 5.3 for listing of the section and subsections headings for the MV.

6.3.2

Design life summary – continued

Section	1 Construction elements	2 Material or type	3 Category of design life for components			4 Maintenance, repair and planned replacements (1) plus frequency	5 Means of maintenance and repair level of maintenance plus access method	6 Category of failure
			1	2	3			
7	INTERNAL FINISHES							
7.1	Walls and doors							
7.2	Ceilings							
7.3	Floors (and skirtings)							
7.4	Stairs							
8	SERVICE INSTALLATION							
8.1	Underground drainage							
8.2	Rainwater gutters and downpipes							
8.3	Hot and cold water supply							
8.4	Space heating							
8.5	Mechanical ventilation							
8.6	Electrical installation							
8.7	Transport (lifts)							
8.8	Communications, security							
9	FITTINGS							
9.1	Fixed/built-in fittings or features							
9.2	Storage, kitchen fittings							
9.3	Sanitary appliances							
9.4	Light fittings							
9.5	Signs							
10	EXTERNAL WORKS							
10.1	Roads and drives, footpaths							
10.2	Hardstandings							
10.3	Walls and fences							
10.4	Planting							
10.5	Site services							
10.6	Lighting and security							
Note (1) The need for replacement should be confirmed by inspection								

Compiler's notes: see Section 5.3.2 for commentary on the completion of each column and Section 5.3 for listing of the section and subsections headings for the MV.

6.3.3

Design life summary – expanded

Example of expanded version of the design life summary for one section heading, Primary elements, showing increased level of detail down to group or individual elements.

Section	1 Construction elements	2 Material or type	3 Category of design life for components			4 Maintenance, repair and planned replacements (1) plus frequency	5 Means of maintenance and repair level of maintenance plus access method	6 Category of failure
			1	2	3			
3	PRIMARY ELEMENTS							
3.1 3.1.1	External wall							
3.2 3.2.1	Internal walls (fixed partitions)							
3.3 3.3.1	Suspended floors (stair)							
3.4 3.4.1	Roof structure							
3.5 3.5.1	Structural frame							
3.6 3.6.1	Stair							
Note (1) The need for replacement should be confirmed by inspection								

Compiler's notes: For each of the sections, or if the need arises the subsection headings, the table can be expanded to identify groups of, or individual, elements or components.

6.3.4

Maintenance cost record by element

For each of the elements or components identified within the design life summary records, see Section 6.3.2, maintenance cost records should be generated for life cycle costing purposes. A typical outline table is shown below:

Element no:	Element:	Manufacturer:				
Address:						
Specification:						

	Recommended/actual maintenance date					
COMPLETION DATE (dd/mm/yy)						
REQUIRED SERVICE LIFE (years)						
CAPITAL COST (£/ms GFA)						
Maintenance costs (% cap pa)						
Replacement costs (£)						
Cleaning costs (% cap pa)						
Decoration costs (% cap pa)						
TOTAL OPERATING COST (£ p.a.)						
TOTAL OPERATING COST (£/ms pa)						
NO OF REPLACEMENTS (No)						
OPERATING LEVELS						
1. Maintenance (Scale 1–4)						
2. Cleaning (Scale 1–4)						
3. Security (Scale 1–3)						
OPERATING REPLACEMENTS						
1. Maintenance (description)						
2. Replacement (description)						
3. Cleaning (description)						
4. Decoration (description)						
CONDITIONS OF USE (description)						
FAILURE						
1. Mode (description)						
2. Effect (Table 5 BS 7543)						

Compiler's notes: These records are best prepared on a computer database from which summary information can be obtained to enable comparisons to be made both within the building and between buildings – see Section 5.3.3 for commentary.

6.3.5

Maintenance cost record by product

At the lowest level, for each of the products identified within the design life summary records (see Section 6.3.2) maintenance cost records should be generated for life-cycle costing purposes. A typical outline table is shown below.

PRODUCT DATA SHEET	Project	Project no	Sheet no
		Prepared by	
		Date	
Description of product			

Primary attributes

Notes				

Secondary attributes

Notes				

Life expectancy data

Whole/part					
Replace costs £					
Timing years					

Maintenance data

Operation				
Description				
Frequency				
Cost				

Cost data

Capital cost £	Annual maintenance cost £pa	Discounted NPV £npv years
Factors	Factors	Discount rate

Manufacturers' details

Company details	Product	Availability
	Cat no	

Compiler's notes: these records are best prepared on a computer database from which summary information can be obtained to enable comparisons to be made both within the building and between buildings – see Section 5.3.3 for commentary.

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It is essential for owners, occupiers and maintainers to keep accurate records of their buildings. An operation and maintenance (O&M) manual defines the requirements and procedures for the effective operation, maintenance, decommissioning and demolition of the building. However, to be effective, it must be well conceived and kept up to date. This book shows you how to go about purchasing a manual or compiling your own.

The guide looks at the benefits of O&M manuals and provides advice on how to specify, procure, use and maintain one. It offers guidance on structure, format, content and sources of information. A separate section investigates the options for applying IT to the production, maintenance and use of O&M manuals, covering operating systems, on-line documentation storage and electronic data interchange.

This user-friendly guide presents the information simply and clearly, using boxes and checklists. Although aimed principally at medium and large new construction projects, the basic principles are also applicable to smaller projects and existing buildings. *Operation and maintenance manuals for buildings* is an indispensable guide for all involved in the construction, maintenance and operation of buildings.