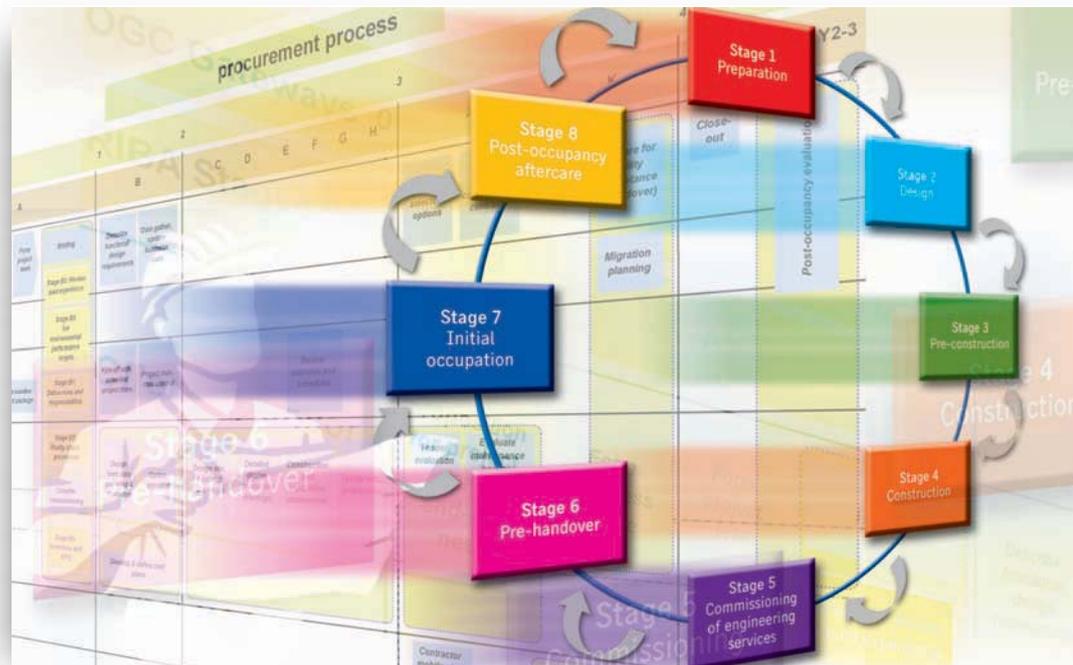


Building Services Job Book



A project framework for engineering services
by Glenn Hawkins

Acknowledgements

The *Building Services Job Book* is a stage-by-stage set of procedures for delivering engineering services in buildings. It is therefore an essential reference document for building services professionals. The job book has been written by BSRIA's Glenn Hawkins with additional information provided by Kevin Pennycook and David Churcher, and has been designed and produced by Ruth Radburn.

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Introduction

What is building services engineering? It is arguable that the terms 'building services' and 'engineering' no longer accurately represent the diverse and influential role of the building services profession.

The building services profession is increasingly blending engineering expertise with knowledge acquired in other fields, such as life sciences, psychology, computer modelling, production management, materials science, organisational behaviour and environmental science. This integrated set of skills is required to satisfy the demands being imposed on the built environment, such as:

- Creation of man-made environments that meet the needs of the present population, without compromising the ability of future generations to meet their own needs
- Careful management of energy, encompassing generation costs, security of supply, efficiency of use and the environmental consequences of waste
- Utilisation of water resources to ensure that production, distribution and use is efficient and pollution is minimised
- Clients who want performance outcomes from their facilities to meet their business, operational and human requirements, rather than technical solutions that do not function as required, are not resilient, are difficult to operate and maintain, consume too much energy and have detrimental effects on the environment
- Fast-track construction programmes that allow clients to start making money from their new or refurbished facilities at the earliest opportunity
- Site working environments that are safe, conducive to high standards of worker health and neighbour-friendly.

In response to these demands for a construction project delivery process that really meets the needs of businesses, society and the environment, building services professionals are being asked to lead the thought process at the inception of projects to provide strategic guidance on issues such as energy, water and new technologies, and to ensure that designs make economic, social and environmental sense. They are also integrating the needs of users and operators in the early stages of the design process. This interaction helps both the project team and the ultimate occupants of the building to understand what is needed in terms of building usability, manageability and maintainability.

Technological advances and demands for shorter programme durations mean that project teams are exploring new ways of designing, making, constructing and operating. Architectural and structural specialists are also recognising the value that building services engineers can bring to the design of the building's form and fabric – as well as the landscape in which it sits – to inform passive design.

Whole-life costing is beginning to inform decision-making in building design. Building services professionals are being expected to understand the whole-life consequences of technical options and communicate them to the project team.

Project teams are being asked to ensure that buildings that are physically complete are also operationally ready when handed over to the client. This requires a different professional emphasis, away from technical inputs and more to operational outcomes. It follows that building services engineers are being expected to assist users and operators during the initial period of building occupation and to fine-tune the engineering systems in the light of initial operating experience.

Inevitably, the building services profession's skills with computer modelling, work sequencing or cost control need to be accompanied by knowledge of methods of obtaining feedback from building performance in-use. Project teams need to understand what works and what doesn't, and to ensure that each building that is delivered is better than the one that's gone before.

So, building services engineer? Energy, water and technologies specialist? Sustainability and engineering systems consultant? Environmental engineering expert? Low-carbon technologist? Engineering ecologist? Whatever the title, the status and importance of this profession is greater now than it has ever been. In a world of increasing technical complexity, population growth, natural resource depletion, climate change, greater lifestyle aspirations and 24-hour global business regimes, it has become even more important. This job book has been written to reflect all these demands, and to provide the organizations and individuals in the construction chain with the tools and procedures to help meet the challenges.

The use in this book of material originally published in BSRIA's BG 6/2009: *A Design Framework for Building Services* shows that the incorporation of mechanical, electrical and public health systems within buildings combines design, manufacturing and installation. Design activities may be undertaken by different types of organisation, such as consultants who only do design, manufacturers who design and manufacture, and installers who design and install. Whatever the contractual relationships, a successful project is only possible when there is a resolve on all sides to work together to produce the optimum solution for the client's requirements. Many clients are well served by consultants, manufacturers and installers acting in this way. This job book helps to promote this relationship.

Glenn Hawkins
BSRIA, July 2009

About this job book

Good buildings need to be well-briefed, well-specified, well-designed, well-constructed, well-commissioned, well-handed over, well-managed and well-evaluated. This job book provides project management guidance for building services professionals to help them – and the project teams with whom they work – achieve these objectives.

The job book is not a textbook about project management principles or techniques. Rather, it aims to help construction project teams to achieve better project outcomes in two different, but complementary, ways:

- By employing an eight-stage project process that starts with a clear definition of a client's business, operational and human requirements, and ends with a post-occupancy evaluation of how these requirements have been met
- By populating each stage of this project process with a series of activity checklists and associated project documentation examples that will help building services professionals execute their work.

In addition to assisting with the management of the programme, cost, quality, safety and environmental elements of a project, the job book's checklists and specimen forms encourage strategic building services input at the inception of the project. The job book also fosters early end-user consultation, clear definition of building performance targets, minimisation of engineering services through passive design, use of efficient and user-friendly controls, off-site manufacture, interdisciplinary preparation of construction works, and clearly defined handover and post-occupancy aftercare works.

The job book has been prepared from a neutral perspective of engineering services, rather than as a tool for a specific discipline, such as a designer, a specialist trade contractor or the package manager of a principal contractor. It adopts an approach that concentrates on the things that need to be considered in order to deliver the best outcomes for the project team, the client and the wider world, rather than what a designer, an installer or a package manager does.

In this manner, it is envisaged that the job book's contents will provide a comprehensive series of focal points that will bring work colleagues and the different members of the project team together during a project's delivery.

The job book does not aim to cover every project management task, every procurement route or every project activity related to building services. Instead, it provides a structured framework of core checklist items and associated project documentation that project personnel can adapt and add to in accordance with their own requirements. Project teams should also be able to apply the guidance at a time and manner that is appropriate to the specific circumstances of each project.

An electronic version of this job book is available with all checklists, tools and templates supplied. For further information go to www.bsria.co.uk/bookshop.

The construction project process

The construction project process used in this job book is composed of a series of eight integrated work stages.

The project process starts with clear identification of the client's requirements, translates these requirements into a design, converts the design into an operationally-ready building, helps users and operators to get to know their building, and concludes with post-occupancy activities to establish the building's fitness for purpose and that it meets requirements to the satisfaction of the end users. The outcome of the post-occupancy stage should feed back into subsequent projects.

Figure 1 provides a simple illustration of the eight work stages and the key principles that should be applied to each work stage.

Figure 1: Stages of work for the construction project process.

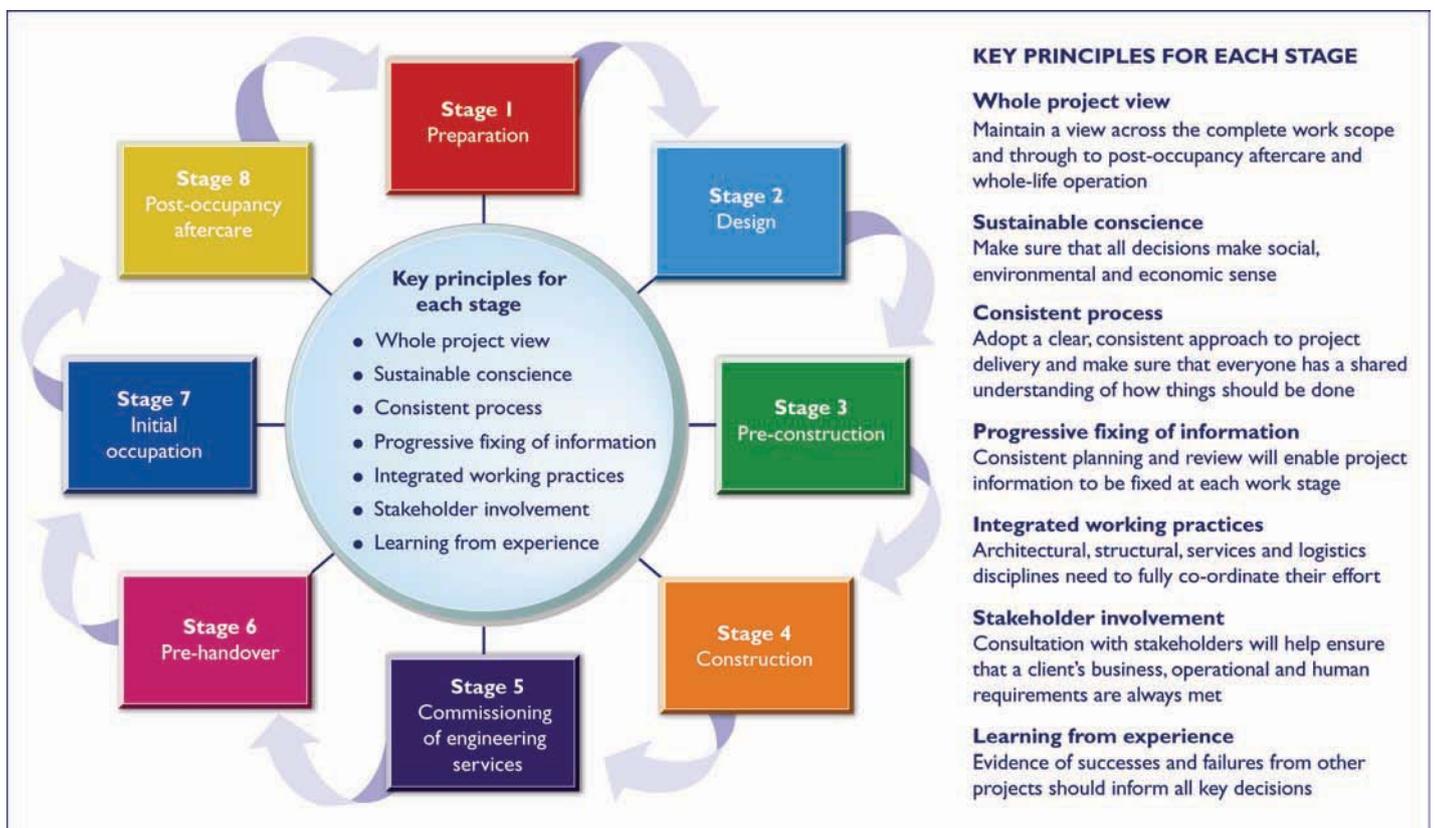
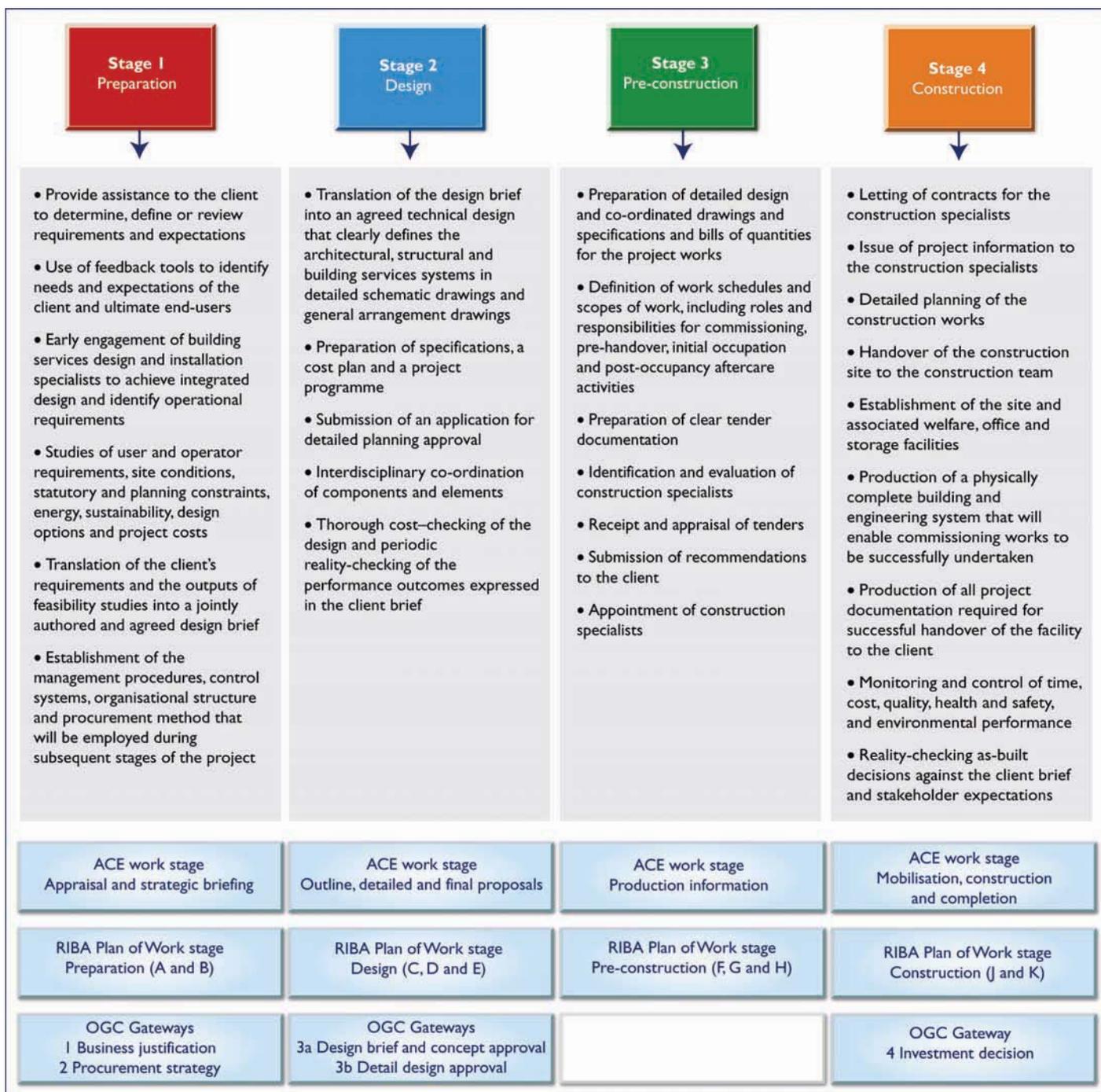
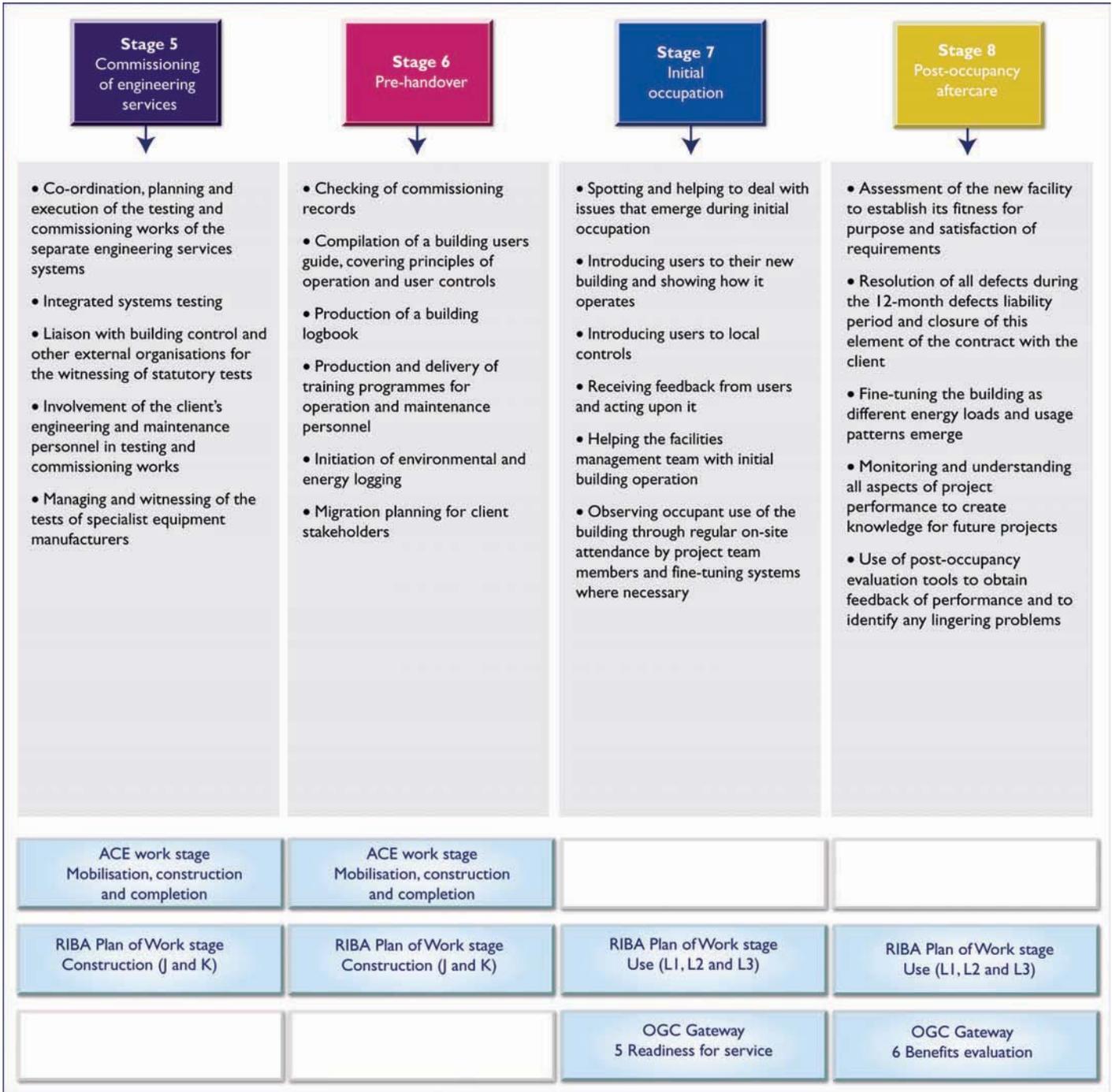


Figure 2, on the following pages, summarises the principal activities that take place at each stage of the project process, and provides an overview of how the work stages of this document correspond with the work stages of the Royal Institute of British Architects (RIBA), The Association of Consulting Engineers (ACE) and the Office of Government Commerce (OGC).

Figure 2: The principal activities for each stage of the project process.





How to use this job book

This project management job book has been designed to make it easy to read and easy to navigate between sections.

The job book is composed of a series of chapters that relate to the different stages of the project process, as shown below:

-  **Stage 1:** Preparation
-  **Stage 2:** Design
-  **Stage 3:** Pre-construction
-  **Stage 4:** Construction
-  **Stage 5:** Commissioning of engineering services
-  **Stage 6:** Pre-handover
-  **Stage 7:** Initial occupation
-  **Stage 8:** Post-occupancy aftercare

Each stage has a colour-coded tab on every page to make it easy to find and is structured in the same manner:

1. An overview of the work stage
2. The role of the building services discipline
3. Work stage inputs
4. Work stage outputs
5. Work stage activity checklists
 - The client and the brief
 - External parties
 - The project team
 - Your company
 - Tests and inspections
6. Tools and templates.

In the printed version of the job book, the notes or comments column of the checklists has been populated with useful information and references to tools and templates contained in the stage activity. This is shown in the example below:

The part of the project to which the checklist items relate is shown here

The phase of the project is shown here

Comments to assist the user of the job book are in grey text

Design phase: Activities checklist			
The client and the brief	Tick if relevant	Initial if completed	Notes or comments
The layout, naming and numbering protocols in the design management plan are in accordance with the client's standards			It is essential to verify criteria such as definitions, drawing production, master outlines, drawing numbering, room numbering, floor naming, drawing frames, standard layering, m&e symbols and file submission ▶▶ For a client brief document template go to Page 15

The activity that should be checked is described in this column

References to tools and templates contained in the job book are in blue text

In the electronic version of the job book, the text in the notes and comments column is hidden, so that the user can complete this column with information that relates to the project they are working on.

When using the tools and templates of each work stage, the user, should replace the fictitious logo with their company logo and provide a document reference, project title and project number, as shown below.

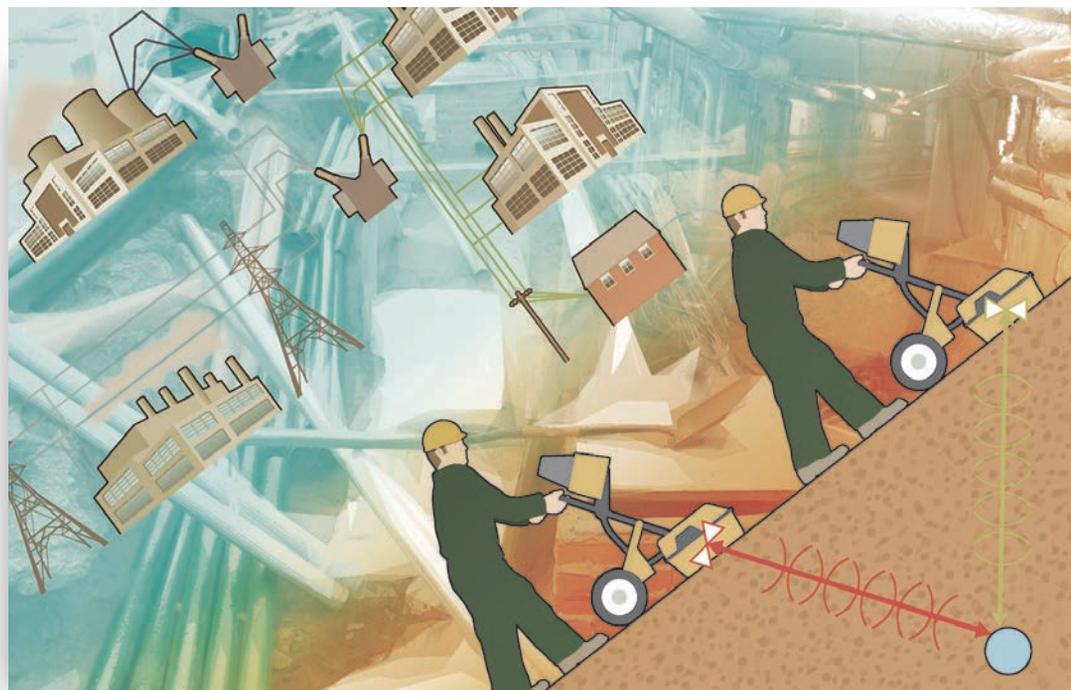
Note that some of the checklists and templates continue over two or more pages.

DESIGN BRIEF		Your Company Name and address here			
Document reference:	DB 001				
Project title:	Building F2				
Project number:	FH230056B				
Revision control:					
Revision	Description	Originator	Date	Approved by	Date
Document distribution:					
Recipient name	Recipient title	Date of issue	Revision		

Alphabetical list of tools and templates

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Utility Connections and Diversions



Planning, design and installation

By Jackie Portman and David Bleicher

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This publication has been designed and produced by Alex Goddard and Ruth Radburn.

Every opportunity has been taken to incorporate the views of the contributors, but final editorial control of this document rests with BSRIA.

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PREFACE

All but the most remote building projects require connections to utilities such as gas, water and electricity, and many projects involve the diversion of utilities. Getting these aspects of the project right can be critical factors in ensuring it is completed safely, on time, on budget and with minimal disruptions. They can also affect the long-term efficiency and fitness-for-purpose of the building.

The provision of utilities may not be the most exciting or glamorous element of a building services engineer's scope of duties. Most of the transmission equipment is buried in the ground, and the associated distribution equipment is usually squeezed into innocuous plant rooms hidden in the darkest recesses of a building. Perhaps because of this, it is not covered in academic or industrial training programmes, and thus far there has been very little published guidance in this area.

Historically, utility services were provided by state-run monopolies which might have been referred to as statutory authorities, utility undertakers, statutory undertakers, public works, or public services. During the 1980s and 1990s these were progressively deregulated and broken up by successive policy makers who believed that this would provide better services through competition and relieving the state of having to provide these services directly.

It can be daunting and frustrating dealing with the fragmented provision of utility services by a variety of different organisations. When producing design drawings, it can be tempting to show a utility service as a single straight line leading to a simple connection at the point of supply. In reality there are many considerations associated with co-ordination, phasing, logistics, and the involvement of multiple organisations. Inadequate attention to such issues can lead to the oversizing or undersizing of services or unplanned outages with all their associated consequences.

This guide provides comprehensive guidance and practical tools (including templates and checklists) to assist with the planning, design and installation of utility services from the preparation stage to post-occupancy aftercare. It ties in with the eight work stages described in BSRIA BG 1/2009 *Building Services Job Book – A Project Framework for Engineering Services*^[1]. It does not cross-reference individual clauses but should be sufficient to ensure that the particular requirements at each stage can be achieved. This guide does not cover the provision of temporary supplies for building sites, nor does it deal with the detailed negotiations of utility services tariffs.

It is hoped that this guide will provide project managers, designers, contractors or anyone else involved in the provision of utility services with the confidence to deliver a stress-free and successful installation.

Jackie Portman
October 2011

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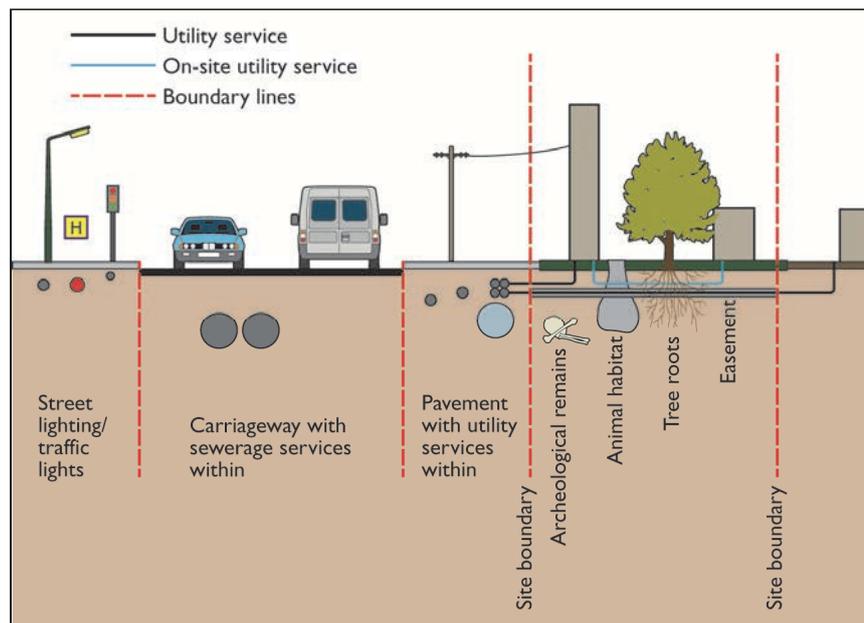
I INTRODUCTION

It is generally acknowledged that refurbishment projects are more demanding and risky than new-build projects and thus need to be managed accordingly. One aspect of new-build projects which carries greater risk is the connection to (and diversion of) utilities. These involve alterations and tie-ins to existing infrastructure. This is further complicated as the utility services are generally buried in the ground making it challenging to verify their nature, condition and exact location by observation.

There are two dimensions to be considered when providing utility services to a premises. Firstly, there are physical issues associated with the equipment and apparatus. Secondly, there are service provision issues associated with the availability, capacity and security of the commodity at the point of supply.

The physical issues include the planning and installation of materials such as cables, pipes and associated apparatus, co-ordinated with each other and with other physical encumbrances. Examples of these are shown in Figure 1.

Figure 1: Physical aspects of utility services design



The utility services provision at the point of supply for any service is a function of the form and fabric of the building and the building services systems serving it, both being influenced by the external environment. The end-users' particular requirements as to how they will operate and run the premises also contribute to the requirements.

There is a wide range of stakeholders who have a right and/or interest in providing the utility services to a premises. The primary stakeholders are the client, design and construction teams and the utility service providers themselves in conjunction with their respective sub-consultants, suppliers

and sub-contractors. Information on the relative roles and responsibilities of these stakeholders can be found in Sections 1.1 to 0 below.

In some cases a particular function will not be required, or more than one function may be undertaken by the same person, for example the architect may also fulfil the role of landscape architect. The particular stakeholders and the contractual arrangements between them will vary from project to project. In many cases, there will be no contractual linkage between parties who rely on one another. All stakeholders must operate within the regulatory environment relevant to the particular premises.

1.1 CLIENT TEAM

The client team consists of different groups affected by the acquisition, design, construction, operation and ultimate disposal of the facility. Some functions may be performed by direct employees whilst others may be sub-contracted or outsourced.

With respect to the provision of utility services, the client team should provide the following information to the design team in accordance with the requirements of the particular contract:

- Access to records pertaining to the current arrangement of utilities and constraints (legal and physical) within the premises. If this information is not provided, additional site investigations will be necessary, and there will be an increased risk of delays to the project.
- Briefing on the activities and operating patterns of the proposed building. Inadequate briefing may result in the utility services being too small, too large, not secure or resilient enough, or with insufficient spare capacity.

1.2 DESIGN TEAM

The design team consists of the various disciplines required to develop and deliver appropriate solutions to meet the client team's requirements, and to prepare the required level of information for the construction team. The key responsibilities of the design team members are as follows:

- The architect leads the design of the building form, fabric and internal spaces such as plant rooms and risers. All of these have an impact on the consumption and connectivity of utility services. The architect also leads the design of the external environment where most of the utility services are located.
- The structural engineer ensures that trenches, plinths and enclosures accommodating the utility services are provided within the structure.
- The civil engineer ensures that the requirements for accommodating utility services in the ground are achieved.
- The building services engineer is responsible for establishing the capacity requirements for the utility services and designing the physical apparatus.

3 THE REGULATORY FRAMEWORK

A construction project must fit into the legal framework governing the premises and those involved must be knowledgeable about relevant legislation. A detailed schedule of legislation affecting building services can be found in the BSRIA Legislation & Compliance resource, which can be accessed through the BSRIA website. Figure 10 summarises some of the key legislation pertinent to the provision of utility services.

Figure 10: Hierarchy of legislation and guidance

