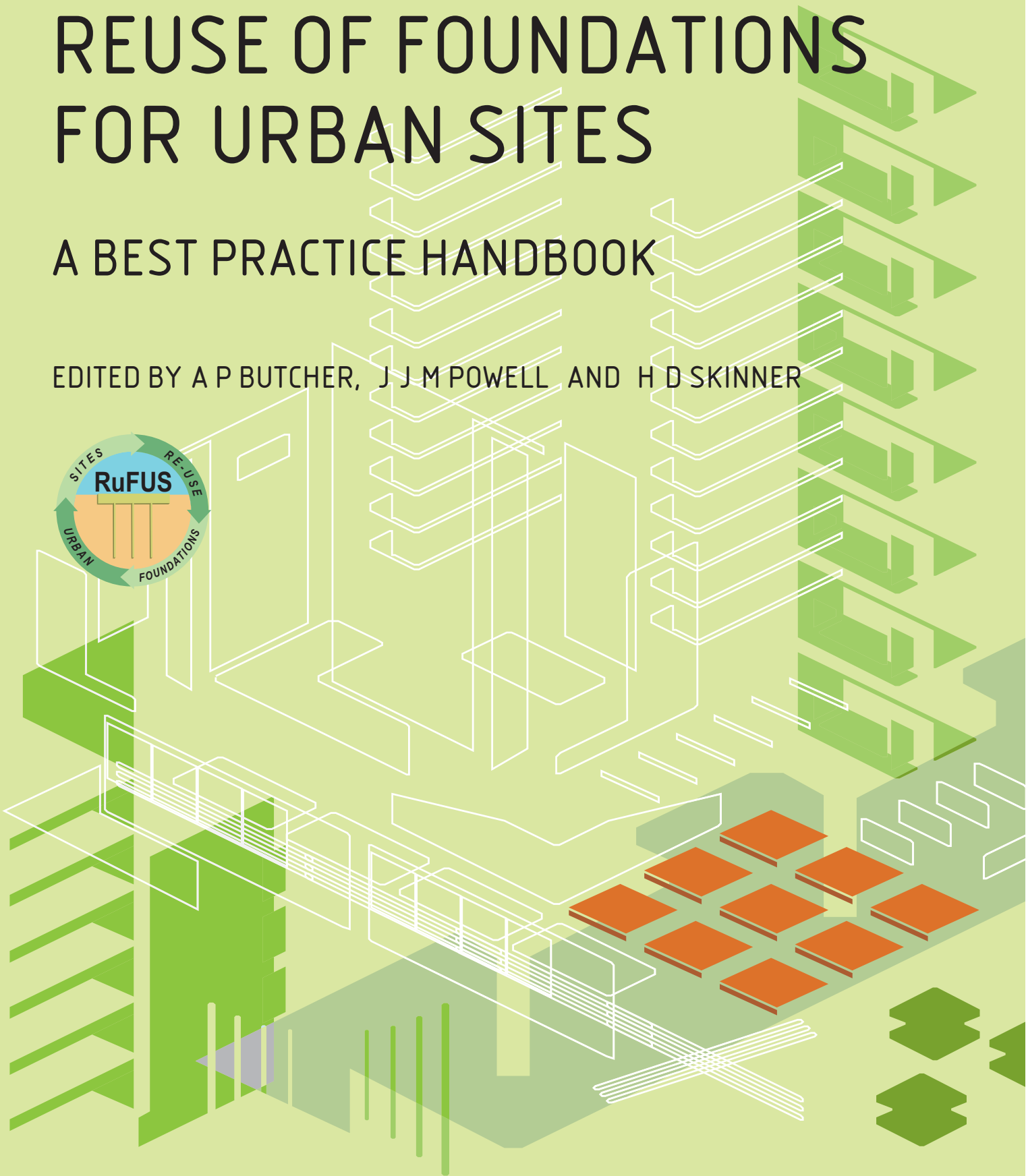
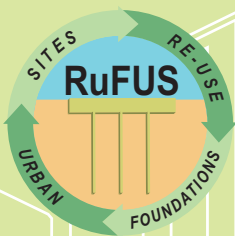


REUSE OF FOUNDATIONS FOR URBAN SITES

A BEST PRACTICE HANDBOOK

EDITED BY A P BUTCHER, J J M POWELL AND H D SKINNER



bre press



Reuse of foundations for urban sites

A best practice handbook

**This Handbook is dedicated to the memory of
Peter Starzec, our friend and colleague,
who died tragically in 2006**

**Further case studies and information can be found in:
*Reuse of Foundations for Urban Sites: Proceedings of
International Conference***

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Foreword

In these days of heightened awareness of the impact we have on our environment and the way in which we manage it, we must not forget that we have to create the foundations for the future. In the past, we have been able to assume that we can largely ignore or remove what we have put in the ground previously. Now, with our ever-improving ability to construct large buildings on poor ground, particularly through the past 50 years, we have to consider the impact of what we have previously put in the ground on the cost and actual behaviour of new foundation systems. In addition, we must consider what impact these new foundation systems may have on future development. It is a matter that cannot be ignored.

As any archaeologist will tell you, the reuse of foundations is not a new subject and the principle of building on something that has already stood the test of time is a good one, provided that you understand the limitations of what you already have in the ground. In the past, a process of trial and error may have been acceptable under such circumstances. However, now, from Funder to Designer, we are risk-averse when it comes to foundations. We need to know what we are using to support our buildings, or at least be assured that, if we do not know precisely, we reduce the risk of anything happening to a level that we feel comfortable with. This requires the development of a suitable strategy to address the issues and give reassurance to all those involved in a project.

In London, we have since the late 1950s, been installing high capacity bored cast-in-situ concrete piles, deep into the London Clay, many of which were designed individually to take column loads. Many had under-reamed bases, some of which were dug by hand, some to the extent that they were touching each other. Such foundations effectively sterilise large parts of a site and may have a major impact on the scheming of a new development over the same footprint. Conversely, it makes no sense to avoid using them as they have proven high capacity. The answer must be to find ways of incorporating them within the new substructure. This requires some ingenuity and presents an exciting challenge to both geotechnical and structural engineers.

This is a new challenge. We have a range of tools at our disposal which can assist us in defining what is actually in the ground and how the new sub-structure may work. This *Handbook* is the product of a large collaborative project involving many professionals from a wide range of backgrounds. Much thought has gone into it! Its objective is to help all those involved in reusing foundations to understand the issues that need to be considered and to give some guidance and encouragement to all.

And finally, I hope that we all rise to the challenge, but whatever we do, that we learn from the experience and pass the information to future generations (preferably in the form of detailed electronic records that everyone can access when they need to!).

Hugh St John
Geotechnical Consulting Group
London

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1 Introduction

1.1 Foundation reuse is not new

Reusing foundations used to be the norm rather than the exception. Large structures whose siting was important, such as castles, tended to be rebuilt on the foundations of their predecessors. In Elizabethan times in London, in an attempt to curb urban sprawl, new building was only allowed if it was raised ‘on old foundations’ and later this was a common occurrence after the ‘Great fire’ of 1666.

As buildings have become bigger and expectations of their performance have increased, building occupants’ acceptance of damage in structures has decreased. Structures themselves have also become less tolerant to differential settlements. Methods for calculating foundation requirements have become more reliable. All these factors have resulted in installation of new foundations for each new building to avoid aesthetic and structural damage caused by settlement.

Reuse of foundations can take many guises and does not always mean constructing a new building on old foundations. A common form of foundation reuse has occurred where the façades of a building are kept (for conservation or architectural reasons) and the internal parts of the building rebuilt (Figure 1.1). In these cases, modern construction components may allow more storeys to be included without an increase in load.

Recently, piles have been re-engineered and successfully reused on infrastructure projects, for example railway



Figure 1.1 Façade retention for new apartment development

bridges and several major building projects (Chapman et al 2006), and several case studies (see *Section 1.3*, those included in *Appendix A* and Butcher et al 2006).

At the start of the RuFUS project in 2003, a questionnaire study assessed the level of awareness and understanding of reuse. Some 84 respondents from around the EU indicated that reuse was a relevant issue. Potential cost- and time-savings through reuse of existing foundations and avoidance of obstructions and archaeology were seen as opportunities, but technical and insurance issues were perceived as difficulties. Information on the old foundations together with investigation, assessment and design were seen as key technical areas where the RuFUS project could help reduce risks.

1.2 Sound engineering principles for foundation reuse

Foundations for any structure must be reliable, as demonstrated by an adequate factor of safety against failure. For a foundation system that has already been tested and ‘proved’ by the application of the first building load, a lower factor of safety against failure may be acceptable compared to that for new foundations, provided that sufficient details are known.

Foundations are designed to limit settlements. The settlement performance of a foundation system must be acceptable at working load, providing a factor of safety against damage in the structure that might impair its appearance or operation.

Existing foundations that are to be reused should be adequate for their intended purpose in the new building. The design of the foundations needs to be sufficiently robust so that it is no more likely to cause problems than installing new foundations. The requirements for reused foundations are no different from new foundations, and must be investigated, designed and incorporated into the construction so that these requirements can be met. Where foundation performance is critical (perhaps where large capacity is anticipated from reused foundations or where compatibility is required between old and new foundations), the observational method can be adopted to ensure robustness of design and construction. Verification of performance during and after