Guidance Note GN 8/99

REFURBISHMENT OF CONCRETE BUILDINGS:

Structural & services options

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SUMMARY

It is estimated that there is currently 8 million m^2 of redundant office space in the UK, much of which was constructed in the 1960s and 1970s in reinforced concrete. These buildings, and others from the 1980s, 1990s and pre-and post-World War II, have the potential to provide the standards of accommodation required in the 21st century, with increased energy efficiency, if refurbished in the correct manner.

This publication provides guidance for structural and building services engineers on building refurbishment options. The emphasis is on office buildings, but much of the information is applicable to other building types. There is also growing interest in change of use for redundant office buildings, such as converting them into student accommodation, flats or hotels.

This document is the second of three publications concerned with refurbishment of concrete buildings. The first publication is intended for the owners of buildings and their advisers and covers the factors influencing the decision to refurbish in general terms. The third publication details approaches that should be considered in the design of new buildings so that they will be more adaptable to future changes in requirements.

Chapter 1 of this publication provides an introduction to the refurbishment of buildings, including the need to refurbish and viability of refurbishment.

The main reasons for refurbishing a building are:

- to improve the building aesthetics
- to increase net lettable floor area
- changes in regulations
- changes of use
- need to upgrade services.

The levels of refurbishment are:

- minor/cosmetic
- intermediate – structure or services
- major
- complete.

Chapter 2 describes the characteristics of old office buildings. Pre-World War II and 1950s and 1960s buildings generally have narrow floor plates and services are routed around the perimeter. The older buildings have high ceilings but those dating from the 1950s/60s have low floor to ceiling heights. Buildings completed in the 1970s have larger floor to ceiling heights and are deep plan. Many concrete buildings constructed in the 1960s and 1970s are made of precast concrete.

Chapter 3 considers the condition surveys that need to be carried out prior to refurbishment to assess the condition of the existing building services and the structural integrity of the building shell.

Chapter 4 considers the interaction between structural and services work and the issues affecting services selection. The effect of the structural elements used in the building construction and the restrictions on horizontal and vertical routing of services are discussed.

Chapter 5 describes building services refurbishment options, ranging from issues concerning the facade to ventilation, heating, cooling, air conditioning, lighting and electrical installations.

Chapter 6 details structural modification options. Concrete repairs are described together with methods to accommodate increased loadings. Solutions suitable for capacity enhancement of various elements are summarised and these are illustrated with short case studies. Methods of accommodating geometry changes are also detailed, ranging from removal of suspended ceilings where storey heights are limited, to the creation of openings in slabs, beams and walls. Methods for increasing floor area are described including relocation of services, construction of additional floor plates and construction of additional storeys.

Chapter 7 describes case studies to illustrate the feasibility of refurbishment options. The case studies include:

- office building services refurbishment - Howard House, Bristol where the life of the services had expired
- conversion of factory areas to office accommodation - Boots D10 Building, Nottingham
- building services refurbishment to improve the internal environment and increase net floor area at the DTI, London
- addition of escalators and stairs - Allders Department Stores, Croydon and Portsmouth
- complete office building refurbishment - No. 1 Neathouse Place, London
- office to hotel refurbishment.

Appendix A details legislation affecting building refurbishment.

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Whilst every opportunity has been taken to incorporate the views of the steering group, final editorial control of this document rests with BSRIA.

Cover photo courtesy of Martine Hamilton Knight

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1 INTRODUCTION

1.1 CONCRETE BUILDINGS - A VALUABLE ASSET

It is estimated that currently 8 million m^2 of UK office space requires refurbishment, much of which was constructed in reinforced concrete. These buildings have the potential to provide the standards of accommodation required in the 21st century if refurbished in the correct manner. There are many factors influencing the refurbishment of concrete buildings and this Guide presents refurbishment options for structural and building services engineers.

Concrete buildings dating from the 1960s and 1970s and earlier offer several benefits compared with their more recently constructed counterparts. These benefits are:

- the buildings are often in a favourable location
- refurbishment is quicker and generally cheaper than demolition and reconstruction
- the buildings are higher and have a larger footprint and more car parking than would be allowed under current planning regulations
- narrower floor plates and natural ventilation often found in these buildings meet expectations for buildings where windows can be opened. Occupants are more tolerant of poorer internal environments if they have greater control over the environment in their space
- air conditioning can be added where required
- there is a shortage of large buildings and this may add value to the refurbishment.

The refurbishment market is almost as large as the new build market with 48% of building work being repair and maintenance[1]. This is predicted to grow faster than new work and eventually overtake it. Approximately 10% of office space is refurbished in some form every year[2]. Possession of refurbished concrete buildings has been proven to be viable economic stock. If a building is part of a portfolio it may be possible to remove it from the rental market for, say eighteen months, refurbish it and then return it to the market with the increased rental income repaying the investment.

There is much less prejudice against concrete buildings than there used to be. Whilst problems with concrete buildings can exist, (see Section 3.2) the problems are known and can generally be overcome. There are many examples of successfully refurbished concrete buildings, as illustrated in the case studies at the end of this Guide.

Improvements that have been carried out to concrete buildings include:

- reduction in floor loadings by removing floor screed
- extension of floor plates, perhaps adding 20% to net lettable area
- addition of lift shafts, risers, and escalators
- upgrading ventilation and air conditioning systems
- addition of solar shading
- addition of floors or extension to building.

This publication, the second in a series of three, deals with the technical details of the replacement or refurbishment of building services and the structural modifications that are commonly encountered during the refurbishment of concrete buildings. The management and procurement issues associated with building refurbishments are covered in CIRIA Report 33[3] and are not repeated here. The reasons for refurbishment from a client's viewpoint are set out in the first publication in this series[4]. These are also described briefly in the following section.

1.2 REASONS FOR REFURBISHMENT

In a recent survey on behalf of The Royal Institution of Chartered Surveyors (RICS)[2] availability of car parking, flexibility of floor plates for fit-out, the indoor working environment and proximity to transport links were cited as the top four criteria affecting tenants' choice of office properties. When selecting office space, businesses require flexible space that can respond to organisational changes and business developments. The growing importance of the need to optimise use of business space and the environmental conditions within it is demonstrated by the growth of facilities management as a profession.

Many occupied buildings do not meet all the ideal criteria noted above. Whilst some elements are not changeable, such as location, other aspects can be readily upgraded to improve working and organisational conditions as well as to maximise asset/rental income value. However, not all refurbishment work will be financially viable and every case requires individual assessment. Nonetheless, it is increasingly found that refurbishment provides more than adequate returns on investment.

The alternative to refurbishment of an existing building is to demolish it and build a brand new one. This, however, is costly in monetary and sustainability terms (through the greater use of raw materials), as well as in terms of programme, as planning permission will have to be sought, particularly if a change of use is involved. The lettable area for the replacement is likely to be much less than the original building, making refurbishment a more attractive option. A further benefit is that it may be possible to phase the refurbishment so that part of the building remains occupied, thus generating income. It should also be remembered that refurbishment is significantly less time-consuming than demolition and rebuilding, perhaps taking two thirds of the time. When the cost of finance and the loss of rental income are taken into account this represents a significant sum.

The principal reasons for refurbishment are given in the following sections.

1.2.1 Aesthetics

The appearance of a building is particularly important. A poor exterior or interior appearance will influence market perception of the building and will deter many companies from taking a tenancy. Refurbishment of parts of the building such as the facades, entrance or other public areas,

will overcome this. Credibility can be given to a building by giving it a better appearance and even linking it with a 'big name' architect.

However, aesthetic upgrading could impose greater loads on a structure. For example, replacement of existing cladding with something heavier, eg louvred windows, would require that these loads can be adequately transferred to elements capable of sustaining them and that the building foundations can accommodate these loads.

1.2.2 Requirement to increase net lettable floor area

One way of greatly enhancing the value of a building is to be able to collect more rent from it. This can be achieved by increasing the net lettable floor area and is discussed in Section 6.3.7.

1.2.3 Change in Regulations

There are many national Regulations, British Standards and local Acts, as well as property developers' expectations that have to be taken into account during building refurbishment. From the structural point of view, there may be a requirement for increased design floor loading greater than the minimum specified in design codes. Also, recommended design floor loads and recommended wind loads (BS 6399[5]) have changed over time. Reinforced concrete design codes have changed constantly over time. Changes to the Building Regulations have increased fire resistance periods and altered requirements for access and facilities for disabled people. Services- related Regulations include those imposed by the Workplace (Health, Safety and Welfare) Regulations, 1992[6], which applied retrospectively to all buildings from 1996 and required, for example, lighting, heating and ventilation to meet minimum standards. The regulations that influence refurbishment are discussed in Appendix A.

There may be future changes in Regulations and in local or national policies, such as the move towards integrated transport and to restrict the use of private cars in towns, which would reduce the need for car parking and hence make space available for conversion to other use. Current Government moves to restrict out-of-town development and regenerate inner cities are encouraging the conversion of offices to residential and other uses.

1.2.4 Change of use

Many refurbishments are brought about by changes in organisational requirements. Space needs are constantly changing as whole companies, departments, and teams of workers expand and contract. This leads to internal moves taking place, at which point the decision is made to refurbish while the space is clear. Other changes of use relate to conversion of parts of a building to other uses, such as storage areas to office space, or offices to dining areas. However, where higher average occupancy of a building is brought about by changed working patterns, there may be a requirement for increased facilities such as toilets as well as a need to install additional staircases, lifts and

escalators. These will require major structural alterations, as discussed in Section 6.

At a social level, developing technology and changes in working patterns are predicted to affect the use of buildings, particularly office space. Growth in the use of office automation and information technology has led to increased working from home or elsewhere and the export of repetitive, simple operations to developing countries. Consequently, office environments are changing. This is considered in more depth in the third publication *Refurbishment of concrete buildings: Designing now for future re-use*[7].

There is also a growing interest in overall changes of use, for example, changing redundant offices into residential flats or student accommodation. This has been brought about by over-supply of office space during the early 1990s leading to many buildings being unlettable. These buildings can often meet market need for residential, hotel or leisure buildings, the increased rental income or asset value paying for the conversion. This has been aided by regeneration of urban areas making previously undesirable areas attractive. However, overall changes of use are geography-dependent. For instance, in London there is currently much need for office-to-office and office-to- hotel refurbishments, while in Bristol there is more need for office-to-student accommodation refurbishments.

1.2.5 Need to upgrade services

One of the primary reasons for refurbishment from a services perspective will be the need to upgrade or replace existing plant because of a poor working environment caused by ineffective air conditioning, heating or ventilation. This is considered in more detail in Section 5. In some cases there will be reduced cooling requirements in some areas of the building (eg less heat from more efficient modern electronic equipment). In other cases there may be an increased cooling requirement, for example due to 'hot desking' leading to a higher average occupancy of the building.

Refurbishment of services will provide the opportunity for a more energy efficient building with consequent cost savings, an area in which future legislation may have a significant impact.

Other reasons for building services refurbishment relate to the upgrading of electrical services and office communications to meet changing business needs and the upgrading of other systems such as fire/security and building management to provide greater functionality.

1.3 LEVELS OF REFURBISHMENT

The extent of building refurbishment will vary for each job and it is not possible to give definitive levels. There will, for example, be situations where a major refurbishment is carried out on one part of the building, such as the entrance hall, but only a minor refurbishment elsewhere. However, refurbishment can be broadly classified as shown in Table 1. The typical cost and time to recoup the investment based on the increased rent obtainable for different refurbishment levels is based on previous surveys[2,8] and consideration of cost breakdowns given in journal articles on refurbishment.

Table 1 Levels of refurbishment

Type	Cost £/m^2	Approximate time to carry out (months)	Approximate payback period (years)	Description
Minor/ cosmetic	170 - 400	1- 3	2 - 5	This will involve redecorating, improving signage and lighting, replacing floor coverings, exterior painting and repair, minor changes to the fittings. Typically takes place at 5-year intervals.
Services	200 - 400	3- 6	5 - 15	Complete replacement of heating, ventilation and air-conditioning plant. Associated pipework, ducting, terminal units, controls and insulation may be replaced or upgraded as necessary. Typically takes place at 25 year intervals (control systems more frequently).
Structural	150 - 400	2- 6	5 - 15	Addition of new lift shaft, escalators or riser, necessitating structural alterations.
Major	500 - 700	2 - 12	5 - 15	This will involve major changes to the services and the interior fittings but without any significant structural alterations. May include addition of raised floor, improvements to core areas and entrance halls, new lighting, internal shading. Typically takes place at 25 year intervals and in conjunction with a lease renewal.
Complete	800 - 1500	6 - 18	10 - 30	This will involve significant structural alterations, such as the extension of the floors or partial demolition to create an atrium or stripping of the building back to the concrete frame. New cladding may be fitted together with the installation of new services and full fitting out. Timing of a complete refurbishment is variable but likely to take place in conjunction with a lease renewal.
New Build	800 - 1500	18 - 24	10 - 30	Construction of a new building, excluding demolition of an existing building and loss of rent.

1.3.1 Refurbishment costs

Refurbishment projects tend to involve more uncertainty and risk than new-build projects. Even with good planning and on-site inspection it is difficult to establish cost certainty and consequently cost contingencies will need to be incorporated. Fixed price contracts are likely to be unsuitable. Lump sum contracts are more appropriate where they are based on schedule of rates or quantities. When quoting for refurbishment work the contractual issues should be carefully checked and, if necessary, contractual experts consulted.

Refurbishment schemes typically involve a high proportion of services which qualify as plant machinery for capital allowances. Expenditure that may be eligible for capital allowances for refurbished buildings includes that for the construction or acquisition of:

- space or water heating systems, powered systems of ventilation, air cooling or air purification, plus any ceiling or floor included in such systems

- lifts, hoists, escalators, moving walkways
- refrigeration or cooling equipment
- sound insulation requirements
- burglar alarm systems
- partition walls where removable and intended to be moved.

Where alterations are carried out to facilitate installation of the new plant or machinery, the associated alteration work to the structure, such as the demolition of a wall or creation of a hole through a slab may be eligible for capital allowance. Capital allowances can potentially be claimed where old plant rooms are removed, risers and lift shafts are altered and where suspended ceilings and raised floors are used as a plenum for ventilation, thus making refurbishment more cost effective. Where repairs are carried out to HVAC plant they may be eligible for tax relief with the possibility that it may be incorporated within the profit and loss account. This implies that they are eligible for 100% deduction from profits for that year rather than the deduction spread over longer periods for capital allowances. Expert advice regarding tax issues should always be taken.

There is increasing demand for Government to make greater concessions to encourage building refurbishment rather than demolition and creation of more brownfield sites, which are often considered unattractive for redevelopment. Options include extending capital allowances or allowing local authorities to reduce business rates on occupied refurbished properties or increase them on empty properties.

In terms of the increase in letting value that can be obtained by refurbishment, a survey carried out on behalf of RICS *Refurbishment in the office sector 1997/8*[2] suggested that a typical 1960/70s speculative office in a central prime site that had been refurbished comprehensively both internally and externally could have its letting value increased by 16 - 20% from £25/ft^2 (£270/m^2) to £30/ft^2 (£323/m^2). The variation in increase in letting value ranged from a net increase of 6% to a net increase of 30% depending upon geographic area. Such rental increase easily offsets the loss of rental income during refurbishment. Further, costs may be reduced by phased refurbishment (eg floor by floor) with increased rent from completed floors paying for further work.

1 Department of the Environment, Transport and the Regions, Construction Market Intelligence Division, web-site www.construction.detr. gov.uk/cmi/greenc/htm#orders, May 1999.

2 THE CONNAUGHT REPORT. *Refurbishment in the office sector 1997/8*. The Royal Institution of Chartered Surveyors. 1997.

3 *A guide to the management of building refurbishment.* Report 133. London. Construction Industry Research and Information Association (CIRIA). 1994. pp 80. ISBN 0860173941

4 GOLD CA AND MARTIN AJ. *Refurbishment of concrete buildings: The decision to refurbish*. Guidance Note GN 7/99. BSRIA 1999. ISBN 0 86022 525 9.

5 BS 6399, *Loading for buildings: Part 1, Code of practice for dead and imposed load,* London, British Standards Institution. 1996. ISBN 0 580 26239 1.

6 Workplace (Health, Safety and Welfare) Regulations 1992. SI 1992/3004. HMSO. 1992.

7 GOLD CA AND MARTIN AJ. *Refurbishment of concrete buildings: Designing now for future re-use*. Guidance Note GN 9/99. BSRIA 1999. ISBN0 86022 527 5.

8 KENDRICK C, MARTIN A J AND BOOTH W B. *Refurbishment of air-conditioned buildings for natural ventilation*. Technical Note TN8/98. September 1998. ISBN 086022 498 8.