Refurbishment Manual

MAINTENANCE
CONVERSIONS
EXTENSIONS

GIEBELER
FISCH
KRAUSE
MUSSO
PETZINKA
RUDOLPHI

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Preface

"A change that is not an improvement is a degradation." *Adolf Loos*

Many books have already appeared in the Construction Manual series and all deal in detail with one area of construction: concrete, timber, facades, etc. The *Refurbishment Manual*, on the other hand, covers all areas of construction: from the foundations to the final coat of paint inside, from preliminary planning to site supervision. Bringing all this together on just 280 pages would seem to be a daring exercise because there are extensive writings available on each one of these themes. And indeed, this book is based on the knowledge every architect should have at his or her fingertips. It is not intended to replace any of the standard works on building or building materials that have already been published; but it adds something: forms of construction and building materials that we – the planners, the design team – have to deal with during conversion and refurbishment projects.

The reason for this is that the essential difference between conversion work and new work is that in the former case the building is already standing. Even if it is not immediately evident, this facile-sounding statement contains questions such as: Is it necessary to distinguish between the architectural planning for conversion work and new work? If the answer to that is yes, then do the differences pervade all phases of the design and construction work? Do we need additional knowledge in order to master conversions?

The answer is: yes, there are fundamental differences in the planning methods, evaluation models and specialist knowledge that we as planners and designers must acquire in order to realise a conversion, successful in itself and for the client.

The following chapters are therefore mainly dedicated to the differences between the methods used for new building work and conversion work. This presumes that we already have experience in the design of new structures, which we can normally expect to be the case because the planning of new works is part of every architect's training. However, the courses of study generally on offer these days seldom include information on the planning of conversion and refurbishment projects, which is all the more surprising because working with the building stock dating from all previous ages used to be customary and, in addition, was handled very pragmatically: what could be used was used; what could be converted was adapted to suit our own tastes, our own uses; what was "left over" was demolished. It was the Modern Movement that forced us to divorce ourselves from the building stock: the new town, the new house, the new society. Sometime later, after the devastation of World War 2 had made these "new" towns feasible, we noticed that by taking this path we were in danger of losing something. The tide turned. In the early 1960s there was a remarkable alliance between reformers like Alexander Mitscherlich and conservationists like Hans Sedlmayr, who both demanded the conservation of the old towns. The conservation order is a child of that age; its idea of protection and retention resulted in the publication of specialist literature and also corresponding, new courses of study. But economically feasible only in the case of special inheritances from bygone architectural ages, the refurbishment and conversion of seemingly trivial structures was not regarded as a worthwhile pastime for ambitious architects. This attitude did not change until quite recently – certainly partly attributable to the fact that the volume of new build orders has declined significantly. Today it is just such building projects that find their way into trade journals and architectural presentations.

Closing the gap between books dealing with the conservation of historic buildings and monuments and those dealing with the construction of new buildings is the aim of this Construction Manual. Many of the statements found here are based on personal experience. Quite obviously, there will be many other alternative solutions to those suggested here.

A manual that is arranged according to periods and contains historical drawings

Part C of this book is divided into four time periods: founding years, inter-war and post-war years, and prosperous years. A different breakdown, e.g. according to the components of the building such as walls and floors, would have been truer to the standard layout in the other Construction Manuals. However, in order to

understand the building to be refurbished in its entirety, the respective components of one particular age are addressed in a direct relationship. The division into components serves as a subdivision within the four time periods; so there are four chapters for each component, e.g. the suspended floors of the founding years, the suspended floors of the inter-war years, etc. Forms of construction for suspended floors specific to a certain period are therefore presented directly alongside the associated forms of wall construction typical of that age. Besides the descriptions, all components are illustrated by way of historic drawings, most of which have been taken from the works on design and construction that were standard at that time. We are less interested in the – admittedly wonderful – illustrations themselves and more in the information they convey. The reader is recommended to study the drawings very carefully because they often contain much more than the associated caption might suggest, and thus represent a valuable planning and design aid. The reason behind the description of long outdated methods of construction is simple: these techniques belong to, are part of, the building to be refurbished. They therefore form the starting point for our planning assignment: historic details, specific material properties and the materials used at the time of the original construction are key parameters on which to base our design work. Only knowledge of old forms of construction enable us to make sensible decisions regarding their upkeep, replacement or refurbishment.

A manual that dispenses with standard details
No two conversions are alike. Even the attempt at a holistic study of the structure within its time period of course represents a considerable simplification. On the one hand, the time periods are not clearly defined, but instead form a continuum, a fact that also applies to the forms of construction used; on the other hand, there are – especially in periods with deficiencies in the transport infrastructure – regional differences in the styles of building, a fact that is attributable to the materials available locally. So if there is no standard historic detail, e.g. for a timber joist floor, then there can be no standard detail for the refurbishment of such a component – quite apart from the fact that today's demands themselves are not uniform, but instead are responses to different uses and legislation. Instead of making specific and hence preclusive suggestions, this book highlights the common technical flaws in historic forms of construction. Most of these were certainly known to the architects of the time, but owing to the respective state of the art or monetary pressures they were tolerated. Despite the aforementioned problem, this book contains suggestions for improving such "historical" weaknesses – again in the field of conflict between modern legislation, innovations and costs.

A manual that contains much more than just "old" forms of construction
Despite all these limitations, we do meet with very similar and recurring tasks and framework conditions in refurbishment projects. These are mainly collated in Part B. And although the attempt to find definitions, provide advice for the planning of conversions, energy-efficiency upgrades, changes to the technical infrastructure, conservation of historic structures, materials and decontamination are also dependent on the existing building make-up, they are placed in separate chapters to improve overall clarity. This is supplemented by overriding, recurring refurbishment themes such as damp-proofing or thermal insulation measures. The historic forms of construction in Part C only achieve their full potential as a planning aid when considered in conjunction with the information contained in Parts A and B.

In addition to the countless institutions and individuals who provided vital information for this book, I would like to thank the authors of standard works on construction. I recommend that every planner, every designer read those books – in addition to this manual! – because they are not only informative, but in most cases also highly enjoyable.

Georg Giebeler
Cologne, August 2008

Part A Introduction

Fig. A Palais Langhans, Prague (CZ), Ladislav Lábus

Definitions

Georg Giebeler

A 1.1

There is no universally applicable term that covers all building measures on existing buildings and is also understood as such. Instead, we have a number of terms that exist alongside the word refurbishment and mean something similar, indeed, even the same thing: conversion, maintenance, modernisation, total refurbishment, deconstruction, works in the building stock, restoration, renovation. There are several reasons for this vagueness. On the one hand, the degree of change, compared to the extent of the building fabric to be retained, varies greatly – from minor repairs to total refurbishment of the entire building. On the other hand, the intervention in the existing building fabric is carried out for totally different reasons – aesthetic, technical or functional. In addition, a "traditionally" imprecise choice of words makes it impossible to assign the words exactly to the measures involved.
Nevertheless, this chapter will attempt to define the various terms and distinguish them from each other. The purpose of this is not to achieve irrevocable definitions, but rather a classification that will provide architects with a planning aid.
Different types of intervention in the building stock call for both different planning methods and different building measures. If the architect is in the position to be able to assign a certain term to his task, this can help to clarify the planning and construction processes. The terms will therefore be explained and defined below. In addition, practical advice for the realisation of the planning assignment will be given.
The classification will be carried out according to two aspects: firstly, the extent of the intervention in the existing building fabric; secondly, the scale of the building work. The planning methods and the building measures can be derived from this combination. The degree of intervention begins with the rebuilding of a structure that no longer exists, or at best only as a ruin, includes complete demolition and subsequent rebuilding, plus different levels of conservation (from renovation to gutting):

- Reconstruction
- Restoration
- Deconstruction
- Demolition
- Renovation/maintenance
- Repairs/maintenance
- Partial refurbishment
- Refurbishment
- Total refurbishment
- Conversion
- Gutting/rebuilding with partial retention

We can add further terms to this list for works that occur in conjunction with refurbishment but do not fit into this classification:

- Modernisation
- Decontamination
- Extension/additions
- Fitting-out
- Change of use

In many cases more than one term applies to a building project because either the terms overlap to a certain extent or several measures are carried out simultaneously. By contrast, the classification of the project size is relatively conclusive. It can be subdivided into five categories:

- XXL: town/district
- XL: block/complex
- M: building
- S: part of building/storey
- XS: dwelling/room

The expressions "further building work" or "works in the building stock" could be used for the classification. Neither expression describes measures in the technical sense, but rather indicates an approach. The former reflects the continuous process of building: after the conversion is also before the conversion. It also makes it clear that every measure has to react to the existing structures. So strictly speaking "works in the building stock" should really be called "works *with* the building stock".

A 1.1 "Kolumba", art museum of the archbishopric of Cologne, Cologne (D), 2007, Peter Zumthor
A 1.2 Frauenkirche, Dresden (D), 1743/2005, George Bähr
A 1.3 The planning work required for various types of refurbishment work

A 1.2

Reconstruction

Reconstruction is the rebuilding of a structure that no longer exists, i.e. strictly speaking it is new building work. In the case of a serious reconstruction, however, use is made of old forms of construction, too. Reconstructions always invite controversial discussions, with the criticism becoming fiercer as the degree of actual reconstruction decreases, i.e. as faithfulness to the original diminishes. For example, whereas the planning of the Stadtschloss in Berlin is being followed extremely critically, the reconstruction of Dresden's Frauenkirche met with much approval (Fig. A 1.2).

Although reconstructions are based on old designs, they are always new works without original parts. The acknowledged regulations for new building works therefore generally apply. Standards, statutory instruments, manufacturers' recommendations, sequence of building operations, time on site, form of tender and site management mostly correspond to those of new construction projects. The methods used during the planning phase are also similar because only rarely are historic structures documented in such detail that the architect does not need to plan or design anything new. Besides, many European, especially German, archives of drawings and documents concerning the building stock were destroyed in World War 2, meaning that illustrations and/or photographs have to be used for reconstruction projects instead of engineers' and architects' scale drawings. During planning work, reconstruction means not only working through the available sources for the original structure but also that today's architects have to mimic the building style of a certain period, i.e. it is not an exclusively scientific assignment. Contemporary specialist literature is an important aid throughout the planning when the goal is to reproduce historic constructions as accurately as possible using the means at our disposal today.

Restoration

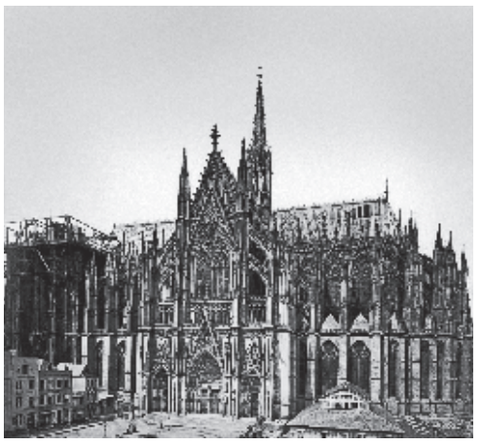
Restoration means finishing an incomplete structure. The term first appeared during the romantic period as people became aware of the cultural monuments of the past. It was essentially coined by the French architect and art historian Eugène Viollet-le-Duc, who in the early 19th century arranged for the restoration of palaces dating from the Middle Ages. Cologne Cathedral is another example of a structure being completed after almost 300 years of inactivity (Fig. A 1.4). Restoration is very similar to reconstruction except that in the former original building elements are still available, which are then supplemented by appropriate additions. Its close relationship with reconstruction means it is similarly disputed: "The process of restoration is a highly specialized operation. Its aim is to preserve and reveal the aesthetic and historic value of the monument and is based on respect for original material and authentic doc-

	Planning work required for building (M) compared to new build[1]					**Planning work required in comparison to M (building)[2]**			
	Prelim. design, design	Approval	Detailed drawings	Tenders	Award, site management, cost accounts	XL: Block/complex	S: Part of building/ storey	XS: Dwelling/ room	
Reconstruction/restoration	++	∘	+	+	+	/	/	/	Costly, time-consuming planning because research is necessary
Demolition/deconstruction	n/a	n/a	n/a	-	-	-	+	n/a	Often carried out by specialised contractors
Renovation/maintenance	n/a	n/a	n/a	-	+	∘	∘	∘	Costly, time-consuming organisation (When can work be carried out?) and accounting (many management services)
Repairs/maintenance	n/a	n/a	--	-	+	∘	∘	∘	Costly, time-consuming organisation/accounts, often no planning services
Partial refurbishment	--	n/a	+	++	++	n/a	n/a	n/a	Costly, time-consuming organisation and accounting, frequently disputes with neighbours
Refurbishment	--	n/a	∘	+	++	∘	+	+	Great demands placed on site management because of many uncertainties
Total refurbishment	--	n/a	+	+	+	∘	+	n/a	In total slightly higher costs/more works reqd. at new/existing interface
Conversion	+	∘	++	++	++	∘	++	++	High design costs due to adaptation to suit the existing; high construction costs
Gutting/rebuild with part retention	∘	+	∘	+	+	/	/	/	Extra costs for safety measures only
Extension	+	∘	+	∘	∘	/	/	/	Measures in the existing account for only a small part of the total budget
Fitting-out	+	+	++	++	++	n/a	n/a	n/a	Many parts of existing bldg. continue to be used; partial fit-out; costly, costly, time-consuming organisation/accounts, often disputes w. neighbours
Change of use	n/a	+	n/a	n/a	n/a	∘	∘	∘	Only an approval required, but can be very extensive

++ much more
+ more
∘ about the same
- less
-- much less
n/a hardly or never required
/ no comparison, cannot be evaluated (e.g. owing to major fluctuations)

[1] Provides a guide as to how much higher the conversion surcharge must be or where it can be ignored.
[2] Necessary increase in the conversion surcharge depending on the size of the project.

A 1.3



A 1.4

uments. It must stop at the point where conjecture begins…" [1]
However, this well-intentioned piece of advice is often disregarded, also because original documents are frequently unavailable. Moreover, it is not always possible to deduce what should be classed as original: the first building, the first extension, the first refurbishment, or the first conversion? This conflict has pervaded the discussions surrounding this subject in recent decades and the answers tend to reflect the respective *zeitgeist* instead of being generally acknowledged approaches. The reason for this may also be that the term "original" has been transferred – wrongly – from the visual arts to the discussions concerning architecture, where this term was unknown.

Deconstruction
It was around the year 2000 when urban planners rediscovered the theme of demolition as "negative building" and repackaged this in the term "conceptual deconstruction". What triggered this was the huge scale of the vacant housing in the towns and cities of former East Germany following unification. But similar problems occur in other regions as well; they are mostly the result of radical, structural processes that give rise to an economic decline and hence the sudden departure of the local inhabitants, e.g. in Detroit following the collapse of car production there. Deconstruction is intended to cure the urban problems of vacant properties through the targeted demolition of individual buildings, blocks or districts, i.e. control the process of negative growth. However, these concepts often fail because of a lack of funding – demolition without subsequent replacement with a new building can never show a profit.

Demolition
Besides deconstruction on a large scale, individual buildings are often demolished in order to erect a new structure on the same site. This is not an original architectural service because it is frequently carried out by specialist contractors before the project development even gets fully underway. Demolition contractors are the only ones with the appropriate specialist knowledge. Factors that need to be considered in addition to the building regulations (demolition permit) are structural aspects (special demolition engineering), safety regulations for the site operatives and the public (local residents and passers-by) and environmental protection measures if any pollutants or hazardous substances are involved. In Germany demolition work has been covered by DIN 18007 since 2000.

Renovation/maintenance
Renovation does not add anything new to the building stock nor does it replace old with new. Instead it maintains the value and the function of the existing building through competent "upkeep". Rented premises are typically renovated. Germany's 2nd Calculation Act (*Berechnungsverordnung*) specifies the following for this situation: "Cosmetic repairs include only wallpapering, painting or whitewashing the walls and ceilings, the painting of floors, radiators and heating pipes plus internal doors and the inner surfaces of windows and external doors." [2] In

Trade	Component	Inspection	Interval
Earthworks	Drainage	Check for sanding up and flush out, root damage	5 years
	Buried pipes and cables	Breakage due to settlement and roots, sludge build-up	5 years
Loadbearing structure	All components	Settlement cracks	First inspection 5 years after completion
Carpentry items	Truss joints	Check bolts for tightness	5 years
	All components	Check for rot (swimming pools etc.) and water damage	5 years
Roof covering	Flat roof	Gullies, flues, penetrations, remove growths, embrittlement cracking	Annually, at start of winter
	Pitched roof	Gutters, downpipes, visual inspection of roof covering	Annually, at start of winter
Heating	Boiler	Measure emissions	Annually, at start of winter
	Pipes	Sludge build-up, seals – especially with automatic top-up	5 years
	Radiators and valves	Valves for operation and seals	5 years
Plumbing	Hot-water provision	Calcification	5 years
Electrics	Circuit-breakers	Function	Annually
Fire protection	Smoke detectors	Function	Annually
	Fire extinguishers	Check, refill	2 years
	Escape routes	Stored objects, wedged doors	Continually
Windows	Wooden windows	External protective finishes	2 years
	All windows	Seals for brittleness and cracks	2 years
Insulation	Constructions with vapour barrier	Moisture	Once only 5 years after completion
Wood-block flooring	Oiled surfaces	Care instructions: clean and oil	Annually
Renovation intervals for rented apartments [1]		Kitchens, bathrooms, showers	3 years
		Living rooms, bedrooms, halls, toilets	5 years
		Other ancillary rooms	7 years

[1] According to the model rental contract of the German Federal Ministry of Justice dating from 1976, but these are not rigid intervals.

A 1.5

A 1.6

A 1.4 Cathedral, Cologne (D), 1248/1880, Gerhard von Rile/Ernst Friedrich Zwirner, Karl Eduard Voigtel
A 1.5 Maintenance intervals (proposal)
A 1.6 Panel construction building after deconstruction, Leinefelde (D), 1961/2004, Stefan Forster Architekten
A 1.7 Conversion of a department store, Eschweiler (D), 2006, BeL Architekten

the same publication, maintenance is defined as follows: “Maintenance costs are the costs that must be expended during the period of use in order to maintain the intended use and eradicate properly the constructional or other defects caused by wear and tear, ageing and the effects of the weather.” This includes work that actually already falls under the heading of maintenance: “The minor maintenance measures cover only the rectification of small defects in the electricity, water and gas installations, the heating and cooking facilities plus window, window shutter and door hardware.”
Neglecting maintenance can lead to major damage, especially for those areas that are not generally visible, e.g. flat roofs. The design team should therefore provide the building owner with a list of suitable maintenance measures together with a schedule of maintenance intervals and maintenance instructions – a service that should be remunerated separately according to the German HOAI scale of fees for architect/engineers. The construction materials used should also be listed because, for example, mineral paints for interior use are then only advisable when mineral paints are used again in all subsequent renovation work. Fig. A 1.5 shows a typical checklist with the intervals at which the inspections or maintenance work should be carried out.

Repairs/maintenance
Maintenance in this case is limited to the replacement or repair of defective building components. Maintenance work is necessary at regular intervals between the total refurbishment intervals and is usually the responsibility of the building manager, not requiring any assistance from the design team. Whether the maintenance work for identical building components coincides should be investigated for economic reasons. A leak from a water pipe, for instance, may occur from time to time, certainly not simply once a year. But in the case of regular leaks, it may be advisable to replace all the water pipes above basement level. The leak may indeed have been caused by earlier maintenance work, e.g. a system of iron pipework being partly replaced by copper.
Maintenance measures inevitably lead to follow-up costs that may far exceed the actual cost of the repairs, e.g. if intact ceramic tiles have to be chiselled off when searching for the source of a leak. In this case we must ask ourselves the question of whether we take the step to complete refurbishment, e.g. renewing all the bathrooms. In rented accommodation, the costs can then be passed on to the tenants, at least partly.

Refurbishment
In contrast to maintenance, refurbishment measures also include intact but, for example, outdated components or surfaces. The difference between refurbishment and conversion, however, is that refurbishment does not involve any major changes to the loadbearing structure or interior layout. It therefore lies exactly between maintenance and conversion, but the extent of refurbishment works can vary enormously.

Partial refurbishment
Partial refurbishment involves only one component or one part of the building, e.g. the facade, the ground floor or the east wing. Such projects are among the most difficult to organise because they are carried out while the rest of the building is still in use. Conflicts with users are inevitable because partial refurbishment measures cannot be carried out in isolation; the technical infrastructure, for example, extends throughout the building. One effective strategy is to provide detailed information about the intended measures at an early stage. For example, cutting and chasing work in occupied buildings is very annoying, especially when it starts at seven o’clock in the morning! A little consideration in the form of specifying working hours in the contract plus communications regarding the duration of the building work offer some relief here: the work remains annoying but limiting the duration increases the acceptance. The same is true for setting up a scaffold, cutting off services (especially the television!), work in internal and external access zones and all measures where excessive dust, noise or vibration is to be expected.
More generous time and cost buffers should be allowed for when planning partial refurbishment in particular, also a budget to cover collateral damage to areas and components that were not included in the refurbishment plans. Such damage is unavoidable and its rectification should be carried out quickly and without bureaucratic fuss. In addition, the owners of rented premises should certainly be warned about the possible risk of lost revenue from rents. For when the “suitability of the rented premises for the use as stated in the contract” is revoked or reduced, German legislation permits rent reductions of 20% on average. This clause comes into play as soon as an apartment cannot be ventilated because there is too much dust, or when the telephone in an office cannot be used because of excessive noise.

“Normal” refurbishment
Normal refurbishment measures encompass an entire building or least a part of the building that already exists as a clearly separate, autonomous element. Any demolition work necessary is mostly limited to surfaces or preparatory work for upgrading fire protection, noise control or thermal performance. Additions and changes to the existing infrastructure are typical, but

A 1.7

A 1.8

A 1.8 Attic storey conversion, Munich (D), 2006, Andreas Meck, Susanne Frank
A 1.9 Museum, Veenhuizen (NL), 2007, Atelier Kempe Thill
A 1.10 Conversion of an old courtyard, Munich (D), 2006, Auer + Weber, Peter Kulka
A 1.11 Conversion of a former briquettes factory into housing, Frechen (D), 2007, ASTOC

their complete replacement less common. Refurbishment cycles for individual components have been relatively well determined empirically (see "Planning refurbishment works", p. 23, Fig. B 1.2). True refurbishment without a change of use does not require building authority approval and is safeguarded by the notion of toleration of the building stock, but this concept is usually no longer valid for total refurbishment or conversion works.

Total refurbishment
Demolition measures during total refurbishment projects are very extensive. The demolition returns the building more or less to its loadbearing carcass. The primary structure remains essentially unaltered. Typical measures include the complete replacement of the infrastructure and the upgrading of all building components to meet the requirements of the latest legislation and standards. Owing to the extent of the work, total refurbishment is an expensive undertaking, especially when decontamination is involved as well. But in the end the refurbished building comes very close to a new one in terms of its facilities and safety. This is also expressed by the fact that upon completion all the components are covered by the warranty, also with respect to current standards and legislation. Such an all-embracing warranty is often missing from simple refurbishment projects because many components are left untouched, still in their original condition. In terms of planning, a total refurbishment is not so very different to a new construction, partly because many uncertainties are eliminated, so to speak. It may be that certain weaknesses in the carcass, e.g. the lack of a damp-proof course, excessive deflections of the suspended floors, or acoustic weaknesses due to a low weight per unit area, remain because their rectification is uneconomic. During the planning, the flatness tolerances should be considered. These usually lie well outside those of current standards, which have been covered by DIN 18202 supplement 1 only since 1969.

Conversion
Conversions always affect the structure of a building. They extend the concept of refurbishment to interventions in the loadbearing members and/or the interior layout. In conversion projects it is therefore always essential to appraise the existing loadbearing structure. Total refurbishment measures almost always involve conversion work, meaning that many construction projects are best described by using more than one term, e.g. "total refurbishment plus conversion". Changes to the structure always require structural calculations, which must also take into account the existing building fabric. This makes early, often destructive, investigations of the materials and methods used unavoidable, e.g. cutting open a concrete slab to establish the position and nature of the reinforcement. Furthermore, true design services are necessary for conversion projects because they involve changes to the interior layout or the access/circulation concepts. Such additional planning input is covered in the German HOAI scale of fees for architects/engineers in the form of a surcharge for conversion work. Partial conversion should be treated similarly to partial refurbishment.

Gutting/rebuilding with partial retention
Gutting comes close to providing a new building. Quite frequently the project involves retaining the facades of an existing building – resulting from a disputed understanding of the conservation of historic buildings – but demolishing and rebuilding the interior completely.

Modernisation
The term modernisation is in the first place relevant in landlord and tenant legislation. According to the German Civil Code, the annual rent may be increased by 11% of the costs incurred for modernisation if the measures are carried out according to the statutory stipulations (including advance warning, detailed description of intended measures). Modernisation can add up to partial refurbishment, e.g. upgrading the thermal insulation or replacing windows, but also conversion work, e.g. the subsequent addition of balconies. In any case, modernisation serves to improve the lettable floor space by increasing the level of comfort or decreasing the running costs. The following measures are

A 1.9

A 1.10

regarded as modernisations in the meaning of German landlord and tenant legislation:

- Upgrading thermal/sound insulation, also internally (e.g. between stairs and apartments)
- New sanitary facilities
- Installation of central heating (to replace individual appliances) or central hot-water supply (instead of separate water heaters)
- Additions to electrical installations, also the provision of cable television or the installation of a door intercom
- The erection of balconies or conservatories
- Installing a lift

Decontamination

This is the proper elimination of pollutants and hazardous substances from buildings and their correct disposal. The contamination of the interior air by hazardous substances has been a constant topic in refurbishment since the late 1970s due to the presence of PCP-based wood preservatives and asbestos fibres. In the meantime, the risks of many other substances have become known; the options for dealing with these are discussed in the chapter on hazardous substances (see pp. 102–115). Various statutory instruments and different limit values exist depending on the use of the building: the maximum workplace concentration, for instance, is applied to commercial uses, recommended values I and II of the Environmental Issues Committee, on the other hand, are relevant for housing and public buildings. If the values established in measurements of the interior air exceed the prescribed limit values, decontamination must be carried out, which can take place before or during the building works. For the building owner, such decontamination measures often result in higher costs and a substantial increase in the time needed for the work. Carrying out measurements well ahead of any proposed building works is therefore imperative where hazardous substances are suspected. In buildings built or refurbished between 1960 and 1990, the chance of finding contamination is relatively high.

Extensions/additions

An extension is a new structure that is directly connected with the use of the existing building. The planning work should consider the fact that conversion work at the junction with the existing building is usually unavoidable and therefore structural issues are involved. A frequent cause of problems is the differential settlement that can occur between the old and new parts of the building, especially in the following cases:

- Different foundation levels
- Building the foundations for the new works in the region of the previous excavation
- Building the foundations in different soils
- Adding extra storeys to only part of the existing building (subsequent settlement)
- Dewatering measures for the new works, e.g. lowering the water table

Fitting-out

Fitting-out is all the works carried out after erecting the structural carcass plus roof structure and roof covering. One typical measure is converting the roof space into one or more habitable rooms, i.e. fitting-out an attic storey not originally in use. The constructional problems that can occur are described in the chapters “General refurbishment tasks” and “Buildings of the founding years” (see pp. 127–129 and p. 153). Added to these are the loss of protection afforded by the notion of toleration of the building stock, which complicates the building authority approval process, especially with respect to fire protection, means of escape, distance to neighbouring buildings and car parking requirements. Further problems result from the fact that the work has to be carried out while the rest of the building is occupied (see “Partial refurbishment”, p. 13). Such fitting-out projects are therefore very demanding from the planning point of view and should be remunerated accordingly.

Change of use

A change of use is subject to construction legislation stipulations. In the first instance this concerns obvious changes like converting an apartment block into offices, even if only part of the building is involved. However, also minor changes of use within the same usage group, e.g. from baker to hairdresser, require approval by the authorities in certain cases, and especially when there are differences with respect to occupational safety and health issues, emissions, car parking, etc. For this reason, more intensive uses represent changes of use that require approval, e.g. if an existing office floor used as a company headquarters is let to a call centre operator. One problem here is the associated loss of protection afforded by the notion of toleration of the building stock. This means that a change of use can have far-reaching consequences because the current building regulations may need to be complied with, and the existing building may not be adequate. This legal situation has been criticised many times because it hinders the long-term use of buildings and is hence questionable in terms of both economics and ecology.

Notes:

[1] The Venice Charter, 1964
[2] Zweite Berechnungsverordnung, cl. 28

A 1.11

Further building work – thoughts on works *with* the building stock

Georg Giebeler, Petra Kahlfeldt

A 2.1

The refurbishment of a building always means adapting it to meet current standards, too, whether because of changes in users' demands or new technical regulations. The building measures required here call for knowledge of both current and historical building methods. Based on an understanding and appraisal of historic structures, this task is solvable in the technical sense. It would appear to be that the focal point in the first place is the technical and not the architectural side, from which we could conclude that refurbishment and conversion projects are purely engineering services. This widely held opinion is probably due to the fact that a major part of the architecture has ostensibly already been completed: the volume essentially set, the structure of the building fixed by the loadbearing members, and even the appearance seemingly predetermined, especially in the case of concrete and masonry structures. The planner's task therefore appears to be reduced to solving the purely technical problems of the existing building, e.g. thermal performance, noise control, with the architecture playing no role at all. This point of view is reinforced by the way that the conservation of historic buildings and monuments has been carried out for many years: the details to be constructed, the techniques to be used and the surface finishes chosen were very often specified by art historians. Such persons are undoubtedly scientifically trained for such tasks, but their very conception of the job means they avoid integrating any of their own design ideas.

But even the simplest of refurbishment tasks calls for an equal amount of architectural input. Very small measures and changes can result in a substantial change to the existing building – mostly spoiling the appearance as well – as the following examples will show.

Adding extra thermal insulation to the outside of a building is a very common upgrading measure these days and in most cases results in much deeper window reveals on the outside and the unsatisfactory effect of "holes for windows". This adulteration of the architecture is even more noticeable when the windows were originally flush with the outside face of the original facade. Furthermore, the new insulation to the reveals themselves reduces the size of the window openings, i.e. the ratio of window area to wall surface changes. The roof overhang at the eaves also decreases – even disappears altogether in some cases – due to the additional thermal insulation on the external wall. Another effect is that any relief or details on the facade – small but perhaps significant, e.g. stone door jambs or moulded window surrounds – are also levelled off. For reasons of cost, labour-intensive methods such as stone plinths worked with masonry tools disappear behind new render and the narrow window surrounds common on the rendered facades of the post-war years are simply forgotten. Even the surfaces of existing rendered facades disappear with the refurbishment work because instead of older sprayed and scratched render finishes, the lack of skilled, experienced workers means that now only trowelled finishes are on offer.

Likewise, the replacement of windows – necessary for technical reasons – almost inevitably by new products with wider frames is accepted virtually without any comment; and the greenish, reflective float glass as a substitute for the thinner, wavy cast glass is then particularly alarming when you compare the old and new elevations. Re-covering a steep pitched roof with wide concrete roof tiles can disfigure a gable because a delicate verge detail is replaced by crude verge tiles bedded in mortar.

Another example is the way facing masonry is treated in northern Europe; inexpensive external thermal insulation composite systems are causing more and more characteristic clay brick facades to disappear from the urban landscape. But even if an expensive double-leaf solution with new facing brickwork is chosen instead, the colouring, the imperfections and hence the character of the old facade can never be regained.

Inside the building, new ceilings needed for sound insulation or fire resistance purposes alter not only the proportions of rooms but also cover old plaster coves between wall and ceiling, even ornamental mouldings on the ceiling itself – quite apart from the fact that the difference between the hand-crafted old plaster on the walls and the perfectly flat plasterboard ceiling is unpleasantly conspicuous even to the uninitiated. Simply improving the impact sound

A 2.1 Town hall (extension), Gothenburg (S), 1937, Gunnar Asplund
A 2.2 Querini Stampalia Foundation, Venice (I), 1963, Carlo Scarpa
A 2.3 Roman amphitheatre (conversion), Sagunto (E), 1994, Giorgio Grassi

A 2.2

insulation calls for changes such as covering up nailed floorboards and removing the high, painted and profiled skirting boards, which for reasons of cost are replaced by simple timber battens. Following refurbishment, old panelled doors frequently look out of proportion because they have been shortened to accommodate the new floor construction. Even purely technical adjustments often leave behind a peculiar, alienated overall feeling in an old building. For example, in old surroundings simple sheet steel radiators appear mundane in contrast to the massive original radiators, and on staircases skirtings of ceramic tiles or other special finishes are irreparably damaged when cutting chases for new electrical or fire safety installations. There are many more, similar examples, and the refurbishment measures always appear unavoidable. To be sure, many of the building measures described here are inescapable where noise control, thermal performance or fire protection have to be upgraded to meet statutory requirements. But the result is a different one when the planning work is carried out according to architectural principles, i.e. with a conceptual, formal, technically holistic approach, instead of planning exclusively in accordance with the technical and economic feasibility. The aforementioned measures are among the typical tasks of refurbishment and that means what has been said applies even more so to more extensive interventions in the building stock such as total refurbishments, conversions and extensions, in other words complex architectural assignments that demand a synthesis between architecture and technology. The design approach with respect to such planning tasks seems to be changing, maybe has even changed already. Reconstructive adaptation or contrasting new elements – until recently these two approaches were irreconcilable opponents. In the meantime, the experience gained on a multitude of planning tasks involving the building stock – particularly for buildings not protected by conservation orders, but not only these – has seen the development of a new approach that gives priority to the unity of the building – no longer old and new as opposites, but instead old and new as a harmonic whole (Fig. A 2.1). This notion of "works within the building stock" will be enlarged upon in the following two sections.

A 2.3

Further building work? Further building work!

Building, whether new works or conversions, always means further building work – continuing to build at a certain site, building, street, district, town, landscape.

It always involves tackling the existing situation. No site is unoccupied or undescribed. Our living spaces are cultural spaces full of visible and invisible, but in every case detectable, references, i.e. historical, spiritual/cultural, spatial, social/emotional, functional and physical traces. These are either visible on the surface or can be made legible.

To build is to live. This is why architecture is founded on permanence and continuity. Getting to grips with our own social and architectural history is therefore an essential prerequisite for everything new. Every architectural project is based on what the architect finds and its complex past – spiritually and materially (Figs. A 2.2 and 2.3). Consequently, every change is assigned an importance and a responsibility that goes way beyond the individual design of the architect.

The architectural theme of further building work is as old as architecture itself. At the start we ask the existential question: "Building?" – a simple hut with a roof of leaves, a house between trees or a bird's nest? Sometime after we get the answer: "Further building?" What do we do when our hut, house or nest has to be altered to suit different functional demands, totally different requirements?

Further building always calls for a sensitive weighing-up between preserving and renewing. We expect architects to show interest, knowledge, empathy and self-imposed constraints. For in the end what this entails is – initially – becoming involved with the constructional language and the three-dimensional text of the building stock. Moreover, the design approach called for is one that solves the dilemma of conservation or renewal appropriately.

But what is appropriate? It is not simply provid-

a

b A 2.4

ing an answer to the functional, technical question regarding the connection between old and new in the design. The architectural and spatial task demands a change to the existing building, i.e. a composed, designed treatment. The Italian architect Francesco Collotti sees this as understanding an assignment as being provided "with internal living forms in order to achieve an interpretation, a subtle but at the same time technical and literary act of creative composition". This field of conflict into which the architect is drawn is quickly defined: on the one side the existing building with its idea of space created by constructions and materials, and on the other side the ingredient seen as necessary, which results from a change in demands or a change of use.

In a consequential further development of the catchphrase that appeared during the debate about fundamentals around 1900, "conservation instead of restoration", the approach that has become established in contemporary conservation work, i.e. that the different periods of building work must be clearly evident on a building and readily discernible, means that new and old must be rigorously separated. This notion of a "dual" system – there the old, here the new – has become a general guideline for works in the building stock, irrespective of whether the building is covered by a conservation order. Propagated by architects and the curators of monuments, this categorical separation between old and new has remained the guiding principle right up to the present day– albeit with totally different intentions. For the conservation of historic buildings and monuments based on scientific findings, the integrity, authenticity and legibility of the construction must be preserved; for many architects this is a criterion – thankfully accepted – that enables them freedom to express their own artistic, individual preferences, which at all costs must be distinguished from those of their anonymous architecture colleagues of history. This separation, fragmentation, breakdown into layers – adding new to old in a clearly identifiable way – is widespread. A conversion based on this principle understandably calls for major changes to the existing works in order to be able to establish the figuratively, materially and also constructionally contrasting ingredient. The result is, however, inhomogeneous and discordant.

The basis for the debates about the success or otherwise of further building work, which are heard not only in architecture circles, can only be architectural criteria themselves. The image of a recognisable town, street or district, one with which people can identify as a cultural community of buildings and spaces, forms as a holistic thought that includes and accepts the existing objects as a matter of fact.

Meanwhile, despite all the efforts at separation, an understanding and a practice of further building has emerged that does not place the celebration of time periods in the foreground but rather emphasizes the architectural unity of the building. Is the connection – transcending time – that brings together our modern constructions and those surviving from the past not a good way of illustrating tradition? In the awareness of an ongoing cultural inheritance and taking into account architectural traditions, the design task "works in the building stock" is an explicit invitation to instigate coexistence and cooperation, an aesthetic and figuratively sensitive correspondence, the search for a coherent, cohesive design language. Miroslav Sik, a prize-winning Swiss architect known for his high-quality further development of historically mature European towns and cities, regards the search for a coherent design language as "the middle way between flagrantly trite statements and over-ambitious design antics. Plan the necessary, leave the unnecessary and address the needs of buildings and their occupants as an architect." [1]

This is the only way to create the pictorial metaphor of unification as a transformation consisting of preserved and renewed without changing the origins or losing them altogether. In a design concept of the "new whole", the old is not used as a setting for the new. It is the search for architectural coherency that enables the existing and the new intervention to be equal partners in an overall architectural form, to go beyond the sheer insurmountable categories of new and old without the complexity and diversity needed to master the building task being lost at the same time. The new seen as a transformed whole has a little of both in it without it being seen as a separate layer: a continuous, homogeneous whole. [2]

Works in the building stock? Works *with* the building stock!

But we could understand further building work as the uncritical continuation of a long since outdated era, as a retro wave, engulfing the construction industry in the same way as it has done the design departments of car and furniture manufacturers. Copies of the past – apparently legitimate since the reconstruction of Dresden's Frauenkirche (an understandable act of reconstruction) – are unfortunately also the starting point for architectural monstrosities such as the "Palace Arcade" shopping centre in Braunschweig and all the many small, apparently trivial examples in the tradition of the Bauhaus or other marketable eras.

For "historic architecture" is, as it says, "historic" and cannot be "present-day". Reproducing a building from Germany's *Gründerzeit* "true to the original" is destined to fail to the same extent as its conversion into a palace of glass. Several insurmountable obstacles stand in the way of such projects:

- Different political and social conditions
- A different environment – in terms of both architecture and urban planning
- Different legislation and regulations
- Different manual skills
- A different state of the art
- Planners are not "historic" – consequently, they cannot build in a historic way

For these reasons, the dogmatic copying of history must fail. But where is the aforementioned middle way, the "reconciliatory coexistence and cooperation"? It begins where further building work is no longer regarded as works "in" the building stock, i.e. as something new "within" the existing, but rather as works "with" the building stock, i.e. fusing the existing with the new to form a holistic new object, like, for example, the Feyferlik/Fritzer architectural practice has succeeded in achieving with the new building and conversion works for the Mariazell pilgrimage site (Figs. A 2.4 and 2.5). However, the use of the existing presupposes

A 2.5

A 2.4 Archive rooms in the roof space, ecclesiastical building, Mariazell (A), 2001, Feyferlik/Fritzer
A 2.5 Refurbishment of liturgy area and organ installation, basilica, Mariazell (A), 2000, Feyferlik/Fritzer

an understanding of the existing in its entirety. Only in this way is it possible to understand the entire structure instead of individual pros and cons. Further building work is not limited here to understanding the technical features, but rather to discovering the original conception and liberating this from factual and taste-related constraints, i.e. separating the historical concepts from the necessary, the prescribed, the technically restricted aspects, or the typical fashions of the time. This is different to the case of a new building, which can be adjusted to a position (also known as "style"), something an existing building cannot do. The building stock cannot be subsequently squeezed into a position. Conversions cannot be forced. If the planner sees only the disadvantages of the existing building, satisfactory results will hardly be possible. Further building means using the best ingredients you have at your disposal, discovering the positive sides of the existing structure and shutting out the negative ones, loving the existing structure.

Understanding the existing, learning to love and using the new to form a whole could be likened to a team: the partnership between the architects responsible for the existing building – possibly all totally different – and those of the new works. However, this partnership in actual fact consists of only one – sort of schizophrenic – person, i.e. the architect appointed to carry out the latest work. In order that the partnership can succeed despite different initial conditions, the current planner can refer to a common experience, which was valid for the architects of the past just as much as it is for the architects of the present: costs have to be kept to a minimum and everything must be constructed on time and without defects. Historic constructions and the resulting architecture are usually a demonstration of this set of problems and not the manifestation of independent artistic expressions as often claimed by the curators of historic monuments (a claim thankfully accepted by the retro designers). The delicacy of a window with glazing bars lies not in its design, but rather in its well-functioning, inexpensive construction which, however, no longer meets today's demands. If further building means finding a contemporary solution that fits into the overall concept, neither the fixed glazing without glazing bars in an aluminium frame nor a "looks-from-a-distance-almost-like design" will be adequate. It is the window that the architect of the existing building would have designed if he had had today's technical options at his disposal and could have stood back and viewed the whole from the same distance as today's architect.

Empathy with the creator of the existing is not possible outside our own experience, which rules out an uncritical acceptance of every historical concept right from the very start. Empathy in further building means: How would the architect of history have solved this detail? Which constructions would he have used to implement the Energy Conservation Act, comply with or circumvent the Rosenheimer window-building guidelines? The planning of further building with the new works and conversions necessary for this presupposes modern constructions and modern manual skills, which themselves imply totally different architecture. The texture and waviness of a rendered facade dating from the 19th century – as an inexpensive, good-quality construction – can no longer be imitated because today's bricks are far too accurate, today's workers have little or no experience of lime renders and – made careful through constant complaints – no longer perform manual work.

Further building or works with the building stock means acknowledging the building stock and trying to understand it, identifying and assessing its structure and its position. Only after that is it possible for the architect to develop his own position, as a response to the existing. And a personal position is always related to the present day: current political and social circumstances, current costs, current constructions. So designing according to modern standards – not being forced to create a contrast, not being forced to make the new legible, as is often and wrongly requested – is not objectionable but instead convincing. Why should something be separated when it forms a whole? In other words wishes to be "one" building and not a didactic 1:1 exhibition of various architectures. All we demand, quite rightly, is good architecture, i.e. a conceptually coherent, functioning whole. So in further building the exclusivity of contrast or adaptation is not suitable as a design approach. Both merge into the "team of understanding equals"; that means today's planners exercising respect towards the work of the architects of the past, but also the posthumous consent of those architects for further building according to modern principles.

Notes:

[1] Speech held on the occasion of awarding the Heinrich Tessenow Medal in 2005.
[2] This section is the work of Petra Kahlfeldt, an architect in Berlin.

Part B Principles

Fig. B SUVA Building, refurbished building envelope, Basel (CH), 1993, Herzog & de Meuron

Planning refurbishment works

Georg Giebeler

B 1.1

The planning of conversions is fundamentally different from the planning of new works. For example, the entire planning process for a new structure is abstract until work commences on site: discussions with clients and other members of the design team can be structured by employing interim targets, external obligations exist only as a result of statutory provisions. The client can prescribe unambiguous objectives with respect to costs, completion date and his functional requirements, sometimes even his aesthetic preferences.
But the starting point for a conversion is an existing building, which alters the situation completely. Planning work departs from the abstract level right at the start and delves into the problems of the existing construction. The client's demands remain the same, however: reliable costs and deadlines, functional requirements and architectural requests. The procedure when planning a conversion must take this conflict into account if a satisfactory result is to be achieved.

Analysis

The planning process begins with an analysis of the existing construction – an ongoing task that is repeated many times as design and construction proceeds. The more comprehensive the investigations, the greater is the reliability of the planning and hence also the costs and deadlines. However, for reasons of his fee alone, the architect would never carry out a complete analysis. So it is important to select the critical points. For example, to check the serviceability of a timber joist floor, it is always the supports that are investigated; it is not necessary to remove the ceiling completely.
Besides knowledge of the defects typical at the time the building was constructed and our own experience, a decent portion of commonsense is helpful: a major cause of damage is water in all its forms, so the components that deserve attention are those that could have been damaged in some way by rainfall, splashing water, groundwater, water vapour (organic infestation, rot) or leaking water pipes.

Archives

The first step should always be to study old documents. Drawings and calculations provide an overview of the design and construction process at that time and serve as the foundation for further investigations or inspections. Possible sources are the client himself, previous owners, the architect and structural engineer originally responsible, and the archives of the local building authority.

Research

Researching the building means carrying out a detailed historical analysis of the existing construction with the aim of being able to trace the history and the planning of the building when it was first designed and built. Archive material collected from various sources plus random examinations of components provide the starting point for this. This approach allows different phases of the construction, later extensions and conversions, older and newer refurbishment work or superficial maintenance to be identified and recorded. Knowledge of the building methods used is helpful when trying to assess their typical strengths and weaknesses, but also evidence of constructional deficiencies, e.g. concealed joints between the original structure and an extension.
The cost and work involved in such research is, however, only realistic for buildings with a historic value. But the approach as such can be transferred to simple planning tasks as well.

On-site measurements and as-built drawings

The measurement of structures or components accompanies the conversion measures during all phases of the work. Here, too, the difference between this and a new-build project must be considered. Again and again, the inaccuracies of the existing structure lead to conflicts with the new planning work. So the trick is to interpret the on-site measurements, i.e. deliberately draw other dimensions to those measured in order to achieve a consistent overall picture. For example, deviations from right-angles amounting to only a few degrees are seldom important when planning a conversion and should be ignored. It is also necessary to interpolate the differences in length amounting to several centimetres measured in a room. The aim of on-site measurement is not to create an exact likeness, but rather to achieve a consistent basis for planning.

B 1.1 Conversion of an industrial building into an office building, Cologne (D), 2001, 4000architekten
B 1.2 Lifetime expectancies of various building components
B 1.3 The make-up of the building stock in Germany (residential buildings only)

Component	Lifetime [years] min.	max.
Render, facades	30	60
Pitched roofs	40	60
Flat roofs	20	40
Windows	25	40
Insulating glass units	20	35
Building envelope as a whole	20	60
Heating	12	35

B 1.2

Period	Detached houses [m²]	Apartment blocks [m²]	Total floor area [m²]	Proportion of total floor area
before 1918	305000	227000	532000	18%
1919–1948	244000	145000	389000	13%
1949–1957	209000	185000	394000	13%
1958–1968	252000	223000	475000	16%
1969–1978	303000	258000	561000	19%
1979–1983	383000	246000	629000	21%
total	1696000	1248000	2980000	100%

B 1.3

For this reason, automated systems that can generate CAD data from 3-D measurements are only recommended for very special applications, e.g. the conservation of important historic buildings.
Notwithstanding, to achieve proper, interpretable documents, inaccurate measurements should be avoided. A laser measuring instrument is indispensable for this because it supplies exact dimensional data and in contrast to a tape measure can be used by one person alone (Fig. B 1.6). Additional tools are a folding one-metre rule, a plumb line and a compass. The following recommendations are helpful when carrying out on-site measurements:

- If possible, use chain dimensions instead of starting from zero again each time.
- Measure through open doors etc. in order to obtain the total internal dimensions of the building.
- Measure heights in the staircase and record storey heights.
- Measure the total external dimensions.
- Door openings etc. need be measured on one side only.
- In rooms with walls at odd angles, measure the diagonals; the minimum or maximum dimensions obtained with laser instruments are helpful here because the target can be “run along” an edge.
- Look at the underside of the floor above: heights, downstand beams, etc. are often forgotten when measuring.
- Measure all wall thicknesses.
- Window openings usually include a masonry stop, so two clear opening dimensions are required.
- Take horizontal dimensions at the same height wherever possible because no wall is perfectly vertical.
- If possible, remove wall and soffit linings in order to obtain the dimensions of the structural carcass.

Begin drawing the as-built drawings with the most dependable dimensions, i.e. the overall sizes, and then try to fit the interior layout into this as logically as possible (Fig. B 1.4). Interpreting the information means drawing what should be repetitive dimensions identically, e.g. window openings, and possibly also checking whether the wall sections between windows should not also be identical, even though you may have noted different dimensions. The idea behind this is to reveal the thinking of the building’s original architect and not the vagaries in the skills of the construction workers involved.
At the start of the planning phase, drawings to a scale of 1:50 are adequate. During the later stages, especially when fitting new into old, further measurements will be necessary. As a rule, accurate on-site measurements should not be carried out until after any demolition work has been completed – in order to prevent duplicating the work (see “Clearance” p. 29).

Dimensional coordination
The attempt to standardise the dimensions of components has been a feature of all periods in the history of building. But just like with many other products, different standards have existed in different regions. Harmonisation on a national level took place similarly to the current introduction of Euronorms, i.e. rather sluggishly. Knowledge of the dimensional coordination customary at the time the building was erected can assist in the interpretation of the existing structure, i.e. in order to estimate the dimensions of the underlying structure, e.g. masonry wall thicknesses and their linings, without having to open up the construction (Fig. B 1.5).

Visual inspections
Many patterns of damage and forms of construction can be determined purely by visual inspections and feeling, touching the surfaces. As this is an inexpensive approach, a thorough inspection and full documentation is advisable. As part of this, it is helpful to note the positions at which photographs were taken on the as-built drawings because this is the only way to assign the photographs unequivocally at a later date. The partial opening-up of components is also highly recommended. For example, when assessing a timber joist floor, the nature and construction of the ceiling and infill materials are important, especially when considering load-bearing capacity, sound insulation and fire resistance. In this situation it is usually sufficient to open up the floor beneath one joist support. The position of the joists is easy to determine from above via the positions of the nails securing the floorboards.

Measurements and laboratory tests
The measurement of component properties and laboratory tests can supply further information regarding suspected problems, but because this is costly a full investigation is not feasible. Generally, individual examinations are used to draw conclusions about the entire construction, which does leave some room for errors.
Simple instruments for measuring the moisture content of components measure the electrical resistance in the material by means of two electrodes (Fig. B 1.7). If the material is known, tables can be used to reach conclusions regarding the degree of saturation in terms of percentage by volume. As this method is relatively imprecise and prone to errors, a series of measurements should be carried out. The measurements are carried out on the surface of the component, which means that no statements can be made regarding the moisture in the middle of the component, e.g. a masonry wall. The same applies to dielectric measurements, i.e. those based on measuring electromagnetic waves. Nevertheless, in practice both types of measurement are adequate because normally the intention is only to estimate whether a component is wet or dry.
If accurate values or measurements in the centre of a component are required, taking a sample is the only option. In this case the water content can be established exactly with the help of the Darr method, which uses three weight measurements: first of all, the sample as taken on site is weighed, then the completely dried sample, and finally the saturated sample. This method allows the moisture content to be determined in terms of percentage by volume.
In order to classify the causes of surface moisture, e.g. damp, warm summer air on cool surfaces (basement masonry), measurements of the moisture content in the component should be supplemented by interior humidity, interior temperature and surface temperature values.
Determining the dead loads of components and constructions can be useful when planning

conversions. For example, if we replace the loam filling to a timber joist floor by sound-insulating batts, the weight saved can be offset against floor constructions using floating screeds or suspended ceilings. This is useful for the structural analysis.
Many component analyses cannot be cleared up by way of simple in situ inspections. In such cases samples must be taken and tested in suitable laboratories. This is necessary not only in cases of damage, but also when the material properties are required for new calculations, e.g. grade of concrete and yield stress of steel in a reinforced concrete floor slab. And for decontamination assignments measurements of the interior air to check for parameters such as VOC, PCB, asbestos, formaldehyde and mould are standard (see also “Dangerous substances in the building stock”, pp. 102–115).

Evaluation

The evaluation of the existing construction is an intrinsic part of the architect’s services. Very early on, a decision must be made as to whether the objectives of the client can be achieved with a reasonable budget. Using the analysis of the existing construction as our starting point, a study is carried out to establish to what extent existing components can be used in the refurbished building and the cost of refurbishing such parts. Only afterwards is it possible to conclude whether or not the property is suitable for conversion.

In order to be able to reach a reasonably reliable decision at an early stage, the architect should concentrate on the following three issues.

Usage – new usage

Not every representative of the building stock is suitable for every new type of use. This will always be a problem where very specific, unalterable user interests are involved. For example, the circular saw in a carpentry shop needs a certain amount of space, and no alternative concept will suffice. If essential, i.e. generally loadbearing, components, are in the way, the cost of the conversion will rise substantially. Partial conversions, e.g. a single storey, can lead to further problems. For example, any supports required in the floor below – if occupied – may be just as impossible as the repositioning of a waste-water discharge stack.
The discrepancies between users’ wishes and the survey of the existing construction therefore result in constraints. Identifying and reconciling these is part of the evaluation process.

Conversion potential

The architect should estimate the inherent conversion potential of the structure taking into account the constraints. In other words, to what extent it is possible to intervene in the existing fabric so that it can be adapted to the new user requirements? The conversion potential depends on the type of construction and therefore also on the period in which the building was erected.

“Forcing” a conversion on a building will always lead to an unsatisfactory result – both financially and architecturally.

Patterns of damage, principal problems

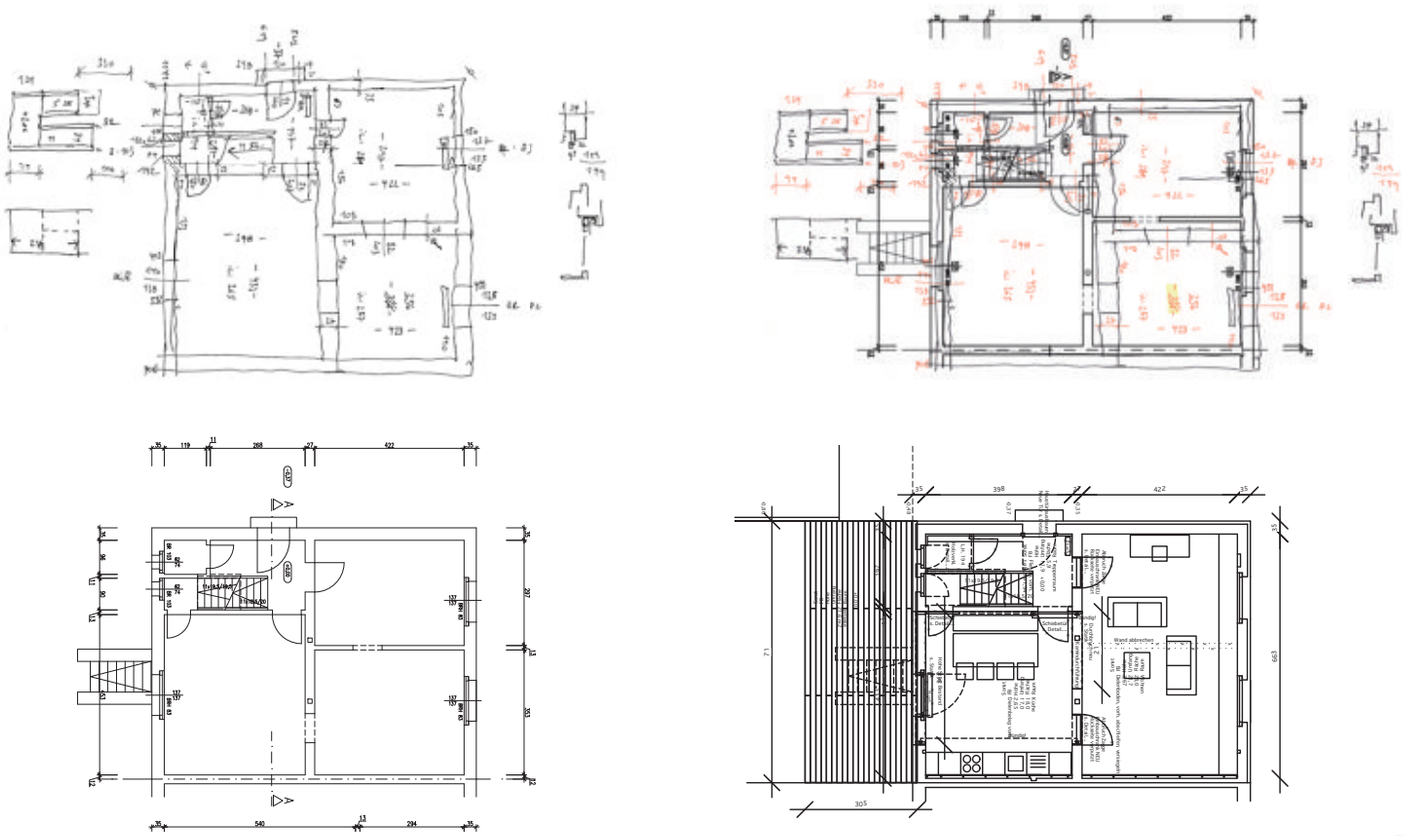
The analysis usually results in a number of patterns of damage that cannot be fully appraised at this early stage of the planning. The aim must be to establish the principal problems and estimate their costs and completion dates. Fig. B 1.8 shows the economic appraisals of a number of typical refurbishment and conversion measures.

Planning process

Conversions exhibit a number of idiosyncrasies, both in terms of the sequence of operations and the boundary conditions. If the architect has been mainly concerned with new structures up until now, he must learn to rethink the planning process. One thing that is very clear is that the planning and site supervision of conversion projects is more involved than that of new-build projects, which is allowed for in the German scale of fees for architects/engineers (HOAI) by way of the conversion surcharge.

Phase 1: clarification of design brief

Clarification of the design brief covers the initial preliminary work and discussions between the client and the architect in which the nature of the future cooperation, the costs of the building work, the completion date and general user require-



B 1.4

ments are discussed. This phase is considerably different to the equivalent phase for a new-build project. Right from the start, the client expects a report on the quality and conversion potential of the building; so the client's questions are much more specific. On the other hand, requirements concerning usage and targets regarding costs and deadlines are attached the same importance as for a new building.
It is imperative to explain to the client that with a conversion the latter two issues cannot be answered at this early stage. Which measures may need to be taken in the future in order to achieve even only a vague target cannot be clarified until after a detailed analysis of the existing structure has been carried out – and in the worst case not until after the structure has been purchased. The client is taking a considerable risk in this latter case because he is buying a property without knowing exactly how much a refurbishment will cost and when it will be completed. And he also has to accept that he may possibly have to modify his usage concept.
It is therefore vital to answer the following questions unambiguously and confidently: Is it worth refurbishing this building? What difficulties are we likely to face?
The initial discussions very often take place as part of a site visit, the purpose of which is to view, not to appraise. Not until the project has been reduced to an abstract level – and subsequent partial analyses have possibly been carried out – is it possible to make a relatively reliable statement as to whether or not conversion is worthwhile. The architect should never forget that answering this question in the affirmative is at that moment a decision regarding a large portion of the total cost of the project. The architect is therefore recommended to include services from the preliminary planning and possibly also the final design phases in this phase of the work. Such consultancy services should also be reflected in the level of the fee. A survey of the existing structure, for example, can be invoiced as a "special service" according to the German scale of fees for architects/ engineers.

Phase 2: preliminary planning
Besides further work originating from phase 1, the main new areas of work in this phase are developing the planning concept, conducting the first meetings with the other specialists in the design team and the authorities, plus estimating the costs.
The loadbearing capacity is an important point in the appraisal of the existing building because upgrading the loadbearing structure can be a very expensive undertaking. And it would be foolhardy to appraise the existing structure without the help of a structural engineer. Estimates of possible spans based on experience of new-build work are not reliable in conversions because the serviceability of historical constructions often has to be investigated according to the latest standards.
Cost estimates according to building volume are also destined to fail in the case of conversion projects because there are insufficient statistics available to use as a basis. The reason for this is that owing to the fact that all conversion projects are different, they are harder to categorise. It is therefore advisable to bring forward the cost estimate from phase 3 or at least carry out a detailed examination of individual components.

Phase 3: final design
If some of the costing has already been carried out in phase 2, the primary task of the final design phase is working through the planning concept, including the provision of drawings. One obvious approach is to use the as-built drawings as a basis for the final design. However, those drawings contain too much information, which could result in apparent constraints. Such drawings also have "graphical" limits, which are then regarded as part of the existing structure and thus generate further constraints. The outcome is consequently often closer to a refurbishment than a new start.
So like with urban planning studies, an attempt should be made to remove small details from the drawings. The most radical method in the planning of conversions is to gut the entire building theoretically: What is left when we demolish all components that are not loadbearing? Left with this drawing of the "structural carcass", it is easier to plan and think without constraints. After this concept phase, the second step is to investigate which non-loadbearing components can be integrated into the concept. One advantage of this method is that it is possible to avoid interventions in the fabric of the building.
Starting with the basic fabric of the building also means delving into the original design and eliminating possibly disruptive interventions at a later date.

Phase 4: building permission application
This phase of the project involves all the work that leads to gaining approval to go ahead with the project from the relevant authorities. But contrasting with a new-build project, the aim of negotiations with the building authorities is to achieve a number of exemptions. These concern both urban planning regulations, e.g. clearance to neighbouring buildings, and building technology regulations, e.g. fire resistance, thermal performance, sound insulation. Possible exemptions required should be specially investigated from the very start in order to avoid problems at this stage.

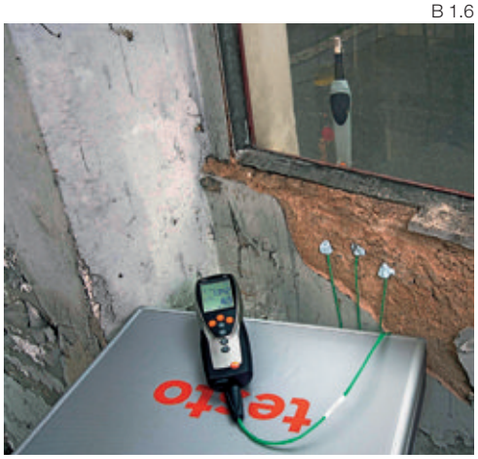
Phase 5: working drawings
This phase includes all the fabrication and detailed planning work prior to issuing tenders. The basic differences between new-build and conversion projects disappear at this stage, apart from a few significant exceptions: accuracy, presentation and technical fundamentals. Taking inaccuracies into account represents

Clay brick format	**Length [cm]**	**Width [cm]**	**Height [cm]**
Oldenburg format	22	10.5	5.5
North German thin format	22	10.5	5.2
Hamburg format	22	10.5	6.5
Flensburg format	22	10.5	4.8
Kiel format	23	11	5.5
Hamburg format	23	11	5.6
Holstein format	23	11	5
Imperial format	25	12	6.5
"Ilse" format	25	12	4.6
Old Bavarian format	29	14	6.5
Old Württemberg format	29	14	6.5
Viennese format	29	14	6.5
Baden format	27	13	6
Monastery format	28.5	13.5	8.5
Monastery format II	29	14	9
Württemberg format	29.8	14.3	7.2
Bavarian format	30	14	7

B 1.5

B 1.4 Preparing an as-built drawing: from the in situ freehand sketch to the finished CAD drawing
B 1.5 Common clay brick formats prior to 1940
B 1.6 Laser measuring instrument
B 1.7 Moisture measuring instrument
B 1.8 Economic effectiveness of typical refurbishment and conversion measures

B 1.6



B 1.7

one great difference in the planning process. Planners with no experience of conversion work often try to implement the fabrication and detailed planning techniques they have applied in new-build projects. The sometimes glaring inaccuracies in the existing structure, e.g. lack of right-angles, lack of verticality, walls not in line vertically, excessive plaster/render thicknesses, sagging floors, bowing walls, etc., all have to be taken into account in the fabrication and detail drawings. Joints between components – especially those between existing and new components – are sometimes totally different to corresponding details for new projects.
Two methods have proved to be very helpful: bringing forward the demolition work and visiting the site together with specialist companies and specialist consultants from industry, whose experience in conversion measures is very useful for the planning and tendering. Quite naturally, working together with long established, local companies whose employees are familiar with the old methods of building, even partly from their own experience, is worthwhile.
On the drawings for conversion projects the use of the colours grey (for existing), red (for new) and yellow (for demolition) is widespread. Black is sometimes used for denoting existing elements, but solid shading can mask annotation etc. The shading conventions for the materials of existing components drawn in section should only be used when the material is known for certain. In all other cases, the components should be shaded without signifying the material so that the design team and site workers are not led astray.
The subject of dimensioning is not without its problems either. As already mentioned, the dimensions measured in situ often do not match those on the as-built drawings. If we project complete chains of dimensions through a whole building, these – man-made – differences become apparent and lead to confusion among the contractor's personnel. One remedy is to distinguish between "binding" and "uncertain" dimensions; the latter serve only for approximate orientation, determining quantities, etc., "binding" dimensions, on the other hand, specify dimensions of new components or details regarding interventions in the existing fabric (Fig. B 1.4).

Phases 6 and 7: tender, award of contract
Compiling specifications and awarding contracts are other areas where aspects peculiar to conversion projects must be considered. The greatest difficulty is to be found in the uncertainties that characterise the planning process. Not all the components to be retained can be recorded and appraised in full. This calls for a certain flexibility in terms of itemising and also calculating the quantities, a situation that should be avoided at all costs in tenders for new-build projects. In order to avoid unpleasant additional negotiations, optional items should be included for works that are perhaps only suspected. Inaccuracies in the specification cannot be totally avoided because it is not possible to "x-ray" every component. It is therefore necessary to establish whether the problems associated with conversions are adequately covered in the contract documents. Standards and building regulations have been developed with new buildings in mind and may well need to be restricted or even suspended by way of special contractual clauses. Classic examples of this are warranty issues when including parts of the existing building, or adaptive measures in the case of inaccuracies exceeding the standard tolerances. More reliable costs can be achieved by including ancillary works typical of new-build projects, i.e. works to be remunerated separately, among the standard items. One widespread but risky approach is to base many items on daywork rates. In conversion work this is harder to avoid than in new projects, but is just as difficult to keep under control. On conversion projects it is normal to have to invest much more time in site supervision in order to achieve acceptable quality standards and dependable costs and timetables. Nevertheless, predicting all these aspects is still less precise than is the case with new structures.

Component	Pattern of damage/refurbishment measure	Economic appraisal	Appraisal required in individual case[1]	Non-destructive analysis by...
General	House fungus or extensive infestation of timber components		--	Odour, mould pores (laboratory test if suspected)
General	Removal of hazardous substances		--	Not possible (laboratory test required)
General	Reconditioning of worn but intact surface finishes (e.g. floor coverings)	+		Visual inspection
General	Additions to or replacement of water and electric installations	o		Visual inspection of heating and electric installations, visual inspection of valves below wash-basins/sinks (lead pipes)
General	Replacement of waste-water pipes and drains	-		Video camera
Foundations	Underpinning because of settlement		-	Not possible
Foundations	Underpinning for deeper extensions	--		Not applicable
Basement floor	Subsequent waterproofing, no hydrostatic pressure	o		Moisture measurement of ground slab (24-hour measurement with device below plastic sheet)
Basement floor	Subsequent waterproofing, hydrostatic pressure	--		Visual inspection or moisture measurement of ground slab (24-hour measurement with device below plastic sheet)
Basement floor	Subsequent deepening below formation level	--		Not applicable
Basement ext. wall	Subsequent damp-proof course	-		Moisture measurements as series of vertical measurements
Basement ext. wall	Subsequent vertical waterproofing, drainage	o		Moisture measurements as series of vertical measurements
Basement ext. wall	Sealing joints in existing waterproof basement		+	Visual inspection
Flr. over basement	Corroded steel beams to jack arch floor		+	Visual inspection
Flr. over basement	Severe settlement of vaulting	--		Visual inspection
Flr. over basement	Exposed reinforcement	o		Visual inspection, check for hairline cracks and voids
Grd. floor ext. wall	Subsequent damp-proof course	-		Moisture measurements as series of vertical measurements
Grd. floor ext. wall	Efflorescence, salt deposits	+		Visual inspection (possible additional laboratory test in order to rule out house fungus)
Grd. floor ext. wall	Subsequent thermal insulation	+		Visual inspection
Grd. floor ext. wall	Settlement cracks (legacy)	+		Visual inspection (legacy settlement cracks recognisable by way of dirt deposits)
Grd. floor ext. wall	Refurbishment of render, conservation order		o	Not possible (research required)
Grd. floor ext. wall	Exposed reinforcement in fair-face conc. elements, balconies	o		Visual inspection, check for hairline cracks and voids

[1] Normal works for refurbishment measures which, however, are subject to severe fluctuations and therefore require an appraisal in every individual case.
a

B 1.8

Phase 8: construction management
The planning phase accompanying the construction on site is often referred to as site management. However, it also includes supervising the budget and timetable right up to the time of defects-free handover.
The main difference between the planning of new structures and conversions lies in the quantity of existing building fabric that must be retained and refurbished. As long as existing components are being used in some form, the cost of supervision must multiply if "surprises" – which arise from the less precise planning that is inevitable – are to be minimised. This means that working hours are shifted from the planning to the building phase, meaning that a larger buffer is required when planning the time on site. The fact that the loadbearing structure – at least – is already in place might lead us to suspect that conversions can be realised quicker, but this is not true. Trades with many interfaces with the existing fabric require generous time reserves; a typical example of this is plastering/rendering. Decisions recorded in detail and without delay reduce the risk of later disputes when the work has to be paid for! But it is a well-known fact that you should not make any hasty decisions on the building site. Complex relationships are often not identified until planning work is adjusted to suit on site. As the work on site progresses, so the site supervision for a conversion becomes more and more similar to that of a new-build project because the problems typical to conversion work decrease. One activity often neglected is joint measurement work, which should always be carried out promptly. The additional claims typical of conversion work, e.g. adjusting for inaccuracies or increased quantities for demolition work, cannot be checked unless the measurements have been taken beforehand.

Costs
Longer construction times always mean higher costs. Allowances should certainly be built into the trades at risk so that the total budget is not exceeded in the end. Besides extra costs typical to certain trades, additional costs specific to conversion work can also occur, e.g. rectifying collateral damage as a result of demolition or cutting/chasing work. The uncertainties encountered with, for example, structural requirements or damp-proofing are almost impossible to calculate (Fig. B 1.8).
The accuracy of cost estimates and calculations typical in Germany and required by legislation cannot be upheld in conversion projects. The only solution is to add a generous allowance to the total cost, which can only be reduced during the course of the work on site.

Strategies for increasing flexibility
Less dependable planning can be offset by greater flexibility. Manoeuvrability with respect to costs and time on site can compensate for the inevitable problems that will be encountered. Such strategies can take on the following forms:

- Work based on direct labour or daywork rates: This method frequently leads to disputes, also between client and design team. Such work can never be ruled out completely, but it should not exceed 10 % of the value of the contract.
- The inclusion of allowances, as mentioned above: The difficulty here lies in convincing the client on the one hand and the contractor on the other. "Visible" allowances are happily accepted by workers as "already included", which means they lose their effectiveness. The time and money buffers should disappear during the course of on-site work to give the client more planning and financial security.

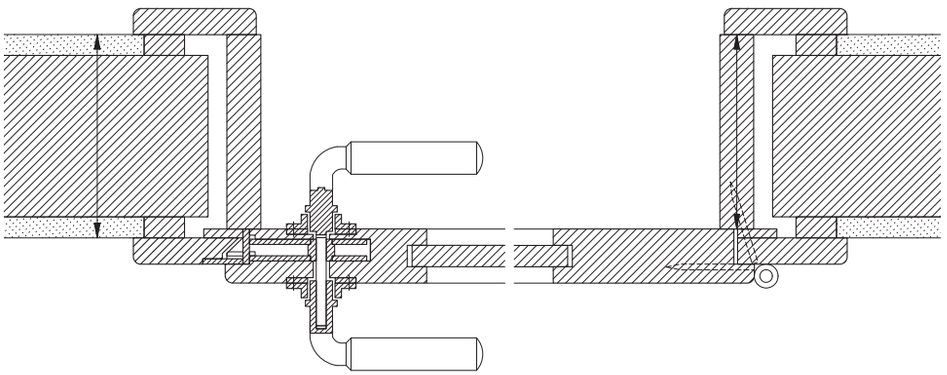
The work of some trades is very similar to that in new-build projects, in particular those involved in the later stages of fitting-out, e.g. floor and wall finishes, painting and joinery work, because by this stage there is hardly any need to adjust to the existing fabric of the structure. Such work requires only a very small allowance. The time and money reserves here can be minimised and based on the experience gained with new-build projects.

Component	Pattern of damage/refurbishment measure	Economic appraisal	Appraisal required in individual case	Non-destructive analysis by...
Window	Replacement of windows in fenestrated facade	+		Visual inspection of bottom part of window frame and seals, also year of manufacture in the case of insulating glass units
Window	Replacement/refurbishment, conservation order	-		Visual inspection of bottom part of window frame and seals, also year of manufacture in the case of insulating glass units
Window	Replacement of curtain wall		o	Not applicable
Window	Partial upgrading of existing curtain wall, thermal and sound insulation, fire resistance		-	Visual inspection, establish year of manufacture, study archive documents
Internal wall	Refurbishment of plaster, repairing cracks	+		Visual inspection, tap to discover voids, especially at base of wall
Internal wall	Chimney refurbishment, sooting up	+		Visual inspection, especially attic floor and cleaning openings in basement
Structural frame	Exposed reinforcement	o		Visual inspection, check for hairline cracks and voids
Structural frame	Upgrading fire resistance		-	Establish year of manufacture, study archive documents (concrete cover)
Structural frame	Corroded rolled steel sections		o	Visual inspection
Structural frame	Corroded cast stanchions	+		Visual inspection
Suspended floor	Upgrading load-carrying capacity/deflection		--	Measure at edge and mid-span in the case of long spans
Suspended floor	Upgrading fire resistance	o		Establish year of manufacture, study archive documents (concrete cover)
Suspended floor	Upgrading sound insulation	o		Not possible, maybe ask users
Suspended floor	Thermal bridges due to cantilevering balconies		--	Visual inspection
Suspended floor	Timber joist floor rotten at supports (no fungus)	o		Not possible (supports must be opened up)
Suspended floor	Exposed reinforcement	+		Visual inspection, check for hairline cracks and voids
Roof/roof space	Some rot at the eaves	+		Visual inspection
Roof/roof space	Upgrading load-carrying capacity/deflection of roof structure	o		Visual inspection and measure deflection
Roof	Replacement of roof covering	+		Visual inspection, especially nibs on underside
Roof/roof space	Fitting-out of previously unused roof space		-	Not applicable

+ non-critical
o less critical
- critical
-- very critical

b

B 1.8



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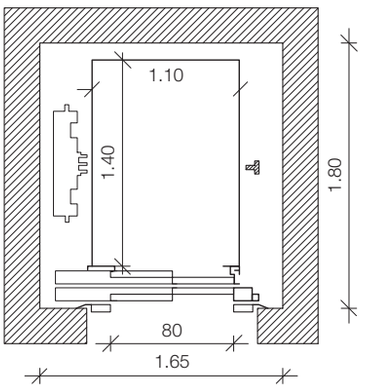

B 1.10

Standards and statutory instruments, toleration of the building stock
In principle, the newest standards, directives and statutory instruments apply to a change of use or a conversion. Quite obviously, however, trying to comply with such a requirement will lead to problems in many areas.
Whether the notion of toleration of the building stock applies can only be decided on a case-by-case basis. In Germany a distinction is made between “active” and “passive” toleration of the building stock. Whereas the passive form protects an originally legally compliant structure against changes due to later legislation, the active form secures the approval of measures designed to retain passive toleration. For the notion of toleration of the building stock to apply, the following conditions must be met:

- A usable existing structure suitable for its function
- Compliance with previous legislation
- Continuation of the usage

Preserving the toleration of the building stock is linked with very strict stipulations; it is intended to safeguard conservatory measures and expires...

- upon a change of use if other building regulations apply to the new use (i.e. possibly even only a minor change of use),
- if there are major qualitative and quantitative changes, e.g. changes to the loadbearing structure,
- the building has not been used for more than 12 months or is structurally “worn out”, e.g. structures at risk of collapse.

Private-law requirements or personal criteria do not affect toleration of the building stock. For instance, a small workshop in the middle of town cannot invoke the notion of toleration of the building stock when an extension to the premises is required. But for the very same reason, i.e. toleration of the building stock, the workshop’s neighbours might have to endure any emissions even if they do not comply with current legislation.

The following legislation especially often conflicts with planned conversion measures, meaning that special exemptions must be obtained:

- Clearance to adjacent structures, plot ratio: Many existing structures, primarily in densely built-up areas, do not comply with the current legal or statutory requirements regarding plot ratios or minimum distances to site boundaries. In most of these cases toleration of the building stock is interpreted very generously. Often problematic, however, are extensions, e.g. the addition of balconies or converting a roof space into habitable rooms, with the associated change in the enclosed volume. Clearances to neighbouring structures will then have to be verified, at least for the new works. In such a case either the infringement of the clearance will be entered in the register of public obligations – with the consent of the neighbours affected – or the absorption of the clearance must be entered into the land registry entry for that building.
- Thermal performance: Measures to improve thermal performance, e.g. attaching external insulation, fall under the heading of passive toleration of the building stock. And in the light of the need to achieve reductions in carbon dioxide emissions, there may exist exemption clauses regarding the infringement of the clearance to adjacent buildings (which have already been incorporated into building legislation in some instances).
- Noise control: The forms of construction used in the past very often do not come even close to meeting today’s requirements regarding insulation against airborne and structure-borne sound. A good example of this is the timber joist floor common in 19th century buildings. Improvement measures are possible in principle, but the low loadbearing capacity of the existing construction means that the options are limited. If a change of use is also planned (e.g. from residential to office space), the inadequacy of the sound insulation values will have to be negotiated with the authorities and the client and exempted because in this case the change of use means that the notion of toleration of the building stock no longer applies.
- Fire protection: Taking the example of the timber joist floor again, such a floor need not be checked for its fire resistance according to current legislation because the frequent demand for a floor construction consisting of incombustible materials is impossible to comply with. As replacing the floor would be uneconomic, an exemption must be negotiated, in this case with the local fire brigade, which can ask for a report from a fire safety expert and/or compensatory measures. Such measures can be expensive and so this issue must be clarified as soon as possible.
- Stability, serviceability: The loadbearing structure will have to comply with the latest standards and codes of practice as well if the notion of toleration of the building stock no longer applies. The standards applied to the materials used, however, are exempted from this. Instead, the standards valid at the time of erecting the building and the permissible material properties of that period can generally be used. The loading assumptions for any new calculations necessary are, however, taken from the latest regulations. A building component can very quickly lose the protection afforded by the notion of toleration of the building stock if the loads increase due to changes to the construction or changes of use, e.g. adding new floor screeds or suspended ceilings to upgrade the sound insulation.

When considering old buildings in the light of new legislation and standards, it is important to establish whether public or private law is involved. Regulations and statutory instruments are certainly public law and must be complied with once the protection afforded by toleration of the building stock no longer applies. Private-law standards, on the other hand, may not apply in certain conditions, provided they are not included by law in the approval procedure. However, deviations of any kind must be approved by the client in writing so that any claims for damages at a later date, e.g. due to loss of rental income, can be dismissed.