Recycling housing

(with particular reference to housing built between the wars)

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Abstract

At the millennium, shortage of landfill sites, building aggregates and timber, combined with pressure from environmental groups and Central Government, has persuaded the construction industry of the need to consider Sustainable Construction principles - at a time when the industry is reporting a considerable drop in the number of apprentices. Demographic changes in Europe have resulted in a new phenomenon known as 'irreversible neighbourhood decline', fuelled by bored unemployed youths. The response to the decline has been large scale housing demolition programmes such as those adopted by Sheffield City Council which has embarked on a ten year housing stock reduction programme, and Germany which has commenced on the demolition of one million houses in the former East Germany.

Recycling Housing develops an integrated solution to the above social and environmental issues. It considers reasons for the decline in the numbers of apprentices in the construction industry and as a solution advocates the on-site training of youths by their employment to dismantle suitable housing, and thereby bind the youths into the construction industry family. Health and safety issues are considered in depth; the author recognises that some youths have reading difficulties and offers a new approach to reading, based on a set of amusing construction illustrations covering matters such as safety and techniques in the use of hand tools. The author develops a system for going about the task of dismantling housing safely and environmentally friendly. All proposals are supported by practical research in which a two storey block of three flats (built in 1936 but extended and modified over the years) was safely dismantled by the author using hand and small power tools only. All building materials were recovered, cleaned and stored for recycling into new construction.

Declaration

The content of this research is the work of Douglas William Brown and includes nothing which is the outcome of work done in collaboration or work copied from others, except where that work is quoted herein and given proper acknowledgement. The practical work was carried at 42 Southbourne Coast Road, BH6 4DA between August 1998 and December 1999.

Acknowledgements

The writer thanks Dr John Chilton for supporting this work back in 1998, when sustainability was not as fashionable as it is in 2001. The writer thanks James and Jennifer Brown for their on-site help and support, and thanks Dr Ian Brown and Dr John Chilton for their constructive proof reading of this thesis.

In January 2000 a pre-tender submission was made to Sheffield City Council in response to an advert (New Civil Engineer 18.11.99) entitled "Housing Demolition Contracts 2000/2001", placed as part of a ten year housing stock reduction programme. A key component of the submission made by the writer was the training of unemployed youths during the deconstruction process. The writer acknowledges the experience gained in contractual matters and legal requirements for demolition contracts, see Appendix C.

The writer thanks the Rt Rev Michael Turnbull - The Bishop of Durham - for his enthusiasm for the social engineering aspects of Recycling Housing and encouragement to persist.

The writer thanks Peter Minchin of the Youth Justice Board for statistical information and counsel concerning young offenders.

The writer acknowledges all 'Sustainability in Construction' initiatives, especially those by the Government and by Jonathan Porritt.

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Chapter 1

Introduction

Although much of the housing built between the wars will last well into the next century, annually two to three percent of the housing stock is now being updated, replaced, or removed as part of a housing stock reduction programme such as that currently being carried out in Sheffield [NCE, 1999]. Scarce fossil fuels are consumed in the demolition and replacement of housing using the current method which is essentially:

- knock down the house using heavy construction plant
- burn the timber and other combustible material on-site (this practice is banned at some sensitive sites)
- transport the masonry and other non-combustible material for burial at landfill sites

followed by:

- tree felling for new timber for floors and joinery
- 'winning' aggregates and materials for the production of bricks, blocks, and cement
- transport of the new construction materials to site
- building the new housing.

Those working in the built environment have been challenged by environmentalists to recycle as much as possible; this thesis describes practical research in the recycling of housing as an alternative to the above 'demolition and replacement', and therefore is part of the Sustainable Construction movement. Recycling requires that the housing be 'dismantled' brick by brick. The term 'deconstruction' [IStructE, 1999] is coming into use rather than 'dismantling', and will be used henceforth even though the Oxford Dictionary defines 'deconstruction' as a method of critical analysis of philosophical and literary language.

1.1 Housing failure

Housing fails for two reasons: structural or demographic. Structural failure is often due to subsidence of the foundations causing cracks in the walls and thereby letting rain soak the structural timbers which in consequence become infested by woodworm and wood rot. The Institution of Structural Engineers report on subsidence [IStructE, 2000] states that "subsidence claims now average around 40,000 cases a year and with no indication that this rate will fall in the foreseeable future, subsidence will continue to be a major issue".

Demographic reasons for failure start with local unemployment resulting in gangs of bored youths looking for anything to do to relieve the boredom, their vandalism and intimidation frightens residents who move leaving empty houses to fuel a vandalism epidemic. Eventually the situation becomes irreversible. The Centre for Regional and Economic Social Research accuses councils of refusing to acknowledge the problem of "Irreversible neighbourhood decline". Their report [CRESR, 1999] urges decision makers to face the possibility that certain neighbourhoods may be beyond redemption. Sheffield City Council has embarked on a ten year housing stock reduction programme starting in the millennium year [NCE, 1999].

The problem of irreversible neighbourhood decline in not confined to Britain, the mass demolition of one million unwanted homes has commenced in the former East Germany because of the continuing flight of economic migrants to the more prosperous west of the country [NCE, 2000].

Government planning policies have been directed towards avoiding irreversible neighbourhood decline, substantial funds - currently in the order of £40,000 per house - have been provided for the refurbishment of whole neighbourhoods only to find that the decline continues. Housing stock reduction programmes such as those in Sheffield and Germany are implemented as a last resort.

1.2 Objectives of this research

Objectives follow from marrying the environmental need for recycling with the social need to provide enfranchisement for the unemployed who live within neighbourhoods which are in decline; Watermeyer [1999] uses the phrase "engaging marginalised sectors of society in construction projects". The objectives for this research are to develop a new system which may be used by those engaged in housing stock reduction programmes to:

- provide safe on-site construction training of unemployed youths
- provide on-site help for those with reading difficulties
- bind unemployed youths into the construction family
- protect the environment by deconstructing using only hand tools.

To test the practicability of the proposed system on-site by:

- recovering, cleaning and storing all materials for recycling
- logging details of techniques developed and lessons learnt
- comparing the new system with the current 'demolish and landfill'.

1.3 Outline

At the millennium, no project would be complete without cognizance of sustainability issues, Chapter 2 reviews major initiatives concerned with the built environment and social responsibilities. Chapter 3 considers the subject of recycling of building materials through the ages and highlights the difference between recycling and refurbishment.

The subject of training with particular emphasis on health and safety matters is considered in Chapter 4. For those with reading difficulties, a set of amusing illustrations on the subject of deconstruction will be found in Appendix A.

Chapter 5 gives the history of No. 42 Southbourne Coast Road, which became the laboratory for the practical research. No. 42 was originally built as a house in 1935 but extended and converted into flats after the war; giving it a good mix of construction methods including traditional domestic construction plus structural steelwork and reinforced concrete floors. Each planning application was associated with a building extension or modification, it was the variety of construction methods used which made No. 42 a good laboratory for studying deconstruction by the use of hand tools.

As this research advocates the use of hand tools for the deconstruction of housing, Chapter 6 gives considerable attention to the use of tools and the development of techniques. The proposals contained in Chapters 4 and 6 have been developed by on-site practical work by the author, but they have not been tested by youths - so far.

Chapter 7, the longest, covers on-site practical experience in the deconstruction of the two storey block of three flats at 42 Southbourne Coast Road, Bournemouth.

Chapter 8 looks at the economics and benefits of deconstruction and recycling and considers various approaches to quantifying them. Chapter 9 discusses various aspects of the research, Chapter 10 gives conclusions from the research and recommendations including proposals for further work. References are listed in Chapter 11.

Appendix A gives correspondence with the DETR and others on the subject of recycling Housing.

A key part of training must make provision for those with reading difficulties, there is little point in handing health and safety instruction to someone who cannot read. Appendix B gives forty examples of illustrations designed to make reading relevant to Recycling Housing.

Appendix C covers aspects which need to be considered in a full scale housing deconstruction project using unemployed youths and hand tools.

Hundreds of digital photographs were taken during the deconstruction of No. 42, Appendix D and the accompanying CD gives an annotated soupçon.

Chapter 2

Sustainability

'Sustainability' is the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs [Brundtland et al., 1987]. A hierarchy with 'Sustainability' at the top would have 'Sustainable construction' in the second division and 'Recycling housing' in the third division. This chapter contains a review of major initiatives in 'sustainability' and 'sustainable construction', no published research was found on the subject of deconstructing housing and recovering building materials for recycling. It will be seen from this chapter that there is a considerable body of literature on the subject of what needs to be done for Sustainable Development; the practical research covered in this thesis on Recycling Housing, concentrates on what can be done and how to do it.

2.1 Factor Four

The Club of Rome (an international group of environmentalists) drew attention to sustainability when they commissioned a report on the subject of the Limits to Growth [Meadows et al., 1972] which argued that we were rapidly running out of essential resources. Factor Four - Doubling wealth, halving resource use - [Weizsäcker et al., 1997] is the latest report to The Club of Rome and describes a new form of progress 'resource productivity', as one which meets the overriding imperative for the future: sustainability. The introduction tells us: "Factor Four, in a nutshell, means that resource productivity can - and should - grow fourfold. The amount of wealth extracted from one unit of natural resources can quadruple. Thus we can live twice as well - yet use half as much." Weizsäcker et al. [1997] admit

"Changing the direction of progress is not something a book can do. It has to be done by people - consumers and voters, managers and engineers, politicians and communicators." Recycling Housing is one contribution.

Weizsäcker et al. [1997] use 'Consumption' (tuberculosis) as a metaphor for the inefficient use of our resources (which they call the wasting disease) and quote a study for the US National Academy of Engineering which found that about 93% of materials we buy and 'consume' never end up as saleable products at all. Moreover, 80% are discarded after a single use, and many of the rest are not as durable as they should be. The authors tell us "The cure for the wasting disease comes from the laboratories, workbenches and production lines of skilled scientists and technologists, from the policies and designs of city planners and architects, from the ingenuity of engineers, chemist and farmers, and from the intelligence of every person. Motivation needs to be experienced as compelling and urgent by a critical mass of people, otherwise there won't be enough momentum to change the course of our civilisation." Recycling Housing - which has failed due to structural or demographic reasons - is compelling and urgent.

Weizsäcker et al. [1997] argue the case for rehabilitating buildings rather than demolishing them, but warn "Labour will not be saved: quite the contrary. Renovations can be more labour intensive than pulling the old building down and making a new one from scratch. If the tax burdens on human labour are reduced while resource taxes are introduced, the cost balance will shift significantly towards renovation, and thus resource efficiency."

Weizsäcker et al. [1997] give an example of the reuse of materials from a demolished timber building in British Columbia, and state "Of the total volume from demolition, 64% was estimated to be wood, 30% concrete, 2% metal, 3% tar-and-gravel roof. Normal demolition would have sent 92% of this entire volume to landfill. But in the pilot project only 5% was landfilled and the other 95% reused or recycled. The contractor believes that, although the building contained an unusual amount of valuable wood, the materials-recovering approach would probably still be profitable even with other buildings without so much wood, wherever there is a market for the materials." The phrase "wherever there is a market for the materials" is the key to success for any recycling project.

2.2 Natural Capitalism

Natural Capitalism - The Next Industrial Revolution [Hawken et al., 1999] is a brilliant review and thesis on the general subject of sustainability. Hawken et al. [1999] give 627 references - it is no wonder that Cambridge University has now appointed a Professor in Sustainability. Hawken et al. [1999] estimate that 99% of the original materials used in the production of, or contained within, the goods made in the US become waste within 6 weeks of sale. The Financial Times one line review of the book is "An analysis of how capitalism would work if the world's 'natural capital' were properly valued, resulting in a drastic reduction in resource use by industrial countries".

Hawken et al. [1999] give examples where commercial buildings have been transformed to energy efficient buildings e.g. the California State Automobile Association was given: better insulation and solar features with advanced windows, daylighting, and efficient artificial lighting to save 63% of the energy permitted by the state's supposedly strict energy requirements. Hawken et al. [1999] tell us: "Green design will slowly replace or retrofit nearly all old structures. If a building can't be recycled, the next best approach is often to reuse wood, bricks, and other materials from prior structures. This is preferable to sourcing new materials from sustainably harvested wood and other natural materials, because the materials were already produced and needn't be produced afresh. The energy required to create the materials (wood, wiring, plumbing, masonry etc.) in an energy-efficient building can exceed the heating and cooling energy it will use in half a century. Reusing that embodied energy saves both energy and capital costs."

Hawken et al. [1999] tell us that Sustainability is not just about the environment it is about "creating a healthy economic, social, and ecological system that develops both better people and thriving nature?". A key chapter entitled 'Human Capitalism' starts with "What destination does our society want to reach, and how will it get there? Lessons in what not to do can often be found in cities, where most officials, overwhelmed by a flood of problems, try to cope by naming them and solving them one at a time. If they are faced with congestion, their answer is to widen streets and build bypasses and parking garages. Crime? Lock up offenders, Smog? Regulate emissions… Communities and whole societies need to be managed with the same appreciation for integrative design as building, the same frugally simple engineering as lean factories, and the same entrepreneurial drive as great companies… Social systems have a dual role. They provide not only the monetised 'human resource' of educated minds and skilled hands but also the far more valuable but unmonetised 'social system services' - culture, wisdom, honour, love, and a whole range of values, attributes, and behaviours that define our humanity and make our lives worth living."

Hawken et al. [1999] use a southeastern Brazilian city called Curitiba as a good example of "weaving the web of solutions which has been done not by instituting a few economic magaprojects but by implementing hundreds of multipurpose, cheap, fast, simple, homegrown, people-centred initiatives harnessing market mechanisms, common sense and local skills. It has flourished by treating all its citizens - most of all its children - not as a burden but as its most precious resource, creators of its future."

2.3 Social responsibilities

Watermeyer [1999] in a paper which examines the employment-generating potential of construction projects, urges the construction industry to:

- be aware of the socio-economic deliverables that can be attained through various types of construction project
- develop and publish Codes of Practice and specifications that facilitate the

linking of socio-economic objectives to targeted procurement

- encourage the development of on-site/point of manufacture test methods
- publicise case studies of the successes in attaining the socio-economic objectives
- mobilise engineers to come forward in identifying technologies (new and old) that have the potential to realise socio-economic deliverables and to share information, based on experiences
- inform and give direction to research initiatives embarked upon by others
- be a catalyst in bringing together research organisations, academic institutions, and practitioners, to share their needs and ideas
- engage with Governments to make them aware of what can be achieved.

2.4 Lean Thinking

Lean Thinking: Banish Waste and Create Wealth in Your Corporation [Womack and Jones, 1996], espouses the doctrine of Taiichi Ohno - the father of the Toyota production system [Ohno, 1988]. Ohno defined waste as "any human activity which absorbs resources but creates no value". Womack and Jones list Ohno's forms of waste as "mistakes that require rectification, production of items that no one wants, processing steps which aren't actually needed, movement of employees and transport of goods from one place to another without any purpose, groups of people in a downstream activity standing around waiting because an upstream activity has not been delivered on time, and goods and services which don't meet the needs of the customer". All construction workers are familiar with such waste.

To avoid the waste caused by conflict between trades, this research was limited to one activity to be worked upon at any one time, and wherever possible by just one person. Throughout this research intense concentration was given to the initial planning of every task and then every single repeated action was studied and modified to save fractions of a second - in much the same way as optimising a Formula 1 pit stop.

2.5 Forum for the Future

Jonathan Porritt of Forum for the Future presented the 20th Maitland Lecture to the Institution of Structural Engineers [Porritt, 1998], on the subject of 'Engineering a sustainable future'. He told his audience "The Government's joint consultation on sustainability in the construction industry is the most important report on the construction industry for decades, to which the Government clearly attaches enormous significance."

There were two different approaches, said Porritt. On the one hand, a standards and quality driven agenda, on the other was the sustainability agenda which was "about efficiency of a rather different kind, about meeting the needs of the future in a rather different way, about engineering excellence of a rather different kind." He believed that a key area of importance was the review of the Building Regulations [Building Regulations, 2000], which would "almost certainly change the way they affect construction in the UK very dramatically. We are beginning to see a much more serious engagement in the process of using the Building Regulations to drive higher performance standards than ever before."

2.6 The DETR

The DETR in its 'Sustainable Development: Opportunities for Change: Sustainable Construction' [DETR, 1998] invited responses to a number of questions. Chapter 9 answers some of the questions posed by the DETR document.

The UK Minister for Housing, Planning and Construction [Raynsford, 2000] acknowledges "not all progress can be achieved without some clear direction from Government. The encouragement of good practice is vital but regulations also have a contribution to make. Regulation is necessary in circumstances where it is unlikely that clients and industry will be willing to pursue voluntarily a sustainable policy of their own volition. The Building Regulations, and their associated Approved Documents and other supporting guidance, can serve to draw attention to the principal physical aspects of sustainable development such as resource depletion, biodiversity and climate change. This was the key finding of industry's response to the Government's consultation paper on sustainable construction [DETR, 1998]."

2.7 Web searches

Various web sites and search engines were used, searching on 'Recycling Housing' and 'Sustainable Construction'. It will be immediately obvious from the following references that 'Recycling Housing' as defined in this study means something very different to 'Housing Recycling' in some of the searches. 'Housing Recycling' means getting the tenants to help in recycling consumables, not deconstructing failed housing, recovering materials, cleaning them and storing them ready for recycling into new construction.

Three responses to searches on 'Recycling Housing' follow, the first obtained by AltaVista, the others by Yahoo.

UO Campus Recycling: Housing Recycling Program, University of Oregon.
HOUSING RECYCLING PROGRAM.
URL: darkwing.uoregon.edu/ ~ recycle/housing.html
Last modified 28-Mar-96 - page size 589 bytes.

Tucson Metropolitan Ministry - social service agency that serves families, children with transitional housing, group homes, homebuyer, child care, and recycling programmes.

Emmaus UK - a Community response to homelessness, providing a home and a job of work recycling and recirculating donated goods.

In all the web sites - whatever the search engine - no literature was found covering the subject of deconstructing housing, recovering and cleaning materials and storing for recycling into new construction. Widening the search to 'Sustainable Construction' reaped rich rewards e.g. the search through ICE and Southampton University on 'Sustainable Construction' yielded: Press Releases; UK Strategy for Sustainable Development; Presidential Addresses; The world's population will double by 2050; Planning Policy Guidance; The 1997 Transport Green Paper; Engineering Information on Environment & Sustainability; Tourism Towards

Sustainability; and ICE's SAID report (Sustainability and Acceptability in Infrastructure Development). The introduction to the SAID report tells us "This document is titled SAID, because it highlights what is "said" in the report - which is a response by the Institution to a challenge laid down by the Secretary of State for the Environment."

ICE's web pages covering 'Environment & Sustainability' contained links to other sites. By far the most prolific source of literature on 'Sustainable Construction' is that of the DETR. Key sections on their consultation paper and responses to the consultation paper follow the ICE web page information. The list of 200 respondents to the DETR's consultation paper are given and would be a good place to start for any organisation proposing to hold a conference on the subject of 'Sustainable Construction'. Respondents include several Universities, their names are listed on the DETR's web site.

The final section in the DETR web site entitled 'ANNEX D - Suggested Indicators for Sustainable Construction' is a suggestion for measuring the degree of 'Sustainability' in any construction project; somewhat different to the percentage of materials and Factor number approach used in this thesis; nevertheless 'Recycling Housing' scores very high on the number of indicators with a 'hit' in almost every section.

Chapter 3

Recycling

3.1 Historically

Through the centuries thousands of builders pillaged stone from the buildings of previous generations. We now know that some of the great pyramids have had their outer surface removed for the construction of later buildings. The recycling of building materials into other public buildings must make archeologists wonder just how many more buildings would exist were it not for recycling. Thus the recycling of building materials is not new; what is new is the flagrant waste of natural resources following the demolition of buildings, the onsite burning of timber and the profligate use of scarce fossil fuels to cart building skips full of bricks and rubble, fixtures and fittings, to landfill.

Forty years ago, the writer - in the middle of a civil engineering degree - was warned by a lecturer that - at the 1960 rate of extraction - Thames gravel would be exhausted within 50 years. At the start of the second millennium the prediction is coming true, with aggregates for London and the Channel Tunnel now being imported from Super Quarries in the north of Scotland where whole hills of stone are detonated. The SNP is against quarrying in Scotland for the benefit of the English. Brown [2000] says "Britain's construction industry currently uses over 250Mt of quarried aggregates every year. At the other end of the cycle, over 70Mt of construction waste are thrown away annually, most to landfill. This is four times the rate of household waste production." Something has to be done.

The writer carried out a structural survey of Dartmoor prison in 1977-78. One striking example of recycling was that the roof trusses in the various prison wings were made from sound oak, won from shipwrecked boats, and carried by Napoleonic prisoners of war to Dartmoor for building their own prison. The use of free or nearly free labour helps the economic case for any recycling project.

3.2 Refurbishment

Recycling is not the same as Refurbishment. Refurbishment is well covered by present building methods and involves the gutting of a building, replastering, the provision of new services, fixtures and fittings. In refurbishment the walls, foundations and floors generally remain intact. Refurbishment is preferred to recycling as it preserves the main fabric of a building, recycling is proposed for failed housing only; it is the recommended alternative to demolish and landfill, which is the current solution for failed housing.

3.3 Suitable housing

Not all failed housing would be suitable for recycling. The decision to deconstruct No. 42 - using hand tools - and recover all materials, was made at the start of this research following a structural survey by the writer. Deconstruction would not be an option for: unsafe structures; housing with extensive infestation of dry rot as this fungi can penetrate the masonry; housing close to the public where a road would need to be closed and thus demolition in days would be required; high rise housing - two storeys is the suggested limit for deconstruction using hand tools as a construction training exercise.

3.4 Reuse of recycled materials

Of course there is little point in recycling bricks, timber and other materials if there is not a market for recycled building materials. Although housing reduction programmes are appropriate for areas of irreversible neighbourhood decline, nationally there is a national shortage of housing. The Government has published a White Paper [DETR, 1999]. In the words of Richard Rogers "The demographics facts are stark. The nuclear family is in decline, single-person households are increasing, and the population is aging. People are going to need homes."

Single person households require flats, flats need concrete floors and heavy separating walls for airborne and impact sound requirements. In-situ concrete floors with continuous reinforcement are structurally better than precast concrete floors which do not have continuous reinforcement. In-situ concrete floors need substantial amounts of timber formwork to support the wet concrete, and substantial amounts of masonry for internal separating walls. Timber for the formwork and bricks for the internal walls can be supplied from recycling the timber and bricks from housing which has failed.

Although recycled timber and bricks from one house will not easily find a market, recycled timber and bricks from ten thousand houses will create an industry; there is sure to be no shortage of customers if critical mass can be achieved for - as the popularity of car boot sales prove - the British like a bargain.

3.5 Practical research

Inspired by Sustainable Construction initiatives, the research commenced with the aim of developing a system for teaching unemployed youths about construction techniques by employing the youths to deconstruct failed housing and clean and store the building materials for recycling into new construction.

It would have been possible to write a thesis on the subject of Recycling Housing by researching the subject of Sustainable Construction in association with DIY books, but such a work would not have had the authority of research based on practical work specifically involved with the subject. "One practical experiment is worth a thousand expert opinions", so this thesis details practical research in the deconstruction of a two storey block of flats. Although some demolition firms now recover materials (Architectural Salvage) for recycling, the work described is believed to be the first time a block of flats containing a mixture of traditional house construction and structural steelwork and reinforced concrete floors, was deconstructed using hand tools and all materials separated, cleaned and stored ready for recycling into new build. At the outset it was decided that no building materials would be sent by skip to landfill; although some soil was taken by barrow or van to neighbouring gardens all other materials, including rubble, were stored either on or off site.

This thesis converts the ideas described in Sections 2.1 to 2.6 into practice; it is as much about social engineering as it is about construction. Although unemployed youths do not work for any corporation, wasting their lives is morally more repugnant than say the double handling of materials.

Chapter 4

Training

Those who get to University have done very well; this thesis is aimed at less privileged young persons (including young offenders) particularly those youths who seek a bit of excitement. Deconstructing houses is an adventure, it is Green and contributes to society by developing skills and social cohesion within a group and by anchoring those young persons involved to the construction industry family. Construction work is predominantly outside work and much closer to man's hunter gatherer nature than sitting in front of a computer. Housing has involved mankind for hundreds of thousands of years and must by now be an activity coded into our genes. This research seeks to devise a practical training system which can use unemployed youths to deconstruct failed housing.

The Home Office Minister [Boateng, 1999] believes boys and young men "must be given a clear sense of their worth in the community". He said that research presented at a Home Office seminar on men's role in society "has shown that men, especially young men, are feeling increasingly vulnerable, lacking self-esteem and confidence in certain areas of social and family life". "As a Government, we intend to reverse this worrying trend and encourage recognition of boys' and men's positive achievements." Recycling housing has a contribution to make in raising the self-esteem of many disenfranchised youths and therefore fits in well with Paul Boateng's stated government intention.

The notorious Oliver North famously described his scheme of trading guns for hostages as 'Neat', this word would be a good descriptor for a system which helped to solve social problems, provided training in the construction industry, and benefited the environment by recycling building materials which would otherwise have gone to landfill.

4.1 The need

The British Medical Association would call a general strike if they were told that - as an economy - medical schools would be closed with future medical training being based on school leavers working alongside doctors.

The position in the construction industry has differed in the past from that of medicine in that tradesmen e.g. the local plumber, took on a school leaver as low paid labour in return for imparting the tricks of the trade. Eventually the school leaver became his own boss, and employed his own school leaver.

Government and European workplace legislation has now made taking on a school leaver more of a hindrance than a help; the writer does not know of one tradesman who is training a school leaver. The position is becoming more and more serious as the years pass and skilled tradesmen retire, with few youths trained to take their place. This shortage of tradesmen [Helgadottir, 2000] has been noted by the construction industry which has carried out a survey to investigate the problem, the results of which predicts significant shortages of tradesmen in the next twenty years. Clerks and some management can be replaced by computers, tradesmen cannot; no person alive today will ever see a robot plumber fixing a burst pipe, or a robot painter erecting a ladder, preparing paintwork at the top of a ladder and painting the prepared work.

Although the shortage of tradesmen is looming, there is not a shortage of unskilled youths or young offenders seeking employment. Central government has recognised the need for training and has announced 'New Deal' to tempt firms to take on school leavers and unskilled youths; Andrew Smith, Employment Minister is responsible for New Deal. The writer has discussed New Deal with his local electrician and plumber, neither are tempted by the £60 per week on offer from the government, so an enabling device will be needed to get youths into the construction industry, though New Deal will serve nicely for lubricating the process. NCE [Nov. 1998] reports "New Deal for Construction, part of the government scheme to combat long term unemployment, has placed only 750 people in the industry by the end of August. The initiative was aiming to place 3,000 people this year." It is hoped that this research will become the enabling device to meet the Government's target.

Just as the medical profession learns anatomy from the dissection of corpses (they use the word cadaver), so construction industry trainees could learn construction principles from the deconstruction of failed housing. The medical profession has one advantage over the construction industry in that one corpse is more or less of the same design as any other, houses on the other hand come in:

- different construction materials
- different structural and building services concepts
- supported by a wide variety of soil conditions and foundation techniques.

Artists do not sit down one day and paint a great picture without first having copied the work and styles of previous artists. It is just the same with learning a trade; if tradesmen cannot spare the time to teach apprentices then the next best thing is to employ youths to deconstruct houses - which have failed - and thereby learn how those who built the houses put them together.

Recycling Housing can be dangerous, but so can the dissection of corpses (those involved with cadavers at the turn of the century were responsible for the high rate of infant mortality caused by bacteria carried from the cadavers into maternity wards). Reducing the danger during the house deconstruction process to the absolute minimum is a significant component of this study and training notes have been developed.

Another key component to the training is that retired or semi-retired architects, builders or tradesmen be mobilised on a voluntary basis (expenses paid) to supervise the deconstruction process, say one supervisor per 15 houses. Builders and tradesmen suffer from back and knee problems from their fifties onwards. The knowledge they have gained over the years should be passed on to youths, the construction industry cannot afford to lose their knowledge.

Medical students when faced with a cadaver do not say they will only work on a new body; therefore those wishing to be trained in the construction industry have no precedent for arguing that they will only work on new construction. The 'hands on' deconstruction of houses will teach more about building construction than any text book can, additionally the work will teach practical structural and building services principles e.g. it will get the youths thinking about 'load paths' and 'pipe and cable runs'.

4.2 Health and safety legislation

There has been a change in attitude to site accidents over the last thirty years. As a site engineer in 1964, for George Wimpey working on the construction of a new Bricketting Plant at Markham Main Colliery, the writer had a 1″ thick metal pile casing roll off the top of a pile head onto his foot pushing it into the ground. He was taken to Doncaster General Hospital and X-rayed, told he had hairline cracks and to keep the weight off the foot for two weeks. He returned to work the next day and spent a month walking on the heel of his right foot, carrying his theodolite or level as usual. He apologised to the agent for having his foot underneath something which could fall on top of it. Although Recycling Housing is no more dangerous than riding a mountain bike, the reader can guess what would probably be today's scenario in a similar situation to that described. Most tradesmen do not have insurance policies, they assume nothing will happen to them, but they are aware that if they take on a youth, then in the event of a serious accident they may get sued in the courts. Today employers are required under the law to ensure, as far as is reasonably practicable, the health, safety and welfare of their employees at work. HSE [1999] gives the employer's duties under the legislation as including:

- making the workplace safe and without risks to health
- ensuring plant and machinery are safe and that safe systems of work are set and followed
- ensuring articles and substances are moved, stored and used safely
- providing adequate welfare facilities
- providing the information, instruction, training and supervision necessary for the health and safety of employees.

It is important to distinguish between the above legal requirements placed on an employer and the relaxation of those requirements for this research where there were no employees. For a Recycling Housing project involving youths, a hard hat, safety goggles and steel toe caps must be worn at all times; and when working on a roof, a handrail must be provided around the edge of the roof. For this research - where the writer worked alone - welfare facilities were not provided, and the photographic record in Appendix D shows that a hard hat was not always worn, nor was a handrail provided around the perimeter of the roof.

The remainder of this chapter gives safety tips, a selection of which are illustrated in Appendix B for the benefit of those who have reading difficulties. Handing a list of safety procedures to an employee who cannot read would not satisfy an employer's duty under the law; the illustrations are designed to teach good safety practice, if advice is wantonly ignored, then the cause of an accident will not be that of negligence by the employer.

The teaching of reading skills is an essential component of site-school. The writer's children were taught using a kit developed by the American clinical researcher Dr Glen Doman [Doman, 1965], followed by the Ladybird Key Words Reading Scheme [Ladybird, 1965].

Quoting from the foreword to the book which accompanied Dr Doman's kit

"When our team members got on this train at the various stations, we were hoping that our destination was better treatment for severely brain-injured children. None of us dreamed that if we achieved that goal, we would stay on the train till we reached a place where brain-injured children might even be made superior to unhurt children. The trip has thus far taken twenty years... The original passenger list included a brain surgeon, a psysiatrist (an M.D. who specialises in physical medicine and rehabilitation), a physical therapist, a speech therapist, a psychologist, an educator and a nurse. Now there are more than a hundred of us all told, with many additional kinds of specialists."

The Ladybird books have helped more than 80 million children to read since the launch of the Ladybird Key Words Reading Scheme in 1959 [Telegraph, 02.12.01]. The association of keywords with pictures has been proved in practice to be a good way to teach reading, and using this association and the writer's experience in the construction industry, grew the extensive set of illustrations and associated keywords, given in Appendix B.

4.3 Health tips

A single side line in the margin of the text indicates advice to those who become involved in Recycling Housing. The advice embodies the practical experience gained on the deconstruction of No. 42. Consideration was given to including the advice with the general recommendations in Chapter 11; but as the advice covers details specific to a section heading, it was thought more appropriate to include it under the heading.

Avoid breathing dust, go to another room to do another task until the air becomes clear. Wear a face mask; the writer has never found them practical (possibly because he remembers wearing a gas mask during the London blitz), he uses the 'hold your breath, bash away, get out of the dust' method. If you have to make a lot of dust, do so before leaving the area for a tea break.

Although asbestos was generally used in industrial buildings between the wars and up to the 1970's, it was infrequently used in housing save for corrugated asbestos cement used for garage roofs etc. Asbestos cement is made by mixing asbestos fibres with cement, the fibres provide a tensile strength to the material. Corrugated asbestos cement was made with corrugations at 3″ and 6″ pitch, the 6″ variety being known in the trade as the "big 6". The removal of asbestos when in fibre form requires the use of special breathing equipment and special techniques. There housing which you are deconstructing has been checked and has been found to be free of asbestos, but if you do find something which you think may be asbestos especially if it is in fibrous form, don't touch it, ask for advice.

Hard physical labour in the sun is exhausting and dehydrating, so mix the work with some which you can do in the shade and drink plenty of water during the summer.

Hold a shovel properly; the left hand should be down near the blade, the right hand holding the top, (reverse hands if more comfortable). Use your inner thigh to push the shovel into rubble, it is much easier on your back.

Turn your gloves inside out each evening to allow them to air; if this is not done your gloves and hands will smell after a few days due to a build up of bacteria inside the gloves.

Use a mat when kneeling, keep moving your position so that your back does not get locked into one position e.g.

- one knee up the other down then change to the other knee up
- if you have to have both knees down on the kneeling mat use one arm as a prop to take the weight off your back.

The kneeling mat will save your knees and allow you to play football for more years than you could if you did not use the mat.

Some jobs such as snipping through wire mesh can go on for tens of hours, and hands get tired (even if you are using both of them); for such jobs, just do a bit at a time say 5%, "Rome was not built in a day".

Make sure you are using the best tool for the job, think for example

- would a crow bar be easier than a pick axe?
- would a screwdriver be better than a cold chisel?

If the job seems harder than it was the last time, think for example

- did I do it this way before?
- did I find an easier way?

Use your brain to save your energy.

On environmental issues there are four types of people:

- Conservation elite - who contribute to a better environment
- Bourgeois - those who neither improve nor damage the environment e.g. 'take nothing but pictures, leave nothing but footprints'
- Ignorant - those who damage the environment through ignorance
- Degenerate - those who deliberately damage the environment e.g. setting fire to Kuwait's oil wells.

Recycling housing improves the environment as it conserves fossil fuels and trees. You are therefore a member of the conservation elite, so on a cold wet morning, when it required a Herculean effort to get up and you feel that you are achieving very little, keep your chin up, feel good about what you are doing; always remember you are a member of the conservation elite, it will help to keep you healthy. Remember and quote the phrase "Sustainability is the issue, all others are of secondary importance" [Porritt, 1998].

4.4 Safety tips

When you are straining with any form of lever, just think what is going to happen to you if the tool slips suddenly; work out where you will jump if you loose your balance.

You must wear protective eye goggles when you are hammering. Some construction workers squint or blink as the hammer strikes.

The chance of anything hitting your face reduces by the square of the distance your face is from the work surface, i.e. if your face is a metre away from the work surface rather than half a metre you will reduce the chance of something hitting your face by a factor of four, so do things at arms length where practical. Arms are tougher if you wear a shirt, old jumper and gloves.

Don't take chances. If something can go wrong, then sometimes it will go wrong e.g. if dirt can get flicked into your eyes then sometimes it will, so always wear safety glasses.

If you want something to jam in a gap to stop it closing, then jam in a screwdriver or hammer, but never your fingers. When you are levering and have your hand wrapped around a wrecking bar or crow bar, pay attention to what will happen to your fingers and thumbs if what you are levering suddenly comes free.

Keep walk-ways clear at all times; and never leave anything at the bottom of a ladder for someone coming down the ladder may not see it.

Dusty floors are very slippery; never run on them. If you are doing difficult or heavy work, sweep up the dust and splash with water to kill the remains.

Stand up timber with protruding nails in the corner of a room so that no one can tread on a nail when they are walking over the timber and unable to look down because they are carrying something.

Shovel against your foot when you are using a shovel as the equivalent of a dustpan and brush.

Falling crow bars and hammers are painful, always make sure that they can never fall on any part of you. There is always a possibility that someone is working above you or that something can fall on your head or you are using a tool that may slip and hit your head so ALWAYS WEAR A HARD HAT. Even if you know what you should do it does not guarantee that you will behave accordingly. For example two weeks after having written the words "Do not pull the crow bar in the direction of your head", the writer did exactly that and ended up with blood gushing everywhere, fortunately the crow bar hit him on the head - rather than in the eye - but unfortunately it was the claws that hit him. The writer ignored his own advice because he was thinking about a totally different matter to the job in hand and was using the crow bar on 'automatic pilot'. Please, do not get caught out yourself, stay as aware as a grand prix driver, and always wear a hard hat, safety glasses, steel toe caps, high visibility vest, with extras like breathing apparatus and harnesses where appropriate.

Always secure a ladder at the top and make it project above the next floor or roof level and provide a hand hold. When there is nothing firm to tie the ladder to, improvise; for example if the ladder is leaning against a parapet, place a heavy pole over the parapet resting on the roof and tie the ladder to the pole, then weight down the pole with bricks or blocks.

When you lose your balance (on brick rubble or other rough surface), program yourself to drop down onto all fours to minimise the possibility of twisting an ankle.

Try to use your left hand for half the time, great footballers can score equally well with both feet. The effort will wire your brain so that if you have an accident to one of your hands you will still be able to get through life with the other one.

Count the stairs for carrying safety. When you are carrying something, then by counting you will know when you have reached the bottom.

You have to learn to be able to hit the end of a screwdriver with the hammer while looking at the point of the screwdriver; you will miss frequently until you are able to do this, so wear thick gloves to cushion your knuckles.

Things which look 'positively dangerous' usually are, do not be bamboozled by statements such as "it would hold up an elephant".

Of course there will be accidents, what life is free of them, the construction industry is no exception. Fatal accidents include:

- falling off a roof or ladder
- messing with electricity, especially for those with a weak heart
- having part of a structure fall onto you.

To minimise risk of the above accidents, taken in order:

- access the roof from inside the house using the outside wall of the house as a parapet i.e. ladders up the outside are avoided
- at the start of the deconstruction work a qualified electrician should disconnect and check all electricity rings and spurs from the meter and provide a temporary fuse box with two 13 amp sockets for hand tools and inspection lamp
- to avoid the danger of collapse, ask if you see the slightest sign of past or present cracking, structures do not normally collapse if they are sound.

Non fatal accidents, which are by far the most common include:

- hitting your leg or some part of yourself with a crow bar or other tool or falling brick
- falling off steps or platforms
- getting grit in your eye/s
- being hit on the head by falling plaster etc.
- walking into pipes, nails etc. which have been left sticking out and not noticed because you were shovelling or doing some other work.

To minimise risk of the above accidents, taken in order:

- always work out in your mind what will happen if any tool which you are using slips and be prepared for it to slip
- do not work when leaning over the side of steps or platforms unless you are satisfied that you will not hurt yourself if you fall
- wear safety glasses or safety goggles
- do not leave bits of plaster etc. dangling precariously from a ceiling
- do not leave things sticking out, especially where any head can bump into them, if you do bump into something which is sticking out, deal with it immediately, do not leave it for someone else to bump into it
- when using power tools follow the health and safety instructions for the equipment to the letter.

Chapter 5

The laboratory

5.1 No. 42 as built in 1935

42 Southbourne Coast Road, Southbourne, BH24 3DE was built in 1935 and has effectively become the laboratory for the recycling housing study.

No. 42 comprised three flats:

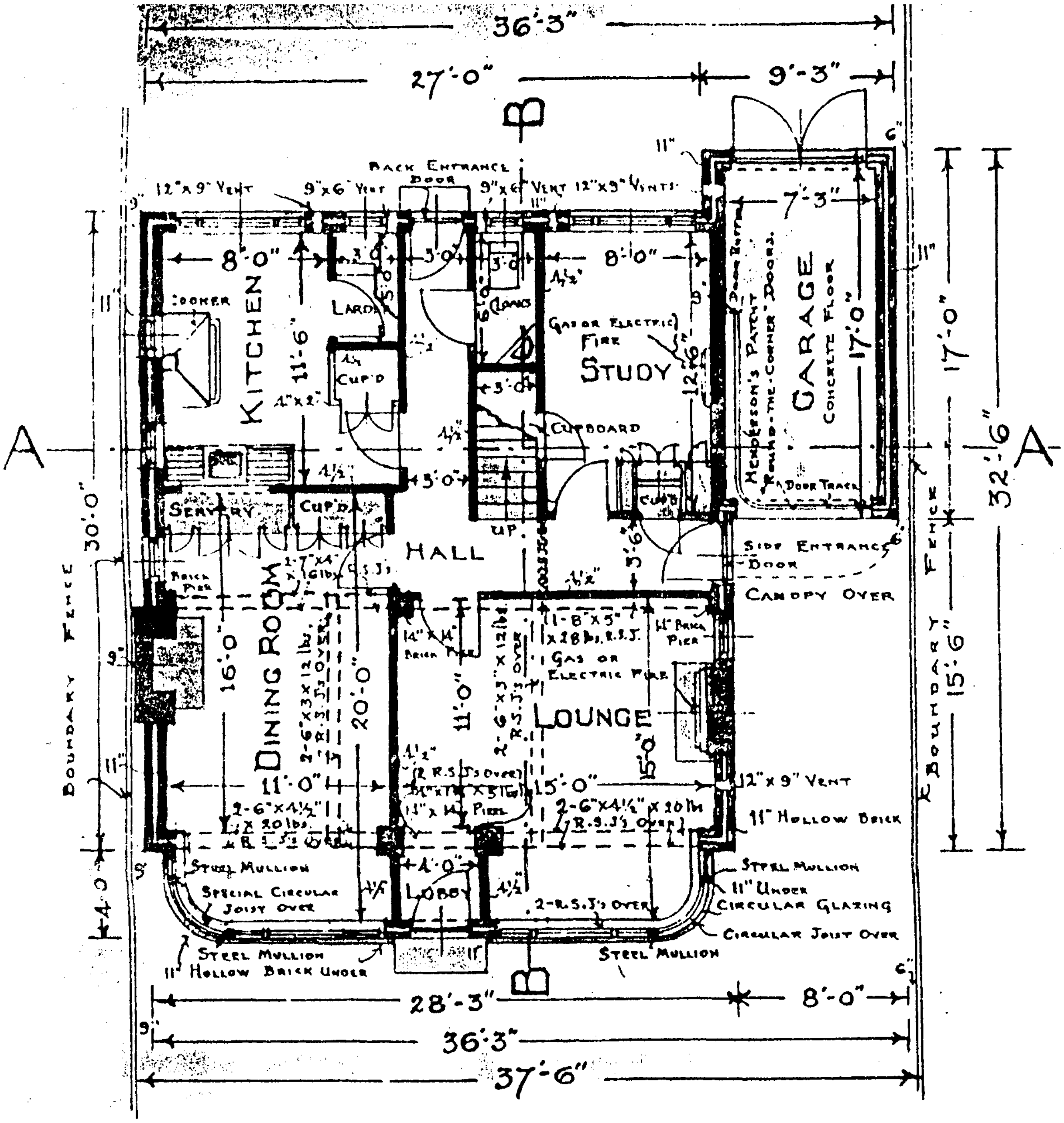
Flat 1 - downstairs at the back of the house with access from the front

Flat 2 - downstairs at the front of the house near the side entrance

Flat 3 - upstairs - access through the side entrance and up the stairs.

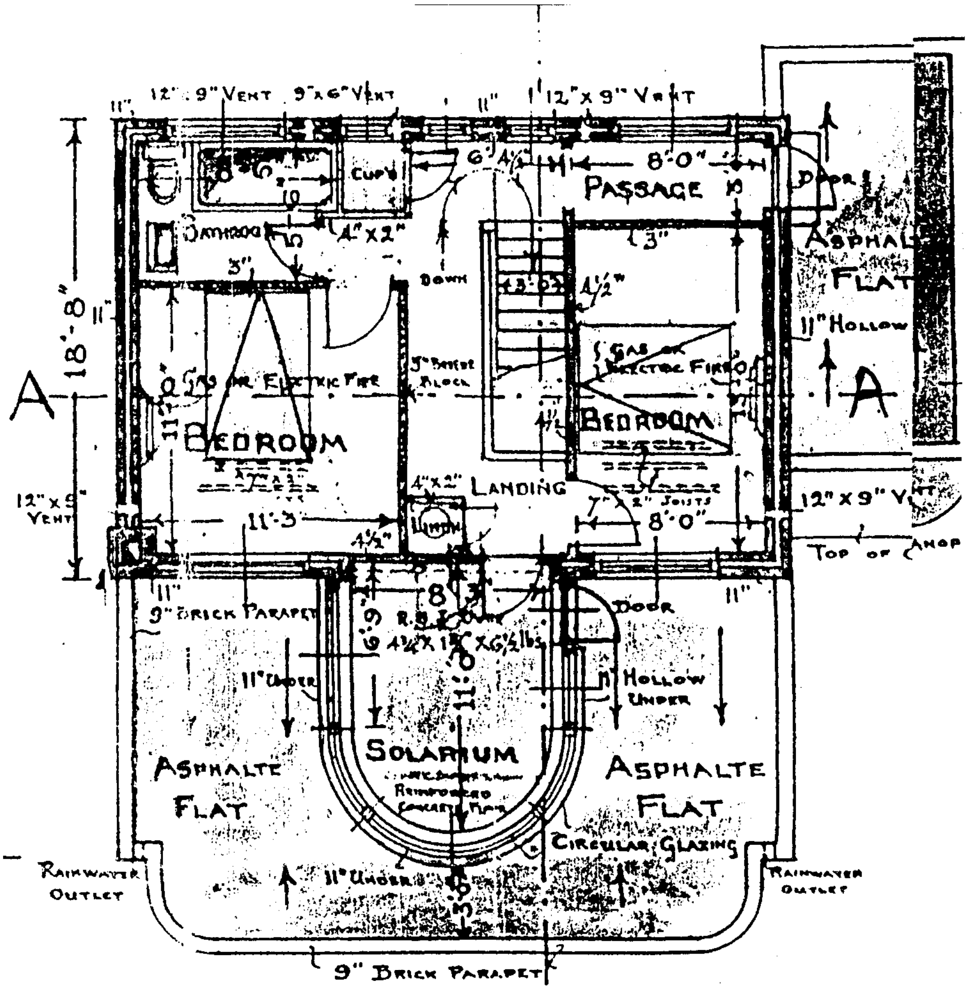
The original plans and elevations follow. As can be seen from the Block Plan and Section, at the time of No. 42's construction, the coast road lay to the seaward side of the house, and the house had its southern elevation which faced the road as its best face; its northern elevation was not expected to be seen and in consequence was peppered with down pipes, plumbing stacks, and a hotchpotch of windows and ventilation openings which can be seen in the North Elevation.

After the 1939-45 war, extensive sea defence works removed the cliff edge road and following construction of Southbourne Coast Road to the north of the house, No. 42 then had the embarrassment of having its 'bits and pieces' visible from the road.



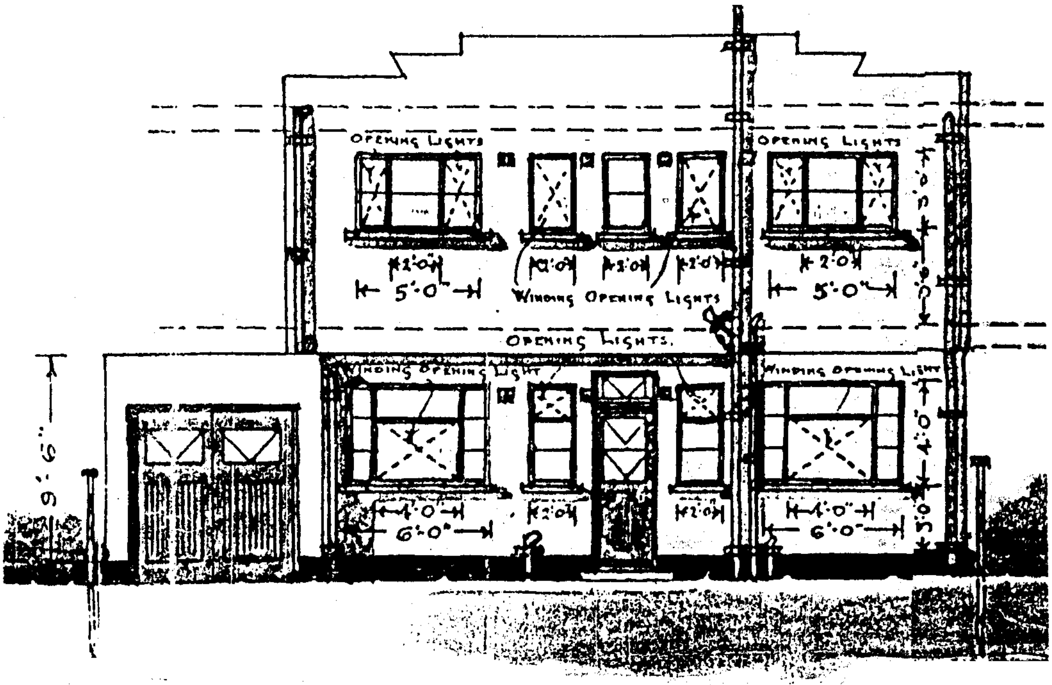
GROUND FLOOR PLAN

42 Southbourne Coast Road - as built in 1935

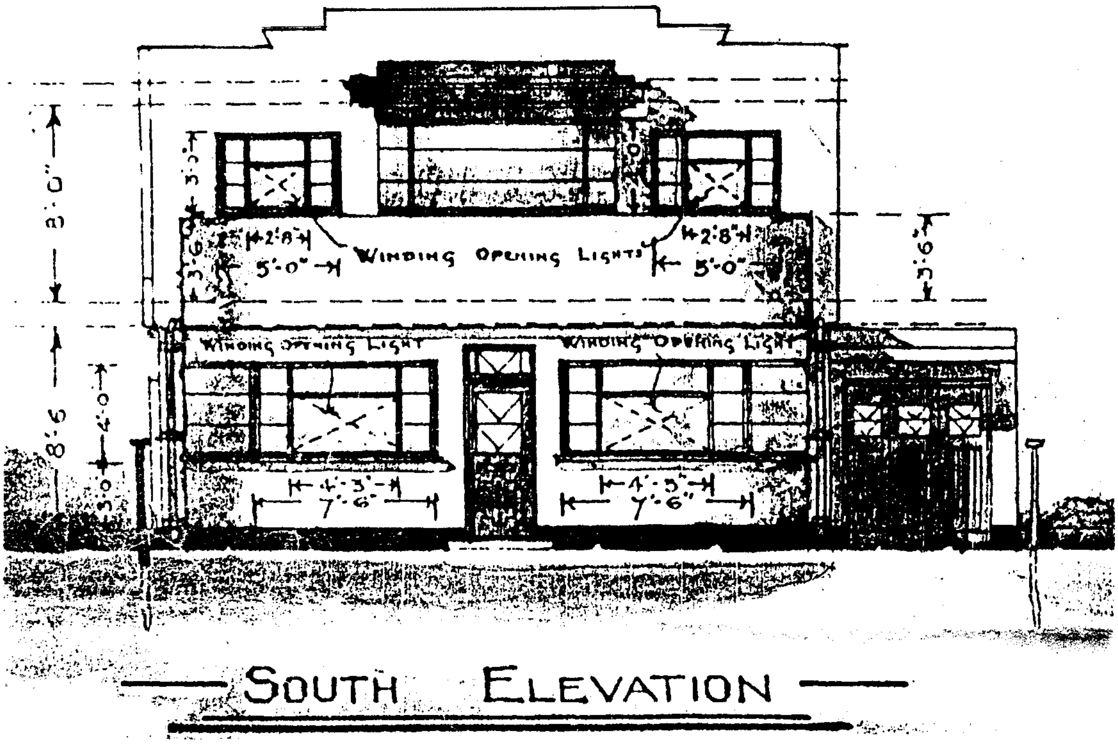


FIRST FLOOR PLAN

42 Southbourne Coast Road - as built in 1935

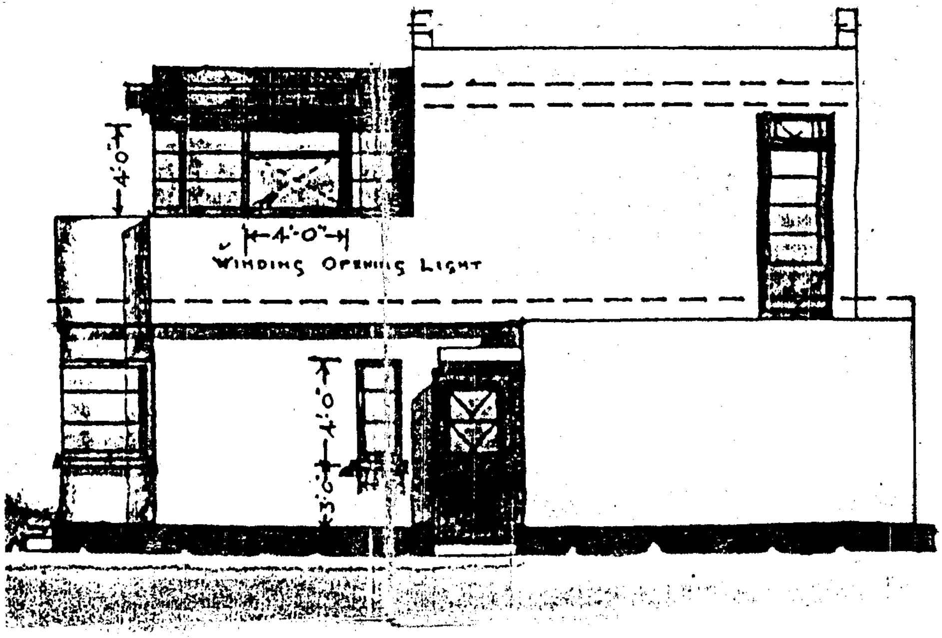


NORTH ELEVATION

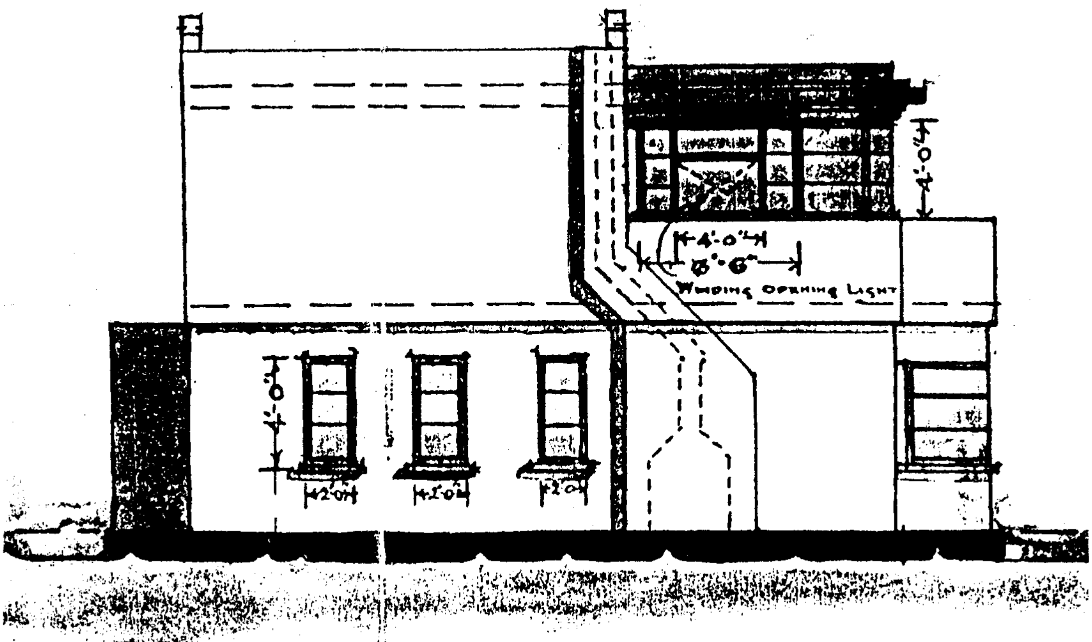


SOUTH ELEVATION

42 Southbourne Coast Road - as built in 1935

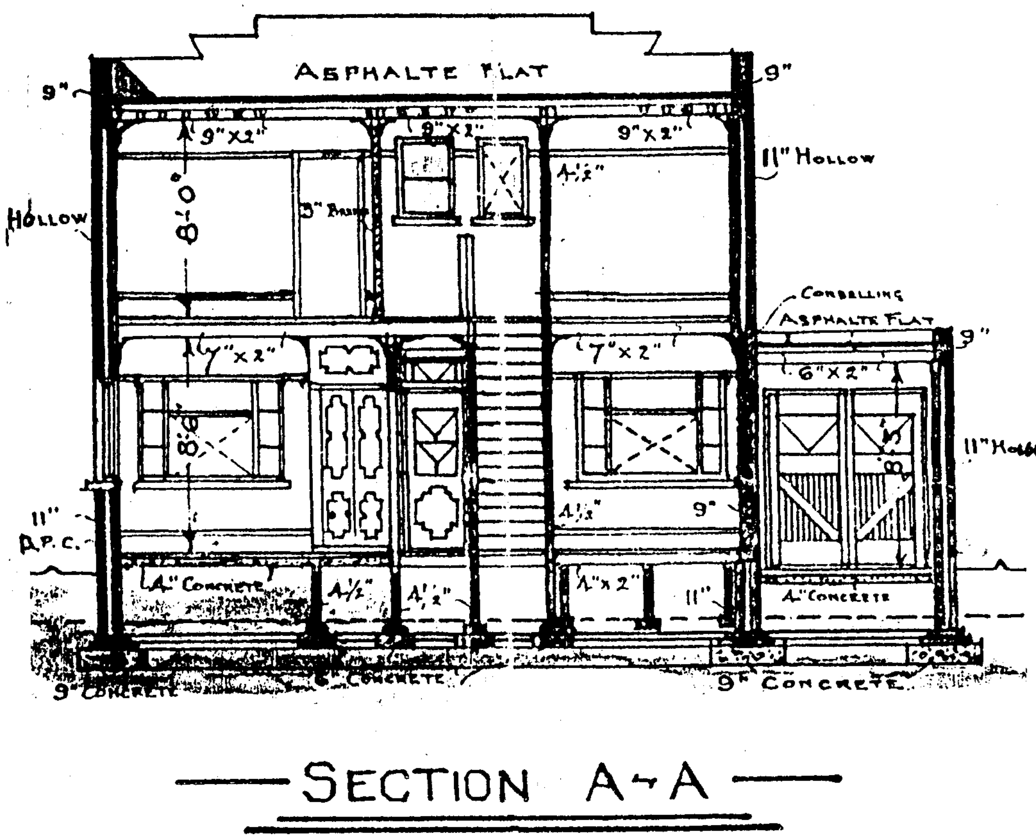


EAST ELEVATION

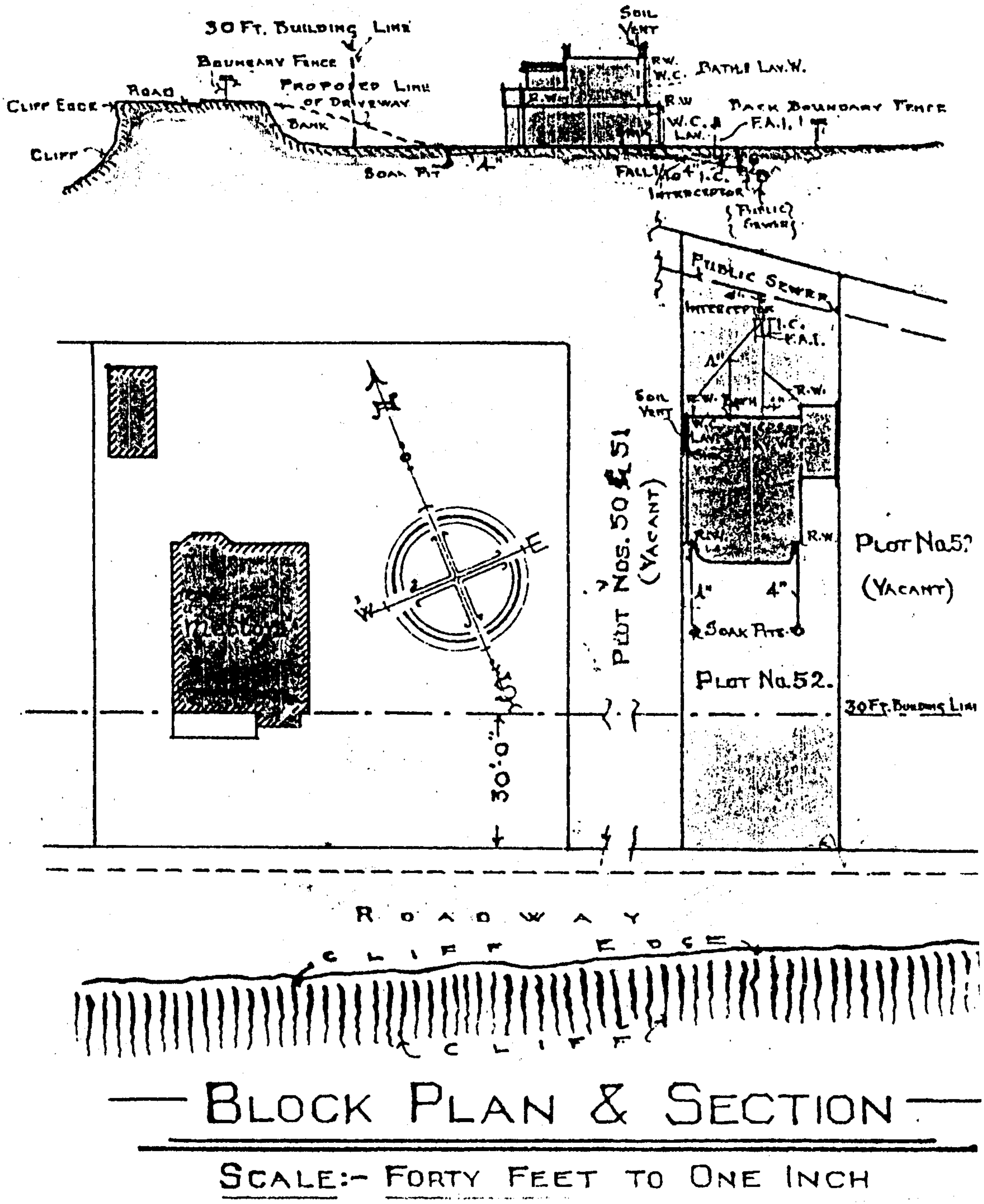


WEST ELEVATION

42 Southbourne Coast Road - as built in 1935



42 Southbourne Coast Road - as built in 1935



42 Southbourne Coast Road - as built in 1935

5.2 Alterations since 1960

No. 42 had been changed and extended over the years. On the next two pages, the extract from the Bournemouth Town Planning Register gives details of the various planning applications since 1960, briefly:

- planning permission was granted on 12.9.77 for the house to be converted into three flats
- the original garage was incorporated into Flat 2, and a new garage built to the north
- planning permission was granted on 26.3.86 for 'enclosure of balcony at first floor level to form lounge and conservatory'
- porches were added to all three entrances.

The new garage can hardly have been welcomed by the highway authority as it significantly impaired sight lines for road users.

The new lounge and conservatory at first floor level overlooking the bay had been put on by Jean and Bob Weeks in 1986 (the writer has known Jean & Bob Weeks since 1989). After Jean and Bob's retirement in 1989, No. 42 was 'on the market' for six years and over that period a number of families had their offers accepted, but they always pulled out after a survey was done. No 42 was auctioned in 1991 but failed to reach the reserve, so went back on the market until purchased by the writer in December 1995. The extract from the Bournemouth Town Planning Register is followed by plans of the three flats as existed when purchased in 1995.

COUNTY BOROUGH OF BOURNEMOUTH — TOWN & COUNTRY PLANNING ACT 1947 — TOWN PLANNING REGISTER

LAYOUT NO .... PLAN NO. 19109 D.E.F .... T.P. SCH. NO. .... RESOLUTION DATE .... MAP REF. .... FILE NO. 19109.

Date of Application	Name and Address of Applicant	Proposed Development	Planning Authority's Decision & Date	Applicant Notified	Direction under Act or G.D.O.	Date and effect of any decision of Minister	Remarks
1960 9/12 19109D	A.E. Munson, Esq, "Seafoam", Southbourne Coast Rd, Bournemouth.	2 Private Garages.	P.D. 30. 1 61 Refused 7.3.61 under (Highways Act, 1959 Sect 75)	7/1/61 1.1/3.61			
1961 16/11 19109E	A. E. Munson as above	Private garage.	P.D. 28-12-61	4/1/62			
1968 31/1 19109F	A. E. Munson Esq (as Above).	Addition — Sun Lounge.	P.D. 26. 2. 68	29/2/68			
1977 20.7 EU259	Mrs I Munson 42 Southbourne Coast Rd Bournemouth.	Application for Established Use Certificate Use as 3 flats.	T.P.C. 19-12-77 NOT GRANTED.				

ADDRESS

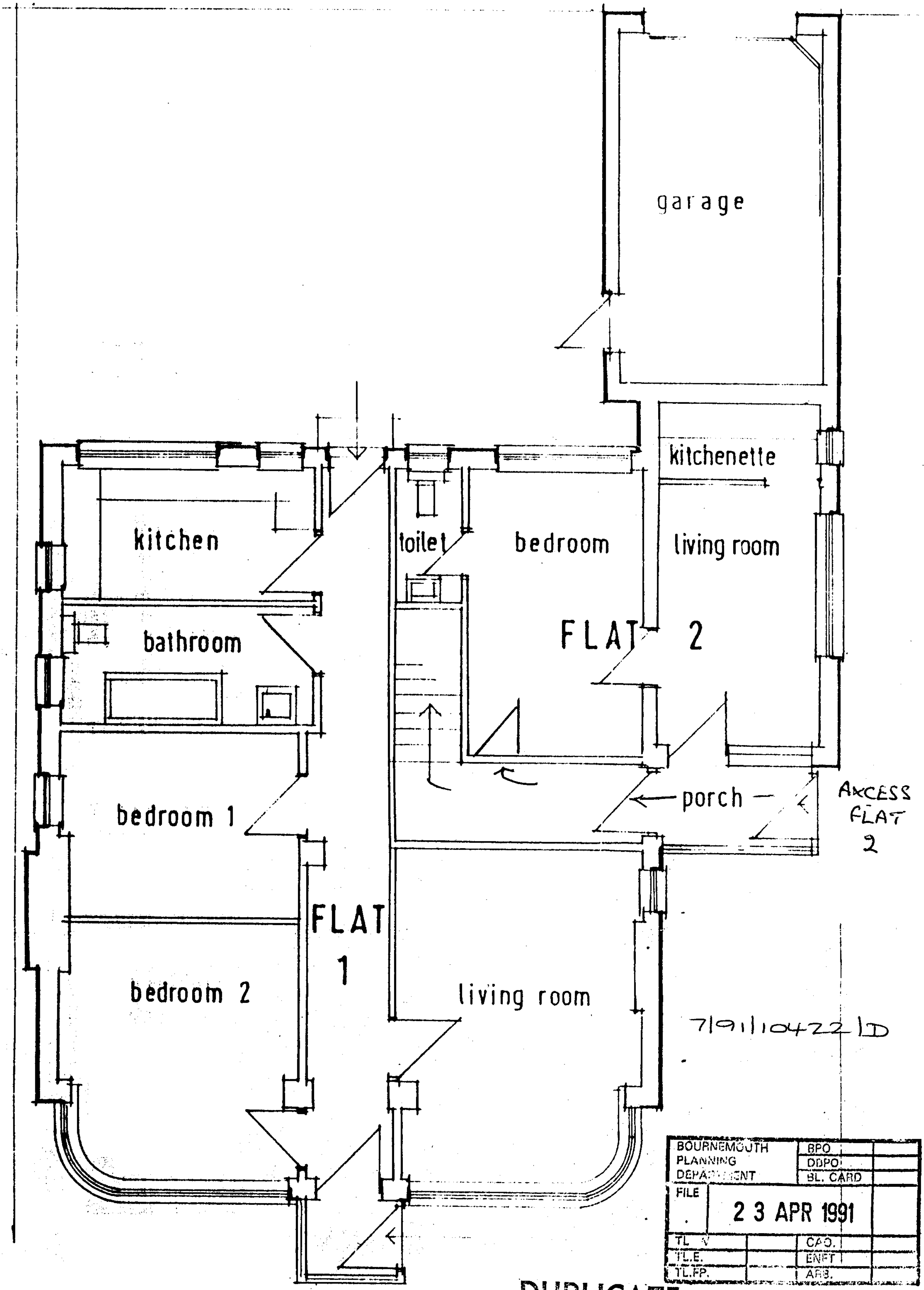
SOUTHBOURNE COAST ROAD, No. "Seafoam". No. 42.

P.T.O.

Kalamazoo 150172 514

LAYOUT NO. ______ PLAN NO. ______ T.P. SCH NO ______ RESOLUTION DATE ______ MAP REF. ______ FILE NO. ______

Date of Application	NAME AND ADDRESS OF APPLICANT	PROPOSED DEVELOPMENT	PLANNING AUTHORITY'S DECISION & DATE	Applicant Notified	Direction under Act or G.D.O.	Date and effect of any decision of Minister	REMARKS
1977 20.7.7/77 10422	Mrs I Munson C/o G Anders, 4 Millhams Street, Christchurch.	Use of dwelling as 3 flats. (2 flats + 1 flatlet)	GRANTED: 12/9/77. Subject to provision of shower facility in Unit No 2.				
1978. 23/3.7/78 10422/A	Mrs I Munson 42 Southbourne Coast Road Bournemouth	Use of dwellinghouse as 2 flats and 1 flatlet.	Withdrawn 20/4/78				
1982 11.2 7/82 10422/B	K. J. Badger, 42 Southbourne Coast Rd, Bournemouth.	Alterations and extension to flat to form lounge and kitchenette.	DEFER 12.7.82. WITHDRAWN 30-7-82.				
1986 3.3. A86/ 10422/C	Mr. & Mrs. R. Weeks, 42 Southbourne Coast Road, Bournemouth.	Enclosure of balcony at first floor level to form lounge & conservatory.	GRANTED 26-3-86 (DEL) Materials to match				

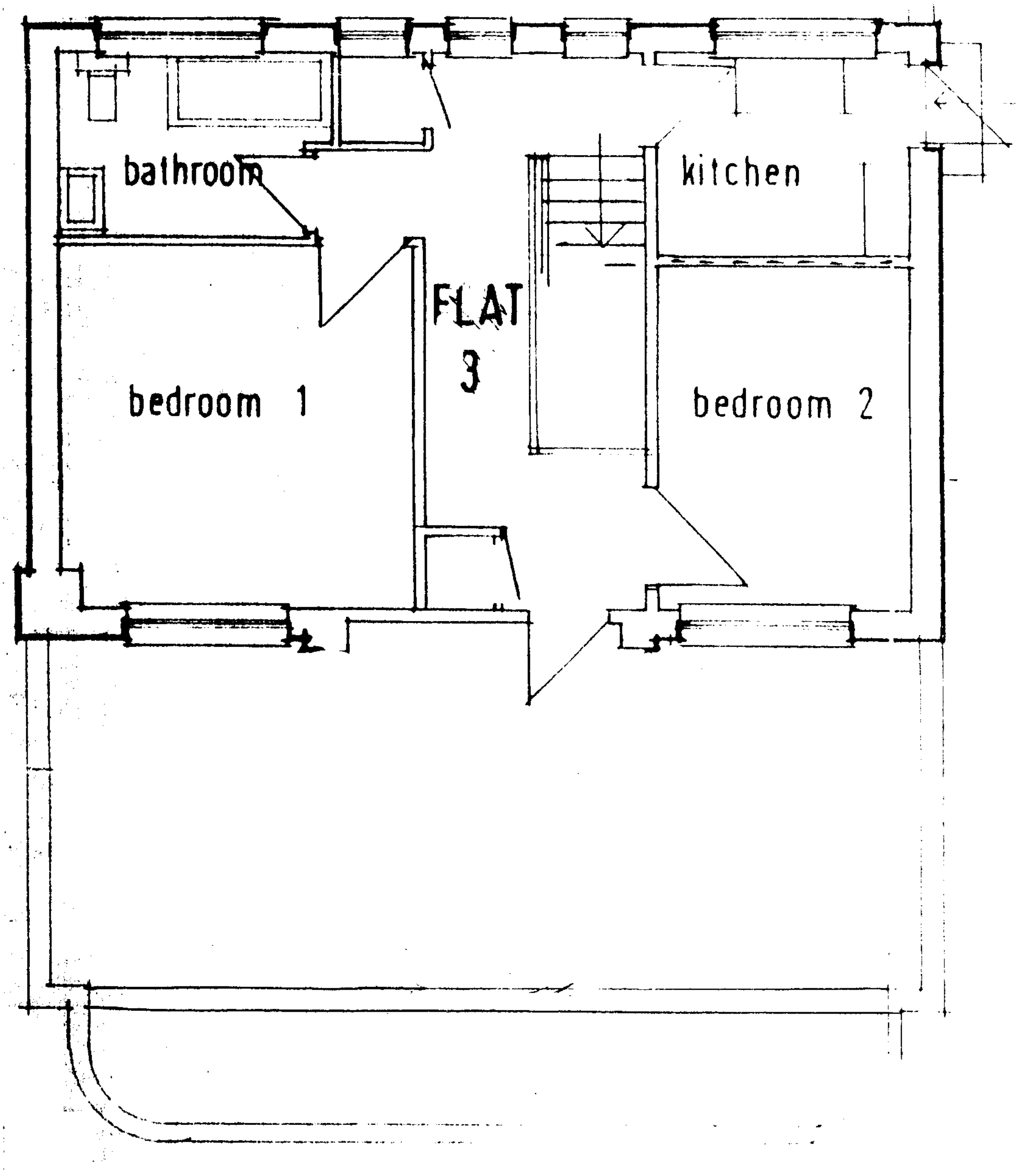


7/91/10422/D

BOURNEMOUTH PLANNING DEPARTMENT		BPO	
		DDPO	
		BL. CARD	
FILE	23 APR 1991		
TL V		CAO.	
TL.E.		ENFT	
TL.FP.		ARB.	

DUPLICATE

GROUND FLOOR PLAN



7/91/10422/D

first floor plan

5.3 Reasons for failure

42 Southbourne Coast Road had many problems, the two main ones being subsidence and water penetration.

The chief reason why No. 42 failed was subsidence, caused by being built on soft sand which over the 65 years of its life has been washed away. Subsidence affects thousands of houses - especially in mining areas - even a hundred years or more years after a pit has closed. Once subsidence has occurred the rain will find a way in through cracks caused by the subsidence. The extensive photographic record on the accompanying CD to be viewed together with the written description in Appendix D tell the story.

5.4 Town planning decision notice

Planning permission for demolition and rebuilding was granted on 4.10.96 for 'Erection of two storey block of two flats and formation of new vehicular access' application number 7/96/10422/E, a copy of which follows on the next three pages.

BOURNEMOUTH BOROUGH COUNCIL
TOWN HALL
BOURNEMOUTH BH2 6DY
Tel: (01202) 451451

BOURNEMOUTH
DEVELOPMENT SERVICES

TOWN PLANNING DECISION NOTICE

RECEIVED 4 OCT 1996

Town and Country Planning Act 1990
Town and Country Planning (General Development Procedure) Order 1995

GRANT OF PLANNING PERMISSION

This permission does not carry any approval or consent which may be required under any enactment, byelaw, order or regulation (eg in relation to Building Regulations or the Diversion of Footpaths etc) other than Section 57 of the Town and Country Planning Act, 1990.

Application No: 7/96/10422/E

Location of Development:
Southbourne Coast Road, No.42

Description of Development:
Erection of a two storey block of two flats and formation of new vehicular access.

In pursuance of their powers under the above mentioned Act, The Borough Planning Authority, HEREBY GRANT PLANNING PERMISSION for the development described above in accordance with the details given in the application numbered above,
as modified by: PLAN - reference 844.5 Rev A, date stamped 18.7.96.

Subject to the following condition(s):

1. The development to which this permission relates must be begun not later than the expiration of five years beginning with the date of this permission.

Reason: This condition is required to be imposed by Section 91 of the Town and Country Planning Act, 1990.

2. That the existing flats and garage shall be demolished on commencement of the construction of the approved development.

Reason: In the interests of a well planned development.

(CONTINUED)

TO: Williams Lester,
Mulberry Court,
Stour Road,
Christchurch,
Dorset, BH23 1PS

(Mr and Mrs D W and J A Brown,)

Signed Andrew Duckworth

Head of Planning Services
for Director of Development Services

PLEASE REFER TO NOTES ENCLOSED

Dated 23/09/96 A

BOURNEMOUTH BOROUGH COUNCIL
TOWN HALL
BOURNEMOUTH BH2 6DY
Tel: (01202) 451451

BOURNEMOUTH
DEVELOPMENT SERVICES

TOWN PLANNING DECISION NOTICE

Continuation Sheet 1

Application No.
7/96/10422/E

3. The materials to be used in the construction of the proposed development shall be agreed with the Local Planning Authority before any development is commenced.

Reason: To secure well-planned development and to safeguard the visual amenities of the locality.

4. That boundary screen walling/fencing shall be provided to the dwellings (as a part of the landscaping proposals) to the satisfaction of the Local Planning Authority.

Reason: In the interests of the visual amenities of the locality.

5. No development shall take place until there has been submitted to and approved by the Local Planning Authority a scheme of landscaping which shall include indications of all existing trees and hedgerows on the land, and details of any to be retained. The scheme shall include details of:
   a) the positions, species and sizes of all existing trees, shrubs and hedges to be retained;
   b) the positions, species, initial sizes and planting densities of all new trees and/or shrubs:
   c) any hard landscaping proposed;
   d) the programme of implementation of the scheme;

Reason: To ensure the provision and maintenance of a satisfactory degree of landscaping in the interest of visual amenity.

6. All planting, seeding and turfing in the approved landscaping scheme shall be completed within eight months of development commencing (or such period as agreed, in writing, by the Local Planning Authority) or prior to occupation of the buildings whichever is the earlier period. The new planting and landscape operations should comply with the requirements, specified in BS 3936 (1980) 'Specification for Nursery Stock Part 1 Trees and Shrubs' and in BS 4428 (1989) 'Recommendations for General Landscape Operations'. Thereafter areas of amenity space shall be permanently retained & maintained. Any trees or other planting which dies within a period of 5 years from the completion of development are removed or become seriously damaged or diseased shall be replaced in the next planting season with others of similar size and species in accordance with the details approved by the Local Planning Authority.

Reason: To ensure that the proposed development makes a satisfactory contribution to the preservation and enhancement of the visual amenities of the locality.

7. The development hereby permitted shall not be brought into use until the access, garaging and parking shown on the plan approved pursuant to this outline permission have been constructed and these shall be maintained and be kept available for the development hereby permitted at all times.

Reason: In the interests of highway safety.

(CONTINUED)

BOURNEMOUTH BOROUGH COUNCIL
TOWN HALL
BOURNEMOUTH BH2 6DY
Tel: (01202) 451451

BOURNEMOUTH
DEVELOPMENT SERVICES

TOWN PLANNING DECISION NOTICE

Continuation Sheet 2

Application No.
7/96/10422/E

8. That details of a screened refuse bin store suitable for the housing of wheeled bins shall be submitted to and approved by the Local Planning Authority prior to the commencement of the development and the approved work shall be completed in accordance with these requirements.

Reason: In order to protect the amenities of the locality.

9. Informative Note: This area is known for foundation instability BH6 (post code area) - properties on south side of Southbourne Coast Road were constructed in sand-dunes at rear of pre-war cliffs - site appraisal recommended by applicant before foundation design commences. Wartime defences may be infilled in rear gardens.

Chapter 6

Tools and techniques

As with Chapter 4, a single side line in the margin of the text indicates advice to those who become involved in Recycling Housing. The advice embodies the practical experience gained on the deconstruction of No. 42. Consideration was given to including the advice with the general recommendations in Chapter 11; but as the advice covers details specific to a section heading, it was thought more appropriate to include it under the heading.

It is not possible to devise a system for recycling housing without first considering the tools and techniques necessary for deconstructing the failed housing and prepare the recovered materials for recycling. The deconstruction of housing and cleaning bricks and denailing timber for recycling requires a considerable amount of physical work, it took approximately one man year to deconstruct the block of flats described in this research.

Hand tools are inexpensive and require little maintenance. From the work on No. 42, it was found that the following were sufficient for the recovery of: fixtures & fittings, electrical switches and sockets, plaster and plasterboard, doors & linings, skirting boards and picture rails:

- claw hammer
- crow bar
- pincers
- bench vice

- pliers
- punch
- bucket
- screwdrivers
- brace and bit
- bench and stool
- kneeling mat
- thick gloves.

Other hand tools and equipment which are useful for just a small percentage of the time include:

- club and sledge hammers and cold chisels
- wrecking bar
- saw
- step ladder
- mobile scaffolding.

Power tools which are required for just a small percentage of the time are:

- inspection lamp
- electric drill
- circular saw
- demolition hammer.

It is recommended that hired tools are not used until the house is nearly completely gutted; hired tools cost money and administrative time, most timber and plaster can be removed with just a crowbar, pincers, screwdriver and claw hammer.

Removal of skirting boards and picture rails will develop crow bar skills and the removal of nails from the timber will develop hammer and screwdriver and punch skills.

6.1 Denailing

DIY Manual [1974] gives tips for the removal of nails. This section covers the techniques required for the removal of all types of nails used in house construction - including 5″ and larger rusty nails - which are outside the range of normal do-it-yourself manuals. The Oxford Dictionary states ″de is now a living prefix in the sense, as decentralise, derequisition, dereserve″ and therefore denailing is defined here to mean the removal of nails from timber.

The cross-sectional shape of nails is generally round or oval, though square twisted nails are sometimes used. In the denailing process, nails may be ′withdrawn′ by pulling them out the way they went in, or ′pulled or driven through′ causing the nail to pass through the timber and out the other side, or ′driven back′ using a punch at the back of the timber so that the nail is driven to come out of the face of the timber. Obviously a nail cannot be pulled through unless the point of the nail is projecting from the back of the timber (assuming the head of the nail is in the face of the timber).

By the time you have decided which piece of timber is worth spending effort on, you could have removed all the nails from it. Remove all nails even from timber and hardboard which you do not think will ever be used, as new houses require lots of packs; bits of hardboard are ideal. Even broken bits of timber can have their split bits used as wedges, new construction needs lots of wedges. Another reason for taking all nails out is that all timber is valuable, it may be that an old piece of skirting will not be used again as skirting, but it will certainly be used for something else even though it may be hidden from view.

A typical house will have enough nails to fill several buckets. When you commence denailing there is a tendency to separate nails and screws by size. Experience shows that the sorting of nails and screws is best left to a rainy day, simply throw all nails and screws into a bucket, and when that bucket is full start a new bucket. When the bucket is out of reach, use the nearest window sill temporarily, and use a tool to 'sweep' the nails and screws from sill to bucket later. If you lob nails at a bucket on the other side of a room, some will fall on the floor and have to be picked up, your spine will get plenty of exercise while you are deconstructing houses, and will not need further exercise.

If you can work out a better method than that described for denailing, please let the writer know.

Some nails are particularly difficult to extract, one trick is to tighten the nail in the vice and lever the wood away from the nail.

Denailing of 50mm fillet (cross-section has a right angle between two equal sides) is straightforward if the fillet is put in the vice for support with one of the sides of the right angle against one set of the jaws of the vice. Obviously you cannot tighten the jaws as this would crush the feather edge. Experience shows that denailing can be accomplished with the minimum of damage to the fillet. Once the nail has been driven back so that the nail head is proud, then the fillet can be gripped lightly in the vice with the diagonal against one set of jaws and the right angle against the other, positioned so that the crowbar can rotate against the top of the vice when withdrawing the nail. Now move the fillet through the vice and repeat the procedure for the next nail.

To prevent a nail from buckling, it may be necessary to hold it with the pliers when driving it back through; this is just one of a hundred jobs where three hands are needed, the vice has to become the third hand.

The technique of rolling the crow bar head against the vice has general use when withdrawing any nails which have been driven in at an angle of say 45 degrees to the surface of the wood.

If the claws of the crow bar are not gripping the nail head, try tapping the crow bar with the hammer to jam the crow bar claws tightly around the nail.

When a nail, screw or bolt falls, program yourself to follow its flight path with your eyes, it will be so much easier to find.

When nails are very rusty, it is often easier to pull them through the wood rather than driving them back the way they came in. Ovals pull through very easily, and some round nails with small heads also pull through easily.

Rusty screws cannot usually be pulled through the wood; if the screws cannot be budged with a screwdriver, or a brace and bit, try using the pliers to rotate the screw and free the rust. When all attempts to remove the screw have failed you will have to drill holes around the screw to loosen it before you can remove it.

Modern 50mm nails with a thread can be extremely difficult to pull out as when a claw hammer (or crow bar) is used on them, invariably the head bends and slips through; so pincers must be used. As this sort of nail is fairly slender, it is all too easy to grip the pincers too tightly and thereby snip through the nail, with the nail head flying up into your face. A good way of dealing with such a nail is to hold the timber in the vice and hold the nail in the pincers to one side and then push backwards so that your face is pointing in the opposite direction to the direction you are pushing. After you have removed ten or twenty such nails you will develop a feel for just how hard you can grip the nail without snipping through it. If that does not work try hammering the nail a couple of times to break the bond between thread and wood and then try pulling it out as described.

6.2 Claw hammer

Hammer skills are 'on par' with those of a golf club swing and include as an absolute minimum:

- the ability to think of the hammer as an extension of the arm
- being able to look at what is happening at the point of a punch or chisel

when striking the head of the punch or chisel with a hammer

- being able to drive a slightly bent nail back through a piece of timber by modifying the strike angle on the point of the nail to compensate for the bend in the nail.

Those teaching deconstruction skills and techniques must be able to demonstrate that they have good hammer skills, in exactly the same way that anyone teaching golf must be able to show that they have a good golf swing.

All construction work requires good hammer skills, such skills take months or years to develop, not days. Just as some will never be able to develop a good golf swing, so some will never master hammer skills. There is little point in pursuing employment in any building trade if you cannot master hammer skills.

6.3 Crow bar

Even the big claws on a 900mm long crow bar may not be long enough to withdraw 125 and 150mm nails, and you will need to use a piece of timber as a pack so that the crow bar roll is a few centimetres above the timber face. Packs used this way not only stop the bruising of the timber, but reduce bending on the nail.

For the removal of picture rails, pull the claws down into the back of the top of the rail and lever the crow bar up from below. Generally when levering out a length of nailed timber, lever at or very near to the nail positions to avoid snapping the timber. For skirting boards it may be necessary to drive a point in first to make room for claws of the crow bar.

When using the crow bar to lever timber away from plaster, lever against the plaster wherever possible, then you are not bruising the timber.

When you are working in a restricted space and there is insufficient room to lever the crow bar in the normal manner, it is sometimes useful to put the point of crow bar into a gap behind the timber and twist the claw end of the crow bar to lever the timber away.

Crow bars are heavy, you must wear shoes or boots with steel toe caps. Never pull the crow bar in the direction of your head.

6.4 Pincers

Pincers (gripping tool made of two limbs pivoted together forming pair of jaws with pair of handles with which to press the jaws together) are often more useful than either a claw hammer or the claws of a crow bar for the denailing of timber. Usually pincers perform best if the nail is withdrawn in stages, typically 2-5 stages, as this will avoid bending the nail.

When a nail head has broken off and the nail which is showing cannot be gripped using pincers in the normal way, try grasping the nail with the side of the pincers; if this does not work you will need to use a punch (possibly one you have made from an old nail) to drive the remains of the nail back through the wood.

Pincers can be used in the normal way with a lever action by gripping the nail and rolling the pincers, they can also be used by gripping the nail with the side of the pincers and levering the pincers in a direction at right angles to the rolling direction withdrawing the nail without bending it.

To achieve a hidden fixing, carpenters saw off a nail head and make a hole of slightly less than the diameter of the nail, then drive the nail head into the piece of timber, the timber itself then being driven into a wall, thus providing a hidden fixing. To withdraw a nail used in this way, when only its point is showing will require pincers.

Pincers are ideal for snipping through electric cables which have been disconnected.

6.5 Bench vice

A bench vice with a 100mm jaw width - used by fitters - is more robust than a woodworker's vice for denailing. To save time it is often convenient to hold the piece of timber in the left hand with the vice jaws open enough so that the timber is supported by the vice but not clamped. The end nail can be removed, then the timber moved along and the next nail removed and so on. The denailing of long pieces of timber is sometimes quicker if the denailing is done in more than one stage, for example

- drive the point of each nail back so that the head of the nail protrudes
- turn the timber over and use the claws of the crow bar or the pincers to withdraw each nail.

Very long pieces of timber for denailing can be held in a vice at one end and supported on the floor or on a stool at the other end. When a nail is too long to withdraw without using a pack, it can sometimes be convenient to clamp the timber in the vice below the vice jaws and use the vice jaws as though they were a pack.

6.6 Pliers

Pliers have several uses in the denailing process:

- for straightening nails before driving them
- for holding the nail to stop it bucking when it is being driven
- to bend the nail back and forwards to fracture it, a shorter length is more easily driven through timber.

6.7 Punch

A punch is an indispensable tool for driving a nail through a piece of timber. It is sometimes convenient to use a screwdriver as a punch, or to saw the point off a nail of similar size to the one being worked upon and use the nail which has no point as a punch.

6.8 Bucket

A bucket on the floor next to the end of the bench is useful for catching nails which fall out when driven back through the timber. Plastic buckets are cheap and make a useful tool box.

6.9 Screwdrivers

A selection of screwdrivers are needed from small ones to unscrew electrical contacts to large ones - which can double as chisels or wedges - and a brace and bit for unscrewing very tight screws.

6.10 Brace and bit

To be able to get the best 'purchase' with a brace and bit, you need to get your back against something firm, and lean forward - be careful and look to see where you will fall if the bit slips - to firmly locate the bit in the screw slot.

Brace and bit, difficulties include:

- remembering which way the ratchet works - for undoing screws hold the brace horizontally with the bit in a screw and the middle part of the brace downwards and screw the ratchet adjuster clockwise
- obtaining bits which will fit inside narrow screw slots - it may be that the bit has to be filed down.

6.11 Bench and stool

A bench is needed to which a vice can be bolted. As there is no shortage of timber in a house recycling project it seems logical to use recycled timber and recycled nails or screws to make a bench. In order to be able to work at ceiling level, a sturdy stool is needed, again it seems logical to use recycled timber and recycled nails or screws.

The bench and stool have to be made from the materials available; they both provide a good exercise in improvisation. Some tips:

- make the height of the bench comfortable for you to work, probably between 700mm and 900mm depending on your height

- make a shelf below the bench to store your tools and to brace the legs
- make the sturdy stool of sufficient height so that you can reach the ceiling easily but not too high that your head touches it (downstairs ceilings are often higher than upstairs ceilings)
- make both bench and stool of strong timber, you can always add extra nails and screws if the joints start to open.

If there is a shortage of timber available from window sills and door linings then make the stool firstly and use this as a temporary bench until more timber is available. If your first plan for the bench or stool does not work, move to another project. When you are relaxed at home, think of improvements to your bench or stool, and when you get back to work, build your improved version and test it. Do not let any job get you down, always look on the bright side for nobody is going to make a fortune out of you. When you have a trade, you may one day make a small fortune for yourself: but more importantly, the more you can do, the more self respect you will have.

If you want a temporary solution to the bench problem, bolt the vice to a heavy bit of timber and support the heavy timber on an old upturned metal dustbin which you can use as a temporary bench even if it is a bit noisy.

Set up your bench about 1.5m away from the corner of a room as some pieces of timber are quite long. Any timber for denailing is best propped up in a corner. Set the bench up under a window if possible, better light means less accidents and the window sill provides extra space for tools. A plastic bucket is useful for putting in bits of skirting and other bits of small timber which have been denailed.

The bench is ideal for the denailing of long pieces of timber when the point of the nail protrudes from the back. Firstly turn the timber so that the ends of the nails point upwards, the timber being laid on the bench with one end projecting over the edge such that when the first nail is driven back through, it will not be driven into the bench. Place a bucket underneath, drive the end nail back through the wood so that the head projects above the face, slide the timber along so that the next nail replaces the first nail position and repeat until half the nails have been driven back. Turn the timber over and withdraw the nails with claw hammer, crow bar, or pincers. Now turn the timber end for end and denail the other half of the timber repeating the process used for the first half.

6.12 Club & sledge hammers and cold chisels

Club hammers typically weigh 1kg and are used by bricklayers to cut bricks using a bolster (a bolster is a cold chisel with a 100mm wide blade). Club hammers used with a 12mm cold chisel are useful for deconstructing brickwork set in cement-sand-lime mortar. Modern mortars tend be much stronger that mortars used in the 1930's, and may need a demolition hammer to deconstruct masonry.

Sledge hammers typically weigh 3, 4.5 or 6kg and are used for knocking in posts and the like and for breaking concrete beams and slabs etc. The writer has found that the 3kg sledge is too light for deconstruction work, and the 6kg sledge is too heavy for getting a high speed swing; the 4.5kg sledge seems to be the best weight for general deconstruction work.

6.13 Pick axe

A pick axe has general use in the deconstruction of buildings; it can be used to lever one part from another part (assuming there is sufficient gap between the parts to insert the chisel end of the pick axe). The writer prefers to use a pick axe for pulling down plaster ceilings but swinging a pick axe over your head can be very dangerous unless you have a good pair of arms. As with all tools, think what will happen if you miss, and if you miss and the pick axe can hit you, then use a crow bar instead of the pick axe.

6.14 Wrecking bar

A wrecking bar typically weighs 5 kg with a length of 1.5m having a lever at one end and a point at the other. It is used:

- as a lever when the leverage of a crow bar is insufficient
- as a battering ram swinging the point of the wrecking bar into the mortar joint of a masonry wall
- for breaking concrete slabs which have been levered up at one side; the point of the wrecking bar is brought down with great speed repeatedly at the same place.

6.15 Hand saw

Hand saws have small teeth for cutting across the grain, and large teeth for cutting along the grain. A hand saw will be used infrequently so a combination saw for both cutting across and along the grain is preferred. The better quality saws have a tapered blade (thinner at the top wider at the teeth) as this reduces the risk of the blade jamming.

6.16 Step ladder

The stout stool you have made yourself will be the safest thing to stand upon when working at ceiling level, but a step ladder is useful for holding your tools while you are working at ceiling level.

6.17 Mobile scaffolding

Traditional scaffolding to the outside of a two storey building is to be avoided wherever possible as:

- it is expensive to erect
- expensive to hire
- you can fall off it.

In contrast, mobile scaffolding is cheap to buy and a small tower can be built in just a few minutes. Each unit is typically 2.1m long and 0.6m high (when part of a tower); a minimum height that can be built needing four such units (two at floor level and two above) and giving a platform level at 1.2m.

Generally three heavy tubes at the platform level support a timber deck which may be made from recycled timber.

The research showed that it was possible to deconstruct housing without the use of a traditional external scaffolding (even for garages with a 10ft high end wall abutting a pavement) providing a small tower - made from mobile scaffolding - was erected hard into each side and corner of external rooms or garage.

6.18 Inspection lamp

It is expected that all deconstruction will be carried out during daylight, working longer hours in the summer and shorter hours in the winter; nevertheless there may be occasions when an inspection lamp may be necessary. If a temporary electrical supply is provided in say one of a group of houses then a trailing lead can be run from the temporary supply to power an inspection lamp and other tools. The maximum current used by circular saws and 240V demolition hammers will be 9 amps. All extension leads must be fully straightened before use; if they are used when they are coiled, the coil heats up and makes the cable brittle.

6.19 Electric drill

An electric drill is rarely required in house deconstruction. A 500W drill is a sensible size.

6.20 Circular saw

Circular saws are infrequently required in house deconstruction, the odd bit of timber that needs to be sawn in two being cut with a hand saw; however if tongued and grooved floor boards have been heavily nailed, a circular saw is ideal for cutting down the grooves. A 1500W circular saw is a sensible size.

The reason why we take ALL the nails and screws out of timber to be recycled is that when we cut the timber to a new size, we do not want the saw to be blunted by an old nail, or the sparks flying at us.

6.21 Demolition hammer

After hiring various demolition hammers, it was found that a 16 Joule (1100W) hammer had insufficient breaking force for dealing with masonry constructed from dense concrete blocks; a 23 Joule Bosch hammer was found to be adequate. Experience in using this hammer for the deconstruction of a 225mm thick wall is given in Chapter 7. Demolition hammers will not go through materials which are not brittle; if you put one on top of a tree root it will vibrate but not do anything.

6.22 Angle grinder

A 9″ angle grinder with a grinding wheel for metal is ideal for cutting metal but dangerous, the kickback from 2kW of power is serious. You need heavy duty clothing, goggles that seal to the face, and you must not be tired. Such a tool is lethal, so do just a little at a time. Do not get too ambitious with the cut or cut too deeply. Read the manufacturers instructions carefully and if you do not understand them, ask someone ″What do they mean by ….?″.

Chapter

7

Deconstruction of housing

The term 'deconstruction' rather than 'demolition' is used as it better describes taking a house to pieces, brick by brick.

It would be irresponsible to recruit a group of unemployed youths, give them tools then ask them to deconstruct houses. The youths need to be taught about safety and about the use of tools and techniques for overcoming expected difficulties in the deconstruction process. To be able to teach the youths about such matters requires that teaching notes be developed from practical experience in the deconstruction process. This chapter, read in conjunction with Chapter 6, is intended to be used as a basis for the development of teaching notes for Recycling Housing.

7.1 Physical requirements

The author is over sixty and reasons that if he can deconstruct a house by himself with occasional help with heavy lifts, then an unemployed youth should be more than able to cope with the physical nature of the work, once he has been given proper training.

Although the following should never happen, it is proposed that physical requirements for those engaged in Recycling Housing should be:

- the ability to jump out the way when something is falling on you
- the ability to jump backwards landing or rolling down a pile of bricks without injury save for bruising
- the ability to be able to lift 50 kg (current safety regulations limit bags

of cement to 25 kg) and get your legs out of the way if the object carried slips from your grasp

- quick enough reactions that if a hammer misses a nail it does not crush your hand that is holding the nail.

7.2 Reading and writing

There is no requirement that persons employed on construction sites should be able to read or write, indeed those who have reading difficulties often develop a canniness and quick thinking, both of these attributes are useful in construction work.

The writer's experience is that although youths at school badger those less able than themselves, once the youths become employed they develop a camaraderie as they unite against the employing authority. Construction workers who have reading difficulties traditionally take their mail to work and ask a pal to read it to them, it's all very civilised. Sometimes it leads to humorous situations, the writer recalls an anecdote by a Wimpey Site Agent called Bob Gray. Bob received a letter from head office asking "who is Mrs Fitzgerald?". After some investigation it was found that one of the concrete gangers who could neither read nor write, had used the help of his landlady to fill out the timesheets for his gang; he dictated the gangs' names and hours worked, and she filled out the timesheet signing the timesheet with her own name.

7.3 Separating the materials

The most important part of recycling is the separation of all materials. In many local car parks there are different bins for clear glass, green glass, plastics, newspapers, cans etc. The same separation exercise is needed for the recycling of houses except that the quantities of materials are much greater. Before the materials can be recycled, timber, plaster, bricks, paper, glass, doors and windows, nails and screws, white goods, electrical plugs and sockets must be separated. The more of any particular size and type, the more efficient the recycling can be e.g. one piece of 12mm timber quadrant of 3m length may not be immediately useful but when there are 20 such pieces collected from 20 houses then someone will soon have their eye on them for a particular job.

Rejoice in the work, if someone asks you what you do you can honestly say

- saving the rainforests
- advancing the sustainability issue in the construction industry for both statements are true.

Do everything neatly, it looks better and gives a feeling of well being. A pile of higgledy-piggledy timber can be straightened and roughly sorted into sizes in a matter of minutes and not only looks better but is more easily handled or 'chosen from'. When bricks, which are to be recycled as hardcore, are neatly and tightly laid with the minimum of voids between them, the resulting pavement will be much stronger than for poorly laid bricks.

7.4 Order of removal

As stated in section 6.11, do not let any job get you down; if your arms are tired from working above your head say, go onto a job which does not require you to work above your head. Jobs can be graded from the worst to the best e.g. in the writer's experience from the deconstruction of No. 42:

- pulling down ceilings
- taking out WC pans
- chiselling plaster off the walls
- dismantling pipework
- removing skirtings, architraves etc.
- denailing timber on a nice day by a window.

If the job on which you are working depresses you, then go on to a better job to cheer yourself up, then go back to the first job when you are feeling cheerful.

Work on two jobs at a time, an exhausting one and one which allows you to be usefully employed but gives you a chance for a breather. The removal of electricity cables and sockets is an ideal job for giving yourself a breather after you have spent half an hour chiselling plaster from a wall. Treat all the work as a gym exercise, it is doing you a lot of good.

There are going to be days when gales (Force 8 with gusts to 60mph) and higher make working outside dangerous. For such days, keep an inside job you can do, e.g. removal of old pipes in kitchens. Gales do not go on for ever.

Removal of electrical and other fixtures and fittings will develop screwdriver and brace and bit skills. Removal of plasterboard ceilings will develop skills with the pick axe and crow bar, and improve upper body strength. If you are unfit, phase your work to allow you to get fitter gradually as the days go by. Removing electrical fittings is a gentle way to improve your fitness.

The manual work in the construction industry is carried out by labourers and gangers (foreman of a gang). As you become experienced in the work, set your sights on becoming a ganger for as the Americans say "You gain a lot of knowledge running for Sheriff".

7.5 Barrow runs

It is a waste of effort manhandling a barrow up steps and over soft soil; a barrow run is required. Recycled floorboards are excellent for barrow runs. The run need be no more than 300mm wide. Experienced barrow operatives generally manage with a single floor board. If a lot of material has to be transported along the run, then it is well worthwhile making the run as smooth as possible by timber packs to alleviate steps in the timber. Construction wheel barrows usually have pneumatic tyres to save jolting the operative when a heavily loaded barrow goes over bumps.

7.6 Materials handling

The fact that the building materials are to be recycled means that they cannot be thrown into a skip and removed from site. The handling of the materials on site presents a planning problem for which it is impossible to get a perfect solution. Experienced construction workers know that the law of diminishing returns applies to planning just as it does to all construction matters. In the words of Cardinal Newman "A man would do nothing if he waited until he could do it so well that no one could find fault with what he had done". For each site someone has to make a stab at the overall materials handling problem, and explain the proposed system to those who are doing the physical work. The explanations should cover where the following are to be stored for reuse, or buried:

- plaster & plasterboard
- render
- tiles
- timber
- blockwork
- brickwork
- fixtures and fittings.

The planning should try to ensure that none of the above are put in one place and then later have to be moved (double handling) to another location.

Saving your effort and time is just as important as the saving of building materials. Planning your own work pattern is the key to saving effort and time. In Yorkshire they call it "thinking on" but it is planning i.e. working things out in your mind when you are away from the work. British car assembly procedures used to be planned by those who did not work, or no longer worked, on the assembly lines. We have now copied from Japanese car manufacturers the principle of getting those who do the work to contribute to the planning, as the workers know what is going on in far more detail than someone who is remote from the work. The principle of getting those who do the work to contribute to the planning also applies to Recycling Housing. Think about:

- every piece of timber or brick etc.
- where it is going
- short or long term storage
- if it is moved will it have to be moved again.

After you get involved in planning you can legitimately say that you have experience in "construction planning" and you will be able to give your own personal examples.

7.7 Time to do any job

Some jobs take much longer than others e.g. it may be possible to pull down a ceiling in a room measuring 3m x 3m in 20 minutes; but if the ceiling has battens screwed to it at 300mm centres with screws at a pitch of 300 mm centres, then there will be approximately 100 screws to be taken out, requiring a brace and bit for the removal of each screw if the screw is rusty. You can do a great deal of damage to timber if you try to take out screws with a crow bar. Allowing just a minute (some may take much longer) per screw will take 100 minutes plus some time to let your arms recover. When you are working on a job that is taking a lot of time, do your own bit of "time and motion" and make a rough estimate of how long the job will take from the time taken to do the first 10%. If someone asks you how long the job will take, you can give an estimate and explain why the job will take the time you have estimated. The chap who is doing the work is the expert on the job being done, the one walking around looking at things is not.

Jobs that take a long time include cleaning bitumen or tar from roof timbers, to do this chisel off with a screwdriver used as though it was a wood chisel holding the timber in a vice - there is no easier way. This is an excellent job for warming yourself up on a freezing cold morning. Although it is possible to use a blow lamp to melt the bitumen, this makes a considerable mess and can take many hours cleaning up afterwards.

7.8 Mass and reinforced concrete

For suspended concrete floors a 23 Joule demolition hammers is fine for up to approximately 100mm thickness. For concrete ground floor slabs of 100mm thickness sitting on a well compacted base, the breaking energy of a demolition hammer gets lost in the slab. If the slab can be levered up then it is simple to break the concrete with a sledge hammer. If the slab cannot be levered up then it is hard work but very good exercise. With safety glasses on, swing the sledge hammer from vertically above your head using your back muscles to increase the speed of the hammer as it falls. Always work from an edge or corner striking the concrete about 100mm away from the edge. Once you have cracked the concrete, bringing the point of the wrecking bar down quickly at the crack is usually enough to penetrate the slab, and with a bit of leverage a piece of the concrete can be separated and put directly into a wheelbarrow. Proceed until the wheelbarrow is full then wheel the concrete to its final resting place (or mini land fill).

At the millennium few people have time to spend hours tending their gardens; the new domestic paving industry testifies to the preference for hardstandings for cars and barbecues and extensive patios are now preferred to the traditional lawn. Broken bricks, and bricks which have mortar that is stronger than the bricks themselves and cannot be removed without the brick breaking, make an ideal base for patios and other paved areas. Of course it is not necessary to pave a garden with concrete, single size stones produce an attractive surface which permits the rain to pass through into the voids in the hardcore below, avoiding the need for drainage and thereby being more in harmony with the environment.

Life gets difficult when demolishing reinforced concrete using just hand tools, especially when the reinforcing bars are at 50mm centres. With perseverance a 23 Joule breaking force demolition hammer was successfully used to break up a 160mm thick RC wall made from high strength concrete and reinforced with 10mm diameter bars at 75 mm centres. Why such a detail was used in domestic construction is beyond comprehension.

Overspecification is as bad as under specification, especially when sustainability issues are taken into account. Once the reinforcing bar positions were located, the concrete on either side of the bars was chiselled off and the concrete between the bars was broken out. Spread such work over several days so that boredom - and the consequent lack of concentration - does not set in.

Demolishing porch steps can be much more difficult than one supposes. The normal concrete mix for porch steps is a 1:2:4 i.e. one part of cement to two parts of sand to four parts of ballast, but sometimes there is no ballast on site so builders mix one part of cement to two parts of sand and thereby produce a very high strength concrete. As with the demolition of reinforced concrete, do a bit at a time (say 20%) if the breaking becomes unbearably hard.

Breaking up old mass concrete foundations is nearly impossible using a sledge hammer, and a demolition hammer having a minimum of 23 Joule breaking energy, will be required. "Nibble away" the concrete no more than 50mm at a time. If you get too ambitious the breaking energy gets lost in the mass of the foundation, the trick is to concentrate the energy near a free edge.

7.9 Mini landfill

One use for rubble is for making up levels e.g. for a patio. Top soil is valuable, so it is essential that top soil be moved (not too far) so that the rubble is deposited on a firm base. A little bit of planning of the levels can save a lot of double handling. If external bricks are to be recycled as paving (a good use for them) then firmly compacted rubble with sand blinding will form an excellent base for the bricks.

Some may argue that rubble should be removed from site. If it is removed, then being of masonry origin, it cannot be burnt and will have to go to landfill. The cost in fossil fuel and wear and tear on lorries and roads can be avoided entirely by the adoption of a mini landfill concept.

Buried rubble is a resource that can be converted to concrete, as and when required by the addition of some sharp sand and cement of just sufficient quantity to fill the voids. If the mini landfill is on site then it can be utilised at some future time; if it has been carted away to landfill with general refuse, then it is unlikely that it would ever be economic to recover the rubble.

The concept of mini landfill should be discussed with those doing the house deconstruction - especially the planning - planning is a practical and essential part of construction training.

7.10 Electricity cables and sockets

After all electricity is off, remove all electric sockets, plugs and switches, firstly including cables if they can be removed easily. Old electricity cables (the ones that are not white, sometimes having the appearance of lead) are usually run through steel conduit and can be cut as the conduit is removed.

Keep all electrical cables, sockets and plugs. Use pincers to snip the cables as they enter the sockets or plugs. If the cables are of the old non pvc type then although they cannot be recycled, they will be very suitable for tying things (as a substitute for string). New houses require many things to be tied together, old electricity cables are ideal. Cables, sockets and plugs will be reused at the discretion of a qualified electrician.

7.11 Porches

The first outside job should be to take down any porches, as they invariably obstruct the free passage of materials; when gutting a house, a great deal of material has to be carried out through the doors.

7.12 Doors, door frames and linings

Older houses have door frames, the frames were propped up and the brickwork constructed around them, new houses are often constructed leaving holes in the blockwork for the doors, putting a lintel over the opening. After the mortar has hardened, a carpenter nails the door lining to the blockwork using packs as necessary. The door itself is hung from the door lining, architraves (the various parts surrounding a doorway or window) are nailed to the door lining to overlap the surrounding plaster and make the door look more attractive; architraves may best be removed by starting at the bottom unless the bottom of the architrave is embedded in the floor.

In old houses it is not unusual for doors to have been bricked up and new doors made elsewhere. Cowboys in the construction industry sometimes forget to put lintels over new doors, so check that each door has a lintel over it before removing the door lining.

Old tooth-brushes are ideal for applying paint stripper to door hinges, make sure that you do not touch the paint stripper or flick it into your eyes when you brush it on - apply the paint stripper at arms length and always wear safety glasses. A claw hammer used to tap a small screwdriver along the screw slot can also be used to clear out the paint and is preferred by the writer.

When new door openings have been made through external cavity walls, the cavity should be closed with masonry (bricks or blocks to match the external wall). Toothing new brickwork into existing brickwork takes a considerable amount of time and effort and builders sometimes skimp by nailing plasterboard or timber across the cavity and then applying a plaster finishing coat.

You will know when a new doorway has been made through an external wall as you will find that the cavity has not been properly closed, take special care with such situations; look to make sure that there is some support for the masonry above and if in doubt do not remove the door lining until ALL masonry above the level of the top of the door has been deconstructed.

Architraves frequently have bits of plaster or filler stuck to their back, the plaster should be chipped off at the time the timber is denailed. To remove the plaster, hold the architrave at right angles to the top of the bench and chip downwards with a screwdriver. To avoid crushing the edges of an architrave, when levering it away from plaster, try pushing a bolster between the architrave and wall to spread the forces, and then lever between the plaster and the bolster.

7.13 Masonry fixings

Some masonry fixings can be almost impossible to get out e.g. the expanding type frequently used to fix up and over garage door frames to the surrounding brickwork. This type of fixing, usually 125mm or longer can sometimes only be removed by demolishing the masonry first. Having retrieved the timber with the fixing going through the timber from one side to the other, the trick is to open up the expanding legs allowing you to tap the fixing back through the timber so the head appears; grasp the head in a vice and using pliers unscrew the end nut; when the nut is unscrewed the bolt can be tapped through, and afterwards the expanding sleeve can be straightened and also tapped through.

It is not possible to lever out nails and other fixings from aircrete blocks without the blocks themselves crumbling and breaking away when the fixing is withdrawn; so try using the pliers to twist the nail to free it, once the nail rotates freely, it may be withdrawn.

7.14 Skirting boards and picture rails

Use a claw hammer and screwdriver to make a gap in the plaster at the back of the skirting board, lever the skirting board away from the wall with a crow bar, put your foot on top of the skirting board to stop it springing back, lever the skirting board away from the wall further along; move your foot and repeat the cycle.

Where skirting looks as though it could be reused (holes can be filled before painting) use a timber spreader before withdrawing nails to avoid bruising the wood.

It is easy to let the deconstruction process of an existing house become an obsession. The archeologists method of using soft brushes for removing soil layers is not appropriate to the deconstruction of "between the wars" housing. Although it is possible to remove skirting boards without marking the timber, it may not be practicable.

7.15 Plaster on walls

Peel off wallpaper and keep it for lining the bottom of banana boxes from your local supermarket; they usually crush them and are happy to give them away. Thirty to one hundred will be useful for the deconstruction of a house.

When construction workers are doing a job that may cause dust or other injurious matter to get into their face, they will instinctively turn their face away at the critical moment even though they are wearing safety glasses; it is useful to develop the practice when removing plaster.

When the plaster is difficult to remove by bolster and club hammer, then it may be preferable to leave the plaster until the wall is being demolished. Using a sledge hammer for demolishing one course at a time can be sufficient to break the bond with the plaster and cushion the brick from the impact of the sledge hammer and thus reduce the risk of breaking the brick.

7.16 Kitchen units

Many houses built between the wars contain new fixtures e.g. kitchen units, the removal of which requires the utmost care. Firstly empty the unit entirely and take out all loose shelves. Locate positions where the unit is fixed to the wall; ensure that the unit is supported by props and/or people, and unscrew the fixings one at a time and lift the unit to the floor and then take to storage.

7.17 Bathrooms and lavatories

Bathrooms and lavatories take much more time to clear than do the other rooms of a house. The recycling of a WC pan depends entirely on getting the pan out in one piece, frequently the four screws holding the pan to the floor are so corroded that they cannot be removed by normal methods and have to be drilled through (a tricky job in itself) or the floor smashed out.

Plumbed in fittings such as showers cannot easily be removed as the copper feed pipes are usually plastered (or even cemented) into the wall. Once the copper pipe is located, although there is no room to get a hacksaw to it, a hammer and screwdriver can be used to slice through the copper quite easily.

Whirlpool baths generally come on their own timber floor plate, to remove the bath requires that the floorplate be denailed from the floor or unscrewed. Remove all fixings between floor plate and floor. Uncouple all pipes and disconnect electrical cables (the electricity must be off of course).

Plumbers using capillary fittings are able to make the joints so that it is not possible to get to the couplings to the taps. In such a situation you may have to spring out a bath, bending the copper feed pipes. Once the bath is sufficiently clear to give access to a hand and spanner, the hot and cold feed pipes may be uncoupled.

After taking up wood-block or vinyl flooring or any type of flooring which leaves a sticky covering to the floor, throw on a handful of dust to kill the stickiness.

7.18 Tiles and fixings

In all the recommendations and techniques suggested for deconstruction, it must be remembered that different conditions exist on different sites, indeed different conditions exist in different places in the same room. As an

example of this, an attempt was made to remove tiles from the downstairs kitchen at No. 42, with the object of recycling them.
Starting from the top of a wall the following was written. "Removing tiles, to avoid breakages start from the corner of a tile which has two adjacent clear edges, and use hammer and screwdriver. Less breakages occur then when levering from the middle of a side. As the tile loosens it can be picked off by the hand that holds the screwdriver."

The technique worked well for the top few courses of tiles where there seemed to be only a small amount of tile cement but did not work at lower levels where a great deal of tile cement had been used. The moral is 'keep an open mind'. The civilisation of man was brought about by his use of tools, keep working at improving your techniques and if you find an improvement please let your supervisor know for the benefit of others. Pooled wisdom started with the first books, but is now advancing faster then ever before due to the world wide web.

Tiles may have been applied to hide cracks in the walls; at No. 42 in the corner of the downstairs bathroom - once the tiles had been removed it could be seen that inside a wide crack was plaster, which was obviously pushed into the crack at the time of replastering in the front of the crack. The surface plastering was holding up quite well with only a few fine cracks. The question arises "how could we tell from looking at the tiles that No. 42 had severe settlement problems?" the answer is that we could not from looking at the tiles, we would have to look at levels. When we look at levels - using a spirit level - we must be on our guard to ensure that the floor finish we can see is actually sitting on the original floor and not on some made up floor designed to hide settlement.

Hidden fixings of 'fixtures and fittings' can cause a great deal of frustration when trying to remove kitchen boilers and other equipment without the benefit of the sheet of instructions which the installer of the equipment used. Some suggestions when it is unclear how the equipment was fixed to the wall:

- can a panel of the equipment be opened or removed to gain access to the back (usually the removal of the front panel of wall hung boilers gives access to the pipes and back)
- wall hung boilers can be particularly difficult for there are usually four or more pipes to be uncoupled
- Venetian blinds usually have a simple system which permits the lifting out of the blind for cleaning the slats. Once the blind is lifted out access to the screws fixing the supporting brackets to the wall can be obtained.

When the writer was a boy his father came home one day with a stainless steel sink to replace the old chipped vitreous-enamelled one. After some puzzling Dad announced that there were no fixing brackets so he would have to drill through the splashback (the bit that runs up the wall) to put screws through to fix the sink to the wall. The writer's suggestion (for he always hung around his late father who seemed to do more interesting things than his mother) was to cut small plates and screw them to the wall with small packs behind, then the splashback could be hooked over the plates. The suggestion was adopted but not with good grace. The story is told not because the writer was smarter than his father, for he was not, but as a reminder that young people have more agile minds that older people. When a young person makes a good suggestion, heap praise on him for he will remember you more kindly if you do.

7.19 Glazing

Three types of double glazing were encountered at No. 42, each required a different technique for removal.

Sliding doors - for these the glazing was rigidly fixed into the door frame so the doors complete with their frames had to be removed together. The frames slid in channel sections at the top and bottom of each door. Firstly the channel section at the top was unscrewed from the 'lining over', to which it was fixed. Where screws could not be unscrewed, they were drilled out.

Two pairs of hands are essential for this job, one pair to hold the door and the other pair to do the work. Once the top channel was loose, each door could be leant forward and then lifted out of the bottom channel. As with most deconstruction jobs, detective work or 'reverse engineering' is required to find out how the work was put together, once this is ascertained, deconstruction is straightforward.

Glazing with internal rubber seals - firstly the rubber seals were prized out using a screwdriver, and then removed. A gentle push of the glazing from the outside, so that the glazing occupied the space formerly occupied by the internal rubber seals, loosened the external glazing strips. The external glazing strips at the bottom, top and sides were removed - taking care to stop the glazing from falling out - and the glazing then lifted out.

Glazing without internal rubber seals - was difficult to remove. A screwdriver and a strong but steady wrist were required to spring out the external aluminium glazing strips. One or two cracks may be expected during the removal of this type of unit.

Much of the double glazing at No. 42 had lost its seals. For aesthetic reasons it was decided not to recycle the glazing into the new building; Thermal Glazing Systems - a large local supplier of double glazing - was consulted about recycling the old double glazing. Thermal Glazing Systems say there is no second hand market in double glazing and that when they replace glazing which has failed due to bad seals they use a crusher to crush the glass to minimise its volume in a skip. Consideration was given to placing a card in local newsagents windows saying "free double glazing - buyer collects", but it was decided to store the smaller double glazed windows and smash the glass of the large patio doors which were too heavy to be lifted by one person. The smashed glass from the patio doors was taken to the local recycling centre and put in the clear glass bin; on a larger recycling project there would be sufficient manpower to take the patio doors to storage prior to recycling.

There were five patio doors, three at first floor level, and two at ground floor level. Breaking glass is a job for covering up all exposed skin so needs gloves, a proper mask - of the type which seals against the face - to protect the eyes, and a turned up collar to protect as much as possible of the neck and sides of the face. So that the glass did not spread too far, a row of lined banana boxes was put on either side of the patio door being broken, to catch the falling glass. It was found that swinging a pick axe at the glass of the first floor patio doors did not break the glass, so the point of the wrecking bar was swung at the corner of the glass several times with increasing force until eventually the glass broke. On breaking the first two double glazed units, each crazed into small pieces just as the glass of a car windshield does, and therefore made from toughened glass. The third double glazed unit was made from laminated glass and behaved quite differently, breaking into larger pieces which held their structural integrity by forming some fusion at broken edges rather as though glue had been applied. Removal of the broken glass from the two double glazed units which crazed was simple, a crow bar was used to tap the crazed glazing so that it fell directly into the banana boxes. Removal of the broken glass from the third double glazed unit was much more difficult, even after the unit had been punctured it was still necessary to use a combination of swinging a pick axe and/or sledge hammer at the unit, and then use the crow bar to lever the two panes apart to get the glass out. The lesson is that some details which look the same may be quite different.

The stories about people perishing in fires because they cannot break double glazing units are undoubtably true. Without exaggeration the point of the 12lb wrecking bar had to be thrown at the double glazing unit before it would break; what householder keeps a wrecking bar in his bedroom in case fire breaks out and he/she becomes trapped? Had it been possible to remove the double glazing from the patio door frames then this would have been the preferred option. Unfortunately the glazing was fixed into the aluminium frames with very large screw fixings which had become so corroded they could not be removed.

There were twelve double glazed windows at first floor level on the south elevation, six on either side of the patio doors. With some perseverance it was found possible to remove the aluminium glazing seals using just a hammer (gently), screwdriver and chisel. Starting in a corner the screwdriver was tapped into the joint between the glazing seal and the surrounding frame and then twisted to lever the seal away from the frame. The chisel was then inserted in the gap to stop it closing, and the screwdriver moved along and the levering process repeated. Proceeding in this manner around the four seals on each of the twelve windows, eleven were successfully removed without mishap; the twelfth one suffered a small crack in one corner.

When removing aluminium double glazing, where possible try and undo all the fittings. Where not possible due to oxidation of the aluminium or corrosion of the connectors, the aluminium sections will need to be cut so that the frame can be removed.

Linseed oil putty which has been stuck to wood for many years and is as hard as brick can be very difficult to remove using hand tools. The writer has found that the best way is to put the wood in a vice and chisel off the hardened putty using an old wood chisel and claw hammer. The job takes some time so the trick is to imagine you are a stone mason chiselling away on the first block of stone at the start of one of our great cathedrals.

7.20 Ceilings

Keep the pieces of deconstructed plasterboard ceilings in as large sections as possible for they are more easily handled and take less storage space. If a row of battens has been fixed to the ceiling then it could be because there were signs of collapse and the householder did DIY rather then get a plasterer in to replaster the ceiling. If a ceiling or any beam is sagging then it is definitely suspect. Proceed extremely carefully when taking down ceilings, clear one small area firstly so that you have a cleared area under which to stand when you tackle the remainder.

Demolishing ceilings is a job where a hard hat and safety glasses and heavy clothing - such as a donkey jacket - are essential. Upstairs ceilings can normally be demolished by tall people standing on the floor. If there has been a ceiling rose then insert the pick axe into the opening and lever to make the hole bigger and thereby find out what is behind, and if it looks OK, pull down the first bit of ceiling. You should now be able to see which way the joists are spanning. With a combination of yanking and levering, work down between a pair of joists pulling down the ceiling in front of you keeping back to stop too much debris falling on you.

Proceed to the wall, then go back to the starting point and proceed in a similar manner to the opposite wall. You should now have removed the ceiling for one complete bay between a pair of joists. If parts of the ceiling fall down from other bays, rejoice for it saves you effort. Demolishing ceilings is a job for fit quick people, you have to be ready to dodge blows from the falling plaster; although falling plaster is not as fast as Mohammed Ali was, it is still fast. Demolishing ceilings is a very dusty job, the occasional brickbat lying above the plaster falls down with the plaster so be careful to stay back from the falling plaster.

7.21 Walls

It is not simply a matter of identifying the loadbearing walls and keeping them until the deconstruction is down to their level. In old houses sometimes stud partitions have become load bearing as the nature of support changes with failure or part failure of timber or steel joists, through woodworm/rot or corrosion. If you see signs of structural failure after the ceilings have been taken down, then do not remove any walls or supports which may be contributing to the stability of the structure. An experienced structural engineer, builder or carpenter should be consulted if in doubt.

Temporary stability must be provided for walls being deconstructed. Do not remove all the ceiling joists at roof level as this may cause cracked walls to become unstable. Take down three or four ceiling joists working from an outside wall leaving any strutting to brace those remaining. Next cut through the sole plate (timber usually 100 x 50mm to which the joists is nailed) so that the wall height can be lowered to approximately 1.5m which will be much more stable than if it is left at its full height of approximately 2.4m. Now remove the next three or four ceiling joists, and so on.

Do not take down a wall if it is providing stability to another wall especially if the other wall is sitting on a beam, rather remove one course of bricks or blocks from all the interconnected masonry at a time.

When deconstructing cavity walls look down the cavity to spot the wall ties which should be approximately every 4-6 courses. Always leave the wall so that one or two courses of brick are above the highest wall tie.

7.22 Brickwork and blockwork

Hammer and chisel along the length of the wall removing one course at a time. Work from any unstable end towards a more stable end. Stability is provided by 'a return' i.e. a wall at right angles to - and bonded in with - the wall on which you are working.

When taking down brickwork near a public footpath, erect a small mobile scaffold tower on the inside of the wall and provide a flat surface so that loosened bricks can be pulled away from the public side. Put up signs saying DANGER KEEP CLEAR on the footpath and while working on the wall have someone 'standing by' just to stop the public ignoring the signs, and to give the public a brief explanation as to what you are doing and how long it will take and to say 'sorry for the inconvenience caused'. You cannot deconstruct a wall and deal with the public yourself, for while you are concentrating on your hammer, someone will come and stand underneath you to ask you what you are doing.

It consumes a great deal of energy carrying bricks/blockwork down to the ground; if the bricks are dropped in a pile they will break or chip. If the bricks are already broken drop them into a pile for subsequent recycling as hardcore.

For bricks that are removed in good condition make a bed for them to fall on (earth is ideal) or plaster or render or mortar. Lob the bricks onto the bed so that they do not hit each other. When the space on the bed is getting a bit tight, clear the bricks from the bed to storage and start again lobbing the bricks onto the cleared bed.

Most bricks weigh more or less the same i.e. 3kg (except for engineering bricks which are heavier), blocks range in density from very light aircrete blocks which float in water to dense solid concrete blocks. The new garage at No. 42, which was probably built in the nineteen sixties, was constructed from dense concrete blocks set in cement sand mortar. An afternoon was spent trying to deconstruct a wall using just a club hammer and bolster, but because of very slow progress, it was decided to hire a demolition hammer. After some experimentation with demolition hammers, it was found that a 16 Joule (1100W) hammer had insufficient breaking force for dealing with the solid concrete blocks; though a 23 Joule Bosch hammer was found to be adequate. The Bosch hammer had specially designed handles to absorb the vibrations (as required by current European regulations but not provided on other hammers available) and thereby avoid 'white finger'. The roof of the garage was unsafe and so the inside of the garage had two scaffolding towers previously erected for the roof. The scaffolding gave access to the top of the walls, the stout stool was used for getting above the wall and also for resting the demolition hammer when it was not in use. At all times that the demolition hammer was in use the writer wore thick gloves, safety glasses and ear defenders.

Work started at one end of a wall working along the top towards the other end and inserting the demolition hammer into the mortar joints for 5 to 10 seconds sufficient to loosen the block. Three or four blocks were loosened then the demolition hammer was rested while the blocks were carefully dropped onto a bed of torn up roofing felt below.

The solid concrete blocks had a thickness of 100mm, two blocks, side by side, with a mortar joint between, defined the overall thickness of the wall. At every third course, a row of concrete blocks had been laid horizontally to hold the two 'skins' or 'leaves' together.

Once the wall height had been lowered by 600mm then the platform level of the scaffolding was lowered by one section until the height of the wall was no more than 1.5m, at which point the scaffolding was removed and deconstruction continued working from the top of the stout stool.

The effort required to clean up bricks depends on the adhesion of the mortar. The cement lime sand mortars used between the wars have poor adhesion compared to the modern cement sand admixture mortars. It is quite likely that there will be a mixture of two types of mortar on any project as old houses frequently have modern extensions. Find some bricks which are easy to clean up to start you going and give you a bit of confidence. Work near the pile of bricks, putting cleaned up bricks in a wheelbarrow for transit to temporary or long term storage as was established at the planning stage. You may find it convenient to use a banana box inside the wheelbarrow so you can lift several bricks at one time, but we warned that leaning over a wheelbarrow and lifting is bad for your back - weightlifters always lift with a straight back and bent knees.

Clean up bricks and blocks using the bench at ground floor level. Cleaning the bricks is more pleasant if the work is done outside, weather permitting.

7.23 Reinforced concrete floors

The demolition of suspended reinforced concrete floors using only hand tools requires some thought. The concrete floor of No. 42 at first floor level comprised seven substantial but heavily corroded steel beams with filler joists at 450mm centres. The year of construction (1935) was early for reinforced concrete design in the UK, and reinforcement was provided by 50mm x 50mm angle criss-crossed at approximately 250mm centres. Breaking out was tedious but possible using the 23 Joule demolition hammer switched to the highest energy setting No. 6. The technique was to start by making a hole through the slab and then to nibble away, 50mm at a time, to locate the reinforcement. Once the reinforcement was located, the concrete was broken away along the length of the reinforcement and each piece was removed. The main difficulty was where the 50x50mm angle was tucked between the flanges of the main steel beams; to remove it meant that the chisel had to break out the concrete between the flanges of the beams which in turn meant that the operator has to sit down on the floor holding the demolition hammer almost horizontal; this was one of the hardest jobs in the deconstruction of the block of flats.

The first floor steel beams varied in size, weight and length. The longest beam was 9 metres. All beams were cut to approximately 2m lengths so that they could be manhandled for storage and reuse (where possible) as ground beams encased in concrete. The beams were cut using a 250mm diameter cutting disk for steel in an angle grinder. Cutting was difficult due to the depth of the cut required to get to the web, and although the cutting disk was held firmly and as steady as possible there were occasions when the angle grinder 'kicked back' when the cutting disk jammed. The kick back experience was unpleasant as bits of the grinding disk flew in all directions, some striking the operator in the face with great severity. After experiencing half a dozen 'kick backs' it was decided that some sort of clamping device was needed to hold the angle grinder. A Tee was made by welding together two pieces of 50 x 50mm angle (cost of welding was £3 at Sopley Forge). The long leg was drilled to receive two 6mm dia. bolts with holes arranged to align them with holes in the substantial guard on the angle grinder. The Tee was a great success, the operator stood on the cross bar about which the stalk of the Tee could move radially, with the angle grinder clamped near the end. Cutting of the bulk of the steel beams became fun rather than an anxious experience waiting for the next kick back; because the angle grinder was restrained to move in one plane only, the cutting disk did not jam even with the deepest cut.

Before breaking out the reinforced concrete at first floor level it was thought advisable to locate and cover all services, which in turn meant removal of the ground floor which was suspended (floorboards on 100 x 50mm timber joists supported on dwarf walls). The main electricity supply, which ran underneath the first floor reinforced concrete, was located and covered with substantial joists laid along its length, the joists being supported by bricks on either side of the armoured cable. Once the services had been protected the broken concrete was allowed to fall producing a bed of aggregate over the electricity supply. When all the concrete, reinforcement and filler joists had been broken out, consideration was given to erecting mobile scaffolding to support the beams so that they could be cut in place just as had been done for second floor steel beams. As the services had a good protective layer above them it was thought simpler to unbolt the steelwork and lever it from its pad supports allowing it to fall to the ground. Corrosion of the bolts and cleats was very severe and only a small number of bolts could be unbolted, the remainder were removed by using the angle grinder to cut through the centre of the bolt head or nut and then using a club hammer and cold chisel to break away the two halves of the head or nut. After the cleats were removed, the freed beam - with careful use of a wrecking bar and crow bar - was levered from its supports and allowed to fall to the ground where it was safely cut into sections using the angle grinder and T.

7.24 Roofs

The work in this research has shown that it is possible to deconstruct housing working from the inside and without the use of external ladders. When working on the top of flat roofs of a two or more storey building, it is essential that handrails be provided around the perimeter even though the photographic record does not show a handrail. Once the roof has been removed, then the deconstruction can be planned so that the external wall always acts as a handrail.

For traditional tiles on battens on rafters construction, it will be straightforward to remove the tiles from within the roof space and take them down through the house. For tiles on battens on felt on rafters the deconstruction becomes a bit more difficult as the felt has to be cut away to gain access to the back of the tiles.

For tiles on battens on counter battens on felt on close boarded timber on rafters, deconstruction of the roof - working from the inside - becomes difficult, and the roof would need to be deconstructed from the outside which would require an external scaffolding. The hire cost of erection of a scaffolding around a two storey building measuring 10m x 10m is approximately £800 + £70/week + VAT. The provision of a scaffolding does not guarantee that workers - especially the scaffolders who have to erect the scaffolding - will not fall from the scaffolding. Such close boarded roofs are unusual; the hire cost of the scaffolding is likely to exceed any savings from recycling the roof, therefore housing with this type of roof would be less suitable for recycling as part of a construction training programme.

If the roof is flat and looks as though it will not support the weight of two people, or if it is a pitched roof then, then for safety use two 2.1m x 2.1m x 1.8m high scaffold towers erected inside the house or garage, beneath the roof and near the corners of the walls, so that you can open up a hole in the roof from the inside. By this time in the project, a considerable amount of timber will be available and there should be sufficient floor boards to make decking for the top of both the scaffolding, and to provide load spreaders and packs for the scaffolding.

Two scaffolding towers 2.1m x 2.1m x 1.8m high filled the garage at No.

42, and gave access to the whole of the underside of the roof when walking in a bent position. The roofing-felt and boards were removed leaving the joists to provide stability to the walls until the start of deconstruction of the walls.

To deconstruct pitched tiled roofs, remove the tiles from the inside but leaving trusses and tile battens for stability; this may require roofing felt to be cut or ripped to give access to the back of the tile. If the roof has been 'close-boarded' then it is not practical to remove the tiles through the inside of the garage and external scaffolding will be required. In either case remove the tiles equally from both sides working from one end of the roof to the other. This way of working avoids placing eccentric loading on the walls.

Flat roofs formed from nailed down 2.4m x 1.2m plywood sheets can be very difficult to lever up especially if they have been nailed down with nails which have a thread. One method of removal is to use a circular saw to cut each sheet down the centre to make the sheet into two 2.4m x 0.6m sheets and lever up the long side of one of the two sheets. Once one half sheet has been removed a stout timber beam can be laid across the joists and used as a support for levering up the next half sheet using a 1.5m wrecking bar or stout steel tube.

Flat roofs (usually garages) can sometimes be opened up from the inside, unless the timber boards are overlaid by plywood. If there is any suspicion that this is the case e.g. it is not possible to push a chisel through the gap between the boards and through the roofing felt, then it may be necessary to erect a scaffold tower or ladder or steps to give access to the roof. Tie the ladder or steps to the side of something stable, e.g. a scaffold tower. When using a step ladder, always ensure you have something you can grab if the steps slip.

For flat roofs of felt on boarding on timber joists, it is usually possible to do all the work from the inside. Use a crow bar to prize one of the boards from the rafter sufficiently to insert a tool to cut or rip the felt above. Make a hole in the roof-boards near a high corner but avoid cutting the rafters. With the scaffolding as your support, squeeze through the hole so that the roof is around your waist and acting as a support. You should now be able to use gloved hands to sweep any roof shingle on top of the felt towards you and down onto a swept floor for subsequent recovery. Tear up the felt so that you have cleared an area as far as you can sensibly stretch. Cut the pair of boards near to a rafter support to elongate the hole you have made along the length of the garage. Proceed as above along the length of the roof until you have a two board wide slot along the length of the garage roof and all the shingle you can reach has been swept down onto the floor below and all the felt you can reach has been ripped up and dropped through onto the floor. Once you have completed the two board wide slot, you can stand on the stout stool so that the roof level is at your waist level. Once you have ripped up all the felt you can reach easily, you can lever up the boards by using a crow bar or wrecking bar at 45 degrees to the rafter and hooking the bar under the board and over the rafter and pushing down. It is easy to pull up roofing felt and roofing finishes in pieces, dropping them over a safe edge to the ground. Taking up the boarding for a flat garage roof requires a bit more thought because once the boarding is up it is obvious that you cannot walk over the roof to gain access to the other side; so take up the boarding making sure that you will not need to have to traverse that part of the roof. It's a bit like painting a floor, you have to plan the job so that you end up painting the last bit of the floor as you back out of the door.

Once the roof of a house is removed, a first thought may be that the inside will become so wet that there will be nowhere dry to go to get out of the rain. In practice after a week or so of rain the floor boards or boarding swell to form a more or less watertight surface and the water finds discrete paths to escape - often down the sides of rooms, or where there are holes in the floorboards for pipes. The result is that even through rainy spells there are plenty of dry places on the ground floor of the house, where the bench can be set up for denailing or other indoor jobs. On fine windy days, it is sensible to open the ground floor doors and windows to help with the drying out process; normally all ground floor doors and windows will be kept locked to keep the building secure.

It is easy to underestimate the work involved in deconstructing flat roofs especially if a new roof has been constructed over an existing roof, remember that the main attribute needed for recycling houses is that of sticking to the task.

After the roofing-felt has been removed from the timber boarding, it is usually possible to remove 12mm roofing tacks with a large screwdriver. Push the screwdriver under the tack head to lever up the tack. If the roofing tacks are longer than 12mm or are difficult to remove with the screwdriver then use the pincers.

For flat roofs it is normal to continue the waterproofing membrane up any surrounding masonry for 150mm, and have flashing pointed into the masonry and lapped over the waterproofing membrane. Traditionally the flashing was made of lead, but substitutes are now frequently used. If the flashing proves too difficult to pull out, then one technique is to use the pick axe, with the head resting on the roof and chisel end of the pick axe against the masonry and under the flashing, pulling the top of the pick axe away from the masonry will lever the chisel end up and out, so pulling the flashing out of the masonry. Modern waterproofing membranes can be extremely difficult to tear and if the membrane has a grit finish the membrane cannot be cut by tree loppers and such like. One way of tearing up such a membrane is to use the wrecking bar rather like a large knife. Firstly puncture the membrane with the chisel or point end of the wrecking bar, then jam the wrecking bar say 300mm into the hole and lever up to tear the membrane. It is hard work but good exercise.

On top of timber joists plywood boarding is sometimes laid directly on the timber joists or sometimes on top of 50x50mm battens which are at right angles to the timber joists beneath. For the latter case levering up the boarding is very hard work as the batons often lift when the boarding is levered up. The remedy is to get down on your knees - on a kneeling mat - and look underneath the levered up board to see what is happening. Once you have used the wrecking bar to lever up a corner of the boarding, shove a piece of short 50x50mm batten in the gap to stop the gap from closing. If you can see that the battens below the boarding are coming away from the joists you need to jam the chisel end of the wrecking bar between the boarding and battens and lever it open. With a little bit of thought you will see where to place a short length of batten so you can lever open the gap by pushing down on the wrecking bar. Eventually the work develops its own pattern e.g.

- lever up using wrecking bar and 50x50mm short length of timber as a fulcrum
- shove 50 x 50mm into the gap, move along and repeat
- look underneath the plywood sheet or boarding to see what is happening, whenever possible use 50x50mm timber as a fulcrum to save your back as it is easier to push down than to lift
- when one piece of 2.4m x 0.6m sheeting is free, remove the nails and any nails left in the supporting joists and lay the timber back down (arranging it so that it cannot tip) as a working surface.

Modern flat roofs covered in roofing felt have additional fabric reinforcement at joints so twice the effort is needed to tear through the felt where the layers overlap. In exposed conditions bitumen is usually laid onto the boarding so that the felt is effectively glued to the boarding. Various techniques for tearing up the felt were tried unsuccessfully: including cutting with tree loppers; putting a 50x50mm timber under the felt and using a (half moon lawn edge cutter) along the edge of the timber rather like a guillotine. The only success was with the wrecking bar. Techniques with the wrecking bar included:

- using the chisel end to cut through the felt at edges where the felt flashing was of several thicknesses returned up the parapet

- using the bar to lever the felt up and so tear it and using a leg to keep the gap open and pushing the wrecking bar further along the tear line and levering up again.

The removal of the felt was hard physical work - another job for doing a bit at a time. Flat roofs are usually laid to a fall and at the lower end are dressed around a small fascia board to form a "drip". If the tears in the felt are arranged so that a 600mm wide strip is left along the lower edge with tears at say one metre centres, it will enable the felt to be levered up and bent over the edge thus cracking the bitumen. Use of the wrecking bar to lever and tear the felt away from the fascia and thus fall to the ground. Do not be tempted to start removing the roof boarding before all the felt is removed. When you are struggling with all your might to lever up the felt; on a garage roof, the last thing you want is to step backwards and fall through the roof; to avoid falling through the access hole you have made in the roof, cover it with boarding until you want to go down through it.

Fascia boards - made from 'external' or 'marine ply' - boxing steel beams are usually fixed along the top edge and at positions where the beam has been wrapped in timber. The bottom edge of fascia boards is often notched to support a soffit board. Removal of fascia boards is by opening up a gap along the top, inserting the claws of the crow bar into the gap and pulling up the chisel end of the crow bar to lever the board away.

7.25 Floor boards and joists

If a floor finish or carpet looks reasonable, remove it at the start of the deconstruction before it is spoilt or broken by wheel barrows or falling masonry. Some floor tiles in porches cannot be lifted until the porch is deconstructed allowing access to the sides and underside of the tiles; the chisel end of the wrecking bar is good for prizing up tiles.

The removal of the tongued and grooved floor boards at first floor level required some experimentation. Firstly it was attempted to work from a free edge and lever up - using a large steel tube pushing down on strong short joists spanning between the joists - two floor boards at a time with the intention of pulling the first board away from the second board without breaking the tongue and groove. This failed as the tongue and/or groove split. Secondly it was attempted to remove a 'panel' of three boards after using a circular saw to cut through the tongue and groove at every third board. Again it was not found possible to remove the boards without breaking the tongue and groove. The final and preferred solution was to saw down every tongue and groove; the boards were then easily removed. It may be that on other floors the boards have shorter nails and the first or second approach would work. After removing two or three boards, any nails were removed from the joists beneath the boards themselves and the board temporarily replaced to form a working surface.

Measure the sizes of floor joists and other timber and memorise the sizes. Remember floor joist sizes to the nearest 25mm. Floor joists are typically in the range 100 x 50 to 300 x 50; the UK construction industry uses mm rather than cm. Floor boards are usually nailed at both sides of the board at each joist - typically 400mm centres - so do not lever up one side more than is necessary to make a 5mm gap between board and joist otherwise you may split the board if the other side remains fixed by a nail. To make a gap, push the claws of the crow bar under the floor board with the curved part of the crow bar resting on the joist; to do this the centre line of the crow bar has to be at 45 degrees to the joists. Pull up on the chisel end of the crow bar which pushes down on the joist and levers up one side of the board. Once a gap has been made the claws of the crow bar can be inserted fully under the board with the crow bar in line with the joist beneath, in this position pulling up on the chisel end of the crow bar lifts the board from its centre - rather than its side - and pulls out the nails on both sides of the board - assuming you have sawn through the tongues and grooves as described above.

The removal and denailing of floorboards is one of the more satisfying jobs in the deconstruction of houses. Handling floorboards six or more metres in length is awkward in the confines of a house and transport by van is complicated by the need to tie them to a roof rack; so it is suggested that lengths are cut to just over 2.4m. Housing joist centres are usually 400mm so a length of 2.4m (approximately 8ft) is six 400mm modules. A 2.4m length can be carried around a house without difficulty. Some common sense is needed in choosing a sensible maximum length and if would be unwise to cut a floor board length of 3m to make it smaller. Most vans of the Transit type can carry a length of 3m inside the van, with the exception of the short wheelbase version which have been fitted with a full bulkhead thus dividing the driver's cab from the storage bay behind and thereby preventing the boards from resting on the backs of the passenger's seats. For shortish lengths of floorboards in the order of 1.2m, denail by placing on the top of the bench with the nails pointing upward. Experience has found that when floorboards are levered up then generally the nails stay in the floorboard. Start with the end nails just over one end of the bench and drive with the hammer so that the points are flush with the timber surface. Slide the floor board along so that the second pair of nails are just over the edge of the bench and again drive the points of the nails so that they are flush with the timber surface. Repeat until just past the middle and needing the weight of your hand to stop the floorboard falling, then turn the floorboard over and move back to the first position and withdraw the nails using claw hammer (or crow bar if the nails are difficult). Denail the other half of the board in a similar manner. By a bit of planning you will avoid bending the nails and then having to straighten them before you can drive them back flush to the surface. For longer pieces of floorboard say 2.4m use the edge of the bench again but this time with one end of the floorboard resting on the ground and the nails you are working on near the edge (for rigidity) either just below or just above the bench edge, so that when you drive the points back flush with the surface of the floorboard you do not drive the heads into the bench. You will be pleased when you have worked out the longer version for yourself, you will then have a 'system', and 'systems' are what construction is all about. It may be that for driving the points of the nails flush you will need to hold the nail with the pliers to prevent it buckling. It is usual to nail floorboards at every joist position (400mm centres) with two 50mm long vertical nails, but occasionally additional nails are driven in at 45 degrees to stop the board moving sideways when adjacent boards are tapped horizontally to close up any gap. When you find a floorboard with nails driven in at 45 degrees, the detail will tell you that the board was an anchor against which other boards were tapped. Much of construction has small details which tell a little story, so be attentive and if you cannot puzzle out for yourself why a detail is the way it is, get your pals on the subject by saying "Why did the chap do it this way?". To denail fillet - sometimes found around the edge of floors - lay the hypotenuse face down on the bench and drive the nails back through then use pincers to remove.

7.26 Garages which have been converted

Some local person will probably know when a house was built, but houses which are to be demolished may well have extensions or alterations made over the years; a clue to the date of extensions can often be found from old newspapers stuffed in door jambs etc. as packs.

It is likely to be difficult to remove the plaster from the walls of a garage which has been converted into a room in recent years. Whereas in the 30's plaster walls had a base coat of cement:lime:sand render and a finishing coat of just 5mm thickness; post-war house conversion practice has favoured: Unibond, bonding, a cement:sand:plasticiser first or render coat (or less commonly because of the expense, browning plaster), and finish. The adhesion of the post-war plasters is terrific compared to that of pre-war practice. If the plaster cannot sensibly be removed by crow bar or hammer and chisel, then leave it until the brickwork - to which the plaster is attached - is deconstructed.

The fill under the solid garage floor at No. 42 was a mixture of broken bricks and cinders. Obviously waste was being recycled in 1935 when the house was built. During the constructing of the house, the layer of bricks and cinders had been overlaid by mortar which had become compacted over the year of the building process, from wheel barrows and foot traffic. Removal of the compacted mortar was found to be easiest by use of a shovel (or spade) but only taking a slice i.e. less than one shovel's width, and always keeping a free edge. When the mortar was so compacted that even a spade could not penetrate, then it was loosened down to a depth of 100mm with the pick axe and then shovelled.

Removal of the bricks and cinders was found to be easiest by using the pick axe to grub out the bricks and then the shovel to remove the cinders. Do this work in horizontal layers not more then 100mm deep at a time. It is easy to waste effort when using the pick. The pick should not be lifted above waist level, it is only required to hook out the bricks.

7.27 Rubble and miscellaneous materials

Do not allow building materials to become mixed, they are more re-usable if kept separate. For example when demolishing single storey brickwork, clear up the plaster, clear up the roofing gravel then clear up the roofing felt before demolishing the brickwork. A pile of roofing felt, plaster, gravel and brickwork takes of great deal of time to sort into their separate parts, deconstructing one part at a time and clearing up after each part avoids the need for separating the parts later.

7.28 Concrete lintels

Old concrete lintels were usually 'cast in place' often using very small I sections as reinforcement; presumably to get some shear strength into the lintel without the need to use bars and stirrup reinforcement. If the lintel is cracked along its length it cannot be re-used, so it is safer to break it up with a sledge or demolition hammer rather than attempt to remove it in one piece. The ends can present a problem if they are built-in to the masonry wall. Some built-in ends may also be acting as a support to a wall or beam resting on top of the lintel end, and in such cases the lintel end sometimes cannot be moved without endangering the stability of the wall which it supports; an experienced builder should be consulted in this instance.

A 250kg (525lb) reinforced concrete lintel can be walked sideways off its support using a 30″ crow bar then allowing it to drop to the ground; such heavy pieces of falling concrete can kill; so always bear in mind that someone - for their very own good reason and without understanding what you are doing - may suddenly rush up to you to tell you something which they consider to be important.

7.29 Up and over garage doors

Keep any up and over garage door shut once deconstruction of the roof has commenced to avoid the possibility of the wind lifting off the garage roof.

Up and over garage doors can be tricky to remove. They are usually counterbalanced by a spring which has a great deal of stored energy. When the garage door is open then the stored energy is usually at its minimum, so the release of the spring should take place when the door is fully open. If the spring is one which can be seen and can be lifted off, then lift it off; if the spring is hidden then consult with someone who knows about the type.

Up and over garage doors often rely on being tied back into the roof for their support. In such a case use two or three rafters won from the other end of the garage roof as soldiers (i.e. vertically) on the outside of the garage door lintel, and brickwork over the lintel. Rope the soldiers over the top of the brickwork to the scaffold, and rope from the soldiers through the gap between lintel and garage door to the scaffold also. The brickwork should now be restrained by the scaffold.

Rafters provide stability to the top of the wall. Start lowering the height of the wall down to say 1.5m at the end of the garage remote from the garage door, removing the rafters as you work towards the garage door.

7.30 Staircases

Leave deconstruction of the staircase as long as possible, so that you can erect staging - above the staircase landing - to open up the roof from the inside, and take tiles and other recovered roof materials down the stairs. If there is insufficient space to erect staging at the top of the landing, then the top of the staircase may need to be deconstructed before the roof can be started. Balusters (the verticals) and balustrades (the handrail bit at the top of the balusters) may need to be deconstructed. Before taking a saw to the balusters, lift a few floorboards to see if the full length of balusters can be recovered.

The deconstruction of long single flight staircases can be troublesome as it is not always clear in what order the components were put together.

If the handrail is straight and screwed to the wall then this may be simply removed and stored for later recycling. If - as is usual - the balusters and balustrades have several coats of paint on them, use a hammer and screwdriver to clear paint from obvious joints and use the club hammer to open up the joints if possible to see what is beneath and how the joinery was put together. If there is a free end that can be removed, start at the free end and recover some pieces, the exercise will teach you more about the joinery and give clues as to how to tackle the remainder. Persevere until your sticking point, and when all avenues have been exhausted and deconstruction is still not possible, you will have to take a saw to the job.

7.31 Stud partitioning

Modern stud partitioning is usually formed from 100 x 50mm timber 'studs' with plasterboard fixed to both faces of the stud; the studs have a variety of configurations, typically being floor to ceiling studs at 600 crs (to tie in with 2.4m x 1.2m plasterboard sheets). The studs are normally fixed to a 100mm x 50mm 'plate' at the top and bottom of the partition, but sometimes the plate stops and starts with the studs going down to the floor or up to the ceiling. The plasterboard sheets are usually taped at their edges using self adhesive glass fibre tape or other types; sometimes a 'skim coat' of plaster is applied to the plasterboard to hide nail heads and level variations in the surface.

Firstly remove all skirting boards and picture rails from the partition. Although you may think that nothing will fall on your head when you are deconstructing a stud partition, it may be that the hammering will loosen a large area of ceiling, so this job is definitely a hard hat job.

If the plasterboard can be recovered easily then do so; once a skim coat has been applied to the board then it is not easy to locate the nails and in consequence the plasterboard has to be levered, usually pulling plugs from the board at each nail position. Generally it is not possible to reuse plasterboards; no matter how careful you are - removal of the clout nails (which are normally galvanised and therefore not smooth) damages the board.

Start at the top of the plasterboard - which is probably less well nailed - using the pick axe when standing on your stout stool, and levering the plasterboard away from the timber studs. Usually the nails stay attached to the timber studs but if they do come away with the board remove them with the pincers to avoid someone treading on a nail. Avoid treading on bits of plasterboard; clear up as the side you are working on comes down. It is easier to handle large pieces of plasterboard than a pile of bits.

If you know that you can not recoverer the plasterboard in large pieces, once the nearside skin of plasterboard has been removed use the head of the pick axe as a sort of battering ram to bash the far face of the plasterboard away from the timber studs. The pick axe head spreads each blow and with care you should be able to avoid the pick axe from going through the plasterboard.

After removal of the plasterboard look to see what connects to what; lever or sledge hammer away the foot of the studs in the plane of the partitioning to minimise damage to the studs.

7.32 Bad workmanship

Bad workmanship in housing which has been replanned is not uncommon e.g. when carpenters find a space which needs filling - particularly if it is an awkward shape - they knock nails in and bend over the protruding head and fill the space with stiff mortar. Subsequently the mortar gets painted and the occupants are blissfully unaware that some of their woodwork is in fact mortar. Another example is to use old tin cans to bulk out a hole to be filled, and then finish up the surface with sand and cement.

7.33 On keeping going

Ninety five per cent of the time taken on the deconstruction of No. 42 was straight forward labouring, the remaining 5% was anxious or exciting. The anxious and exciting times were when steel beams or concrete lintels were levered off their supports and allowed to fall to the ground. At these times common sense was needed to work out all the possibilities of what might go wrong and how to react if something did.

The work of deconstructing a house goes on for months, to give yourself a sense of achievement you have to create milestones along the way, for example tell yourself "that is the last of the roof floorboards removed and denailed". When you come near to the end of a task there is often some inefficiencies such as difficult bits that you left until later; somehow they do not seem quite so difficult to do at the end of the task as they did when you were in the middle or it.

It is nice to get to a milestone and pat yourself on the back and say job well done; it sounds corny but life is corny. Perhaps a milestone would be a task that lasts several days with mini-milestones set as a goal for a morning or afternoon e.g. levering up forty floor boards say, or less depending on the difficulty.

Chapter 8

Economics of recycling

8.1 Quantities

Consideration was given to cataloguing every piece of timber etc. which has been recycled but this seems to be an exercise in playing with figures rather than getting to grips with the problem of 'where should the effort go and what can be achieved?'. A decision was made at the start of the project that all materials would be stored i.e. no building skips would be used. Storing everything has the advantage that those interested in the project can see for themselves the volumes of materials; a further advantage is that the 'tabulating every piece of timber etc.' exercise can be done at a later date if it is found to be advantageous. The photographic record (Appendix D) gives some idea of the considerable volume of materials recovered.

8.2 Deconstruction costs

	hours
Gutting the building including the removal and storage of all fixtures and fittings, skirting boards & picture rails, plasterboard ceilings and wall plaster.	180
Masonry deconstruction including cleaning 9000 bricks.	400
Deconstruction and denailing and storage of all timber including floors, partitions, stairs, doors etc.	450
Other deconstruction including reinforced concrete floors, structural steelwork and siteworks.	250
Total man hours	1280

Thus the recycling of No. 42, which included deconstruction, cleaning the construction materials and storing them, took approximately 1280 man hours.

The value of recovered timber is estimated at £2400, and that of cleaned bricks is estimated at £2000. There is a shortage of tradesmen in the millennium year, the news tells us that English tradesmen are currently working in Dublin for £200/day i.e. £25/hour. In the following, tradesmen's rates are taken as £20/hour, and apprentice's rates at £8/hour. Cost accuracy is not possible in the construction industry, which one year may be booming and in the following year may be in deep recession.

Cost of deconstruction based on £20/hour tradesman's rate:

Labour 1280 hours @£20/hour.	25600
Equipment hire/purchase including disconnection of public utilities.	3000
	28600
Less saving on recycled materials	-4400
Total cost for the deconstruction	£24200

Cost of deconstruction based on £8/hour apprentice's rate:

Labour 1280 hours @£8/hour.	10240
Equipment hire/purchase including disconnection of public utilities.	3000
	13240
Less saving on recycled materials	-4400
Total cost for the deconstruction	£8840

The gross floor area of No. 42 is 200m² therefore the average unit deconstruction cost = (24200+8840)/2/200, say £80/m² approximately.

Before deconstruction commenced, an estimate of £30000 was given by a colleague experienced in demolition costs for a detached house of similar description and floor area to No. 42.

At the millennium, Tony Williamson of Williamson Doogan in Weybridge (who are involved in new housing schemes) say new house building costs in Surrey (excluding land) vary from £500/m² for basic housing to £1000/m² for luxury housing (marble floors etc.), with £750/m² as an average.

Comparing the above average costs it can be seen that the unit deconstruction to new build cost ratio is 80/750, i.e. the deconstruction cost is of the order of 10% of the new build cost.

8.3 Regional variations

The location of housing has a major impact on the selling price, a nice five bedroom detached house on a half acre plot will cost in the order of £1,000,000 in parts of Surrey, whereas a similar house in the north may only cost one tenth i.e. £100,000. This regional variation has an enormous influence on the choice between Deconstruction and Demolition. Six months interest on £1 million costs £35,000 at 7% per annum, so site developers in the South are likely to opt for demolition of an old house in say six weeks rather than deconstruction in say six months. It is clear that all effort to persuade builders of the environmental and training advantages of Recycling Housing should be concentrated in those areas where there are housing stock reduction programmes.

8.4 Trade cost ratios

House building costs vary considerably with location and the state of the economy. For this reason, rather than quote costs, typical percentages are given for the various trades for the construction of a traditionally built modern four bedroom detached house. The ratios have been extracted from a 1998 Times housing supplement and must be considered as a guide only as they are affected by: time, quality of the housing, and location.

	Labour % of of total cost	Materials % of of total cost
Roofing	0.36	1.92
Masonry	6.36*	8.29
Carpentry and joinery	3.39*	9.55
Plastering	3.70	1.12
Electrical	0.63	1.06
Plumbing	1.17	2.91
Foundations	2.61	3.31
Siteworks	2.66	3.25
Painting	1.13	0.72
Other items	4.44	4.44
	26.45%	36.57
Plot of land		36.98
		73.55%

The plot of land has been separated from the other ratios as it varies far more widely than the trade cost ratios. In remote areas, the plot of land may account for 5% of the total cost of housing, whereas in central London it may account for 95% of the total cost of the housing; thus accuracy is not possible in a general study of housing costs. No. 42 as built in 1935 contained a significant amount of structural steelwork which was increased when the new conservatory was built in 1986; it will be noted that there is no trade cost ratio for steelwork, presumably because steel lintels and the like were included with the 'Other items'.

As can be seen from the above Trade Cost Ratios, timber is the most expensive material in housing, with masonry coming a close second. The combined labour and material cost of both materials account for: $(6.36+8.29+3.39+9.55)*100/(26.45+36.57) = 2759/63.02 = 44\%$, that is nearly half of the total building cost.

Obviously it is a great deal more difficult to remove a nail from a piece of timber than it is to drive it into a piece of timber. Experience on No. 42 was that the time taken to remove a nail is several times that of driving the nail. New timber has to be cut to size, whereas deconstructed timber only has to be recovered, denailed and stored. The experience on No. 42 was that the time to deconstruct timber would be similar to the time to install the timber when costed at normal labour rates.

Some brick walls can be pushed over and clean bricks collected up, but this is the exception. To lay a brick, the bricklayer puts mortar on the bed, picks up the brick and puts mortar on one end of the brick and places the brick and pushes it into place next to his line. Allowing for the setting out of the brickwork the time to lay each brick is in the order of 2 minutes. To recycle a brick, the plaster or render must be removed from one or two sides of the brick, the brick must be recovered from the wall by hammer and cold chisel, then each of the six (or less if the brick is from an external cavity wall and render is not applied) brick faces must be cleaned chipping away the mortar and render or plaster adhering to the faces. Of course 'there are bricks and there are bricks'. Experience on No. 42 was that it is a totally heartbreaking job trying to recover modern bricks laid in cement:sand:plasticiser mortar, especially the modern bricks with holes through from one side to the other rather than frogs. It is easy to spend ten minutes cleaning up one modern brick only to find that, just as you are cleaning up the last face, the brick breaks in two due to the cumulative effect of ten minutes 'bashing'. Difficult to clean bricks should be recycled as hardcore, or as aggregate as described in the next section. For bricks which can be cleaned, the experience on No. 42 was that the time to deconstruct and clean bricks would be similar to the time to lay the bricks when costed at normal labour rates. Therefore it is suggested that the starred labour cost ratios in the previous table be applicable to both new construction and deconstruction - until more deconstruction is completed to give a broader picture.

8.5 Recycled bricks

Although 90% of the timber from No. 42 was deconstructed, denailed, stored and will be recycling into new construction, recycled bricks are not so popular because:

- being of Imperial size rather than the current metric size, they cannot be mixed with modern brickwork
- modern housing thermal requirements of the building regulations greatly favour aircrete blockwork.

In recycling schemes generally it is possible that any excess bricks could be recycled by selling them; surplus bricks which were recycled from No. 42 were advertised on the BRE Materials Information Exchange, unfortunately no one expressed any interest.

It is easy to break bricks with a sledge hammer to produce aggregate. For concrete, Orchard [1958] states that: "Broken brick should be clean, hard, well-burnt and free from mortar and should preferably not contain more than one half per cent of soluble sulphates. It produces a concrete having good fire-resisting properties but on account of its porous nature should not be used for reinforced concrete which is exposed to the atmosphere or otherwise liable to become damp as corrosion of the reinforcement may result. It should be well wetted before use to prevent it absorbing water from the mix. For this reason it is difficult to exercise close control over the quality of the concrete when using broken brick as an aggregate."

No. 42 was built from sand-lime bricks, known by structural engineers as calcium-silicate bricks, and known by bricklayers as 'whites'. To avoid the alkali-silica reaction problem, limits must be placed on the amount of free sodium and potassium in the aggregate; it is not considered a practical proposition to make reinforced concrete from broken calcium-silicate bricks as site control would be too difficult in a recycling project. The recycled bricks could be used as formers in the same way as 'hollow pots'; the recycling of the bricks in this way has three advantages:

- it saves on new concrete
- the bricks allow easy access through the floor for the provision of services
- it makes deconstruction of the floor more easy than if it had been constructed from solid reinforced concrete.

The Trade Cost Ratios for materials given at the start of this section are repeated below together with the percentages of the materials recycled at No. 42 and that percentage applied to each cost ratio.

	Materials	Expected	savings
Roofing	1.92	10%	0.19
Masonry	8.29	70%	5.80
Carpentry and joinery	9.55	90%	8.60
Plastering	1.12	0%	0.00
Electrical	1.06	5%	0.05
Plumbing	2.91	5%	0.15
Foundations	3.31	5%	0.16
Siteworks	3.25	20%	0.65
Painting	0.72	0%	0.00
Other items	4.44	10%	0.44
	36.57		16.04
Plot of land	36.98	100%	36.98

Expected savings in material costs (excluding land) = 100*16.04/36.57 = 44% for No. 42, (coincidentally the same percentage as the sum of the timber and masonry labour and material costs), but other factors have a bearing for example

- labour rates include overheads for purchasing, expediting etc. which will not be incurred if materials are recycled
- recycled materials require more labour to make them fit the purpose
- economies can be made when the volume of materials increases
- ramps for the disabled have now been incorporated into building regulations; recycled render could be mixed with fresh concrete and used to form the inside of such ramps. thus increasing the material recycled.

8.6 Social costs

The statistical information below was provided by Peter Minchin (telephone 0207 271 3104) of the Youth Justice Board, and was correct at the end of February 2001.

The term Borstal has been replaced by 'secure facility', there are 2800 young offenders in secure facilities in England and Wales, 200 of which are female. The financial cost of keeping one young offender in a secure facility is £420/day. The social cost, which includes the loss of the offender to usefully contribute to society, the wear and tear on the members of the offender's family and friends, the loss to society of uncosted time that the carers and all those in youth justice have to spend on the offender, are excluded from the financial cost. (The cost of £420/day is slightly more than that for keeping an adult in prison.) The cost for keeping one young offender in a secure facility is 420 x 365 ≈ £153,000/year. The cost of keeping 2600 young offending males in secure facilities is 2600 x 153,000 ≈ £400,000,000/year for England and Wales.

Coincidentally both the writer's father and his father-in-law left school in 1912 at the age of 14. The writer's father immediately started work in John Brown's shipyard on the Clyde, his father-in-law immediately started work in Henderson Engineering in Aberdeen - a supplier to the ship building industry. Neither had the luxury of choosing a career, they took the only work that was available. Their education did not end at the age of 14, for every day they learnt on the job, and both had successful careers in engineering, although the writer's father used to joke 'I was educated at night school and can't think during the daytime'.

Most Formula 1 drivers who are challenging Michael Schumacher, started their racing careers well below the school leaving age of 16 (racing has been picked as it shares with construction the chance of physical risk). The policy of keeping young offenders who have set their mind against sitting in a school classroom past the age of 14, is wrong. The teachers do not want it, the youths do not want it. If the youths had 'a voice' they could take their case to the European court for violation of their Human Rights. Young offenders must be given the chance of starting in the construction industry at the age of 14, for their sake and the sake of society which every year finds it increasingly more difficult to find a skilled worker for the reasons given in Section 4.1.

This government is happy to recognise 'Stage schools' and is now actively promoting the return of 'Technical schools'; young offenders should be given the chance of attending 'Site schools' from the age of 14. There is no point in the writer playing with figures, the cost of £153,000/year/young offender, proves that there are sufficient public resources to fund the placing of apprentices on construction sites, especially those involved in the deconstruction of housing for the reasons given in Section 4.1 paras 6 - 10.

Chapter 9

Discussion

9.1 Factor numbers

Weizsäcker et al. [1997], as reported in Chapter 2, argue that resource productivity can - and should - grow fourfold, i.e. the amount of wealth extracted from one unit of natural resources can quadruple, they call this quadrupling 'Factor Four' and set it as target. The simple concept of a Factor Number can be used to provide a rough and ready measure for resource productivity; if a building is built entirely from recycled materials which have been used just once before, then we can say that it is a 'Factor Two' building.

The building at No. 42, which was recycled in this research, was more typical of a failed building than the British Columbia building [Weizsäcker et al., 1997] reported in Chapter 2. The materials were probably of average quality when No. 42 was built, but had deteriorated over the 65 years of the building's life to below average quality, nevertheless over 90% of the timber will be recycled as formwork to support an in-situ concrete slab, then left in to support a plasterboard ceiling. The original use and the two new uses will give 'Factor Three' [Weizsäcker et al., 1997] for the timber. None of the masonry was sent to tip; 9000 bricks were cleaned up and advertised on the Materials Information Exchange [DETR, 2000] for recycling, the remainder of the bricks and the mortar between were retained on site for use as hardcore beneath a new patio, thereby achieving Factor Two for the bricks. The factor approach [Weizsäcker et al., 1997] provides a simple yardstick for measuring sustainability in construction at any point in time.

9.2 DETR questions

The current research has provided the following answers to Questions 8, 10 & 13 posed by the DETR's consultation paper on Sustainable Development [DETR, 1998]. For convenience the questions are repeated here then followed by answers which have come from this research into the recycling of housing.

Q8 Why is the construction industry not doing more off its own volition? What is required on their part and that of Government to ensure that sustainable development in the commercial sector becomes a higher priority for the industry, its stakeholders and customers?

A8 The construction industry is not doing more off its own volition as the cost of recycling construction materials, using normal labour rates, exceeds the cost of buying new construction materials; furthermore recycled construction materials may not comply with current building regulations, some examples: recycled timber will not have been treated for the effects of woodworm and wood rot; 11″ external cavity brick walls do not comply with the thermal requirements of the Building regulations; recycled bricks are likely to have been manufactured to Imperial dimensions and therefore cannot be mixed with metric bricks. The key to commercial recycling is a plentiful supply of usable materials which have been sorted. Eighty cubic metres of masonry from the demolition of a house (40m of perimeter walls x 6m high x 0.3 thick) is of little use commercially, but 80,000 cubic metres from the deconstruction of 1000 houses would find a market. To stockpile 80,0000 cubic metres requires land, farmers have land for which they are now seeking new uses; farmers are natural scrimpers (make do and menders) which is the right attitude for recycling. The Government should act in an enabling role to encourage recycling by:

- on-site training of tens of thousands of youths for the reasons given and using the methods described in Chapters 4, 6 & 7 of this thesis

- banning the on-site burning of timber and specifying that all timber which is the result of demolition be reused or taken to a recycling centre - each timber recycling centre to be run by a licensed person
- licensing suitable named individuals for the recycling of timber for a period of 20 years
- fixing a zero business rate and zero VAT for all recycling
- classifying the sorting and storage of recycled masonry as a farming crop (which requires no chemicals)
- licensing suitable farmers for the recycling of masonry for a period of 20 years.

Q10 How can bodies such as the Government Construction Client Panel (GCCP), the Construction Industry Board (CIB), the Construction Client Forum (CCF), the Construction Industry Training Board (CITB), other Industrial Training Organisations (ITOS), academia and others assist? How can your organisation assist and what are the benefits?

A10 The Construction Industry Training Board can assist by overseeing the training proposed and by issuing a 'Certificate of Completion of Practical training in the Construction Industry' to each youth who completes a course. 'New Deal' and other funding is essential to feed the youths during their training period.

Q13 How can we develop new materials, products and construction techniques which use fewer resources, have lower environmental impacts (judged over the life cycle of buildings and structures, including demolition and disposal)? How can we measure where we are today and the subsequent improvements?

A13 The deconstruction techniques developed in this research are new, use fewer resources and have lower environmental impacts. This thesis describes how and why the new deconstruction techniques were developed. The factor approach [Weizsäcker et al., 1997] provides a simple yardstick for measuring the success of any recycling process.

9.3 Sheds

Timber floor boards and joists, doors, door frames and stud partitions, will find a market for reuse as shuttering for reinforced concrete. Bricks recovered from housing built before the introduction of metric brick sizes do not have a ready market. Lord Scarman gave us the term 'positive discrimination'; a proposed new class of 'shed building' needs positive discrimination in favour of recycled building materials. Planning permission should only be granted on the condition that at least 80% of recycled building materials be used, as an enabling device to advance the 'sustainability in construction' issue.

Sheds are common in Australia and America, but rare in UK southern suburbs as they do not usually comply with the high standards set by the Building Regulations for domestic housing. Any society needs good quality spacious housing for living in, and also needs spacious sheds for:

- tinkering with motor bikes etc.
- chilling out
- kids to play in when it is too cold to go outside
- playgroup in the summer
- deep freezers
- bicycles
- family junk kept for sentimental reasons.

Planning and building regulations need to recognise sheds as a separate class of building. Sheds do not need gentrification, they need space. The author proposes that sheds be permitted by all planning departments if they conform to the following:

- walls of 100mm brick or block which must have been recycled
- maximum floor area per shed of $20m^2$
- maximum wall height of 2.1m (1.8m to underside of joists)
- flat roof of felt on recycled timber

- walls unplastered
- floors may be soil, blinded hardcore, recycled bricks etc.
- any shed wall must be a minimum of 3m away from any boundary fence
- no noise must be made between 10pm and 6am (with a standard fine for infringement).

9.4 Waivers

The building regulations have been in force since the beginning of the century, as time passes they are amended to improve the performance of buildings. Those who administer the building regulations in each authority have the power to waive any particular regulation depending on the special circumstances obtaining at the site; the regulations are sometimes 'waived' for buildings with big areas of glass. More precisely, a valid method under the Building regulations is to show by detailed calculations that the annual solar gain exceeds the annual heat loss (i.e. a net energy gain from the wall). Although there may be some inward transmission of heat in a masonry wall, this is usually small when compared with the heat loss.

For external walls, if sufficient cavity insulation were used in combination with recycled bricks (e.g. using an insulated cavity of 200mm thickness), no waiver to the thermal regulations would be needed. Such a wide cavity, or the use of externally applied thermal insulation, are unlikely to be popular with the house building industry which prefers to keep to traditional methods, so a waiver to the thermal requirements of the building regulations could be permitted to allow external walls to be traditional 11" cavity construction provided that the walls were constructed from recycled bricks, thereby using a waiver as an enabling device to advance the 'sustainability in construction' issue.

9.5 Young offenders

The involvement of young offenders in Recycling Housing (Section 8.6) needs to be organised differently to that for unemployed youths. Peter Minchin of the Youth Justice Board advises against grandiose schemes when considering the employment of young offenders. If a prototype Site School was limited to a maximum of two young offenders on a site which had a minimum of eight adults, then the adults would have sufficient numbers to afford them collective security, and thereby some of the adults may feel relaxed enough to be able to act as role models. The world of adults is different to that of youths, the meeting point has to be the workplace. If a copy of the Deconstruction Illustrations (Appendix B and accompanying CD) was given to each of the adults and the young offenders and they helped each other with reading the words as a buddy activity while they were both working, then safety could be the incentive for learning to read. As stated in section 4.2 "Handing a list of safety procedures to an employee who cannot read would not satisfy an employer's duty under the law".

The writer's experience of site work is that past offences would probably be treated in a light hearted manner with comments such as "Now you are not going to burgle anyone tonight, because if you do you will let our site down". The site becomes the team, and perhaps even more; although site conditions can never be as bad as the trenches, there is a shared adversity when things go wrong or the weather is atrocious, this shared adversity engenders camaraderie.

Young offenders especially need incentives to bind them into the construction industry family, and the adults who act as their role models need incentives to become involved. It is suggested that the proceeds from the sale of recycled timber and bricks etc. should be kept by the youths and their role models, and that the youths should be involved in all aspects of the selling process including painting the 'Building materials for sale' board no matter how long it takes them. And whether the painting is good or bad encouragement must be given. If Bob has painted the board, then the board must be known as Bob's board, and when someone turns up looking for timber, then someone should comment "Bob's board has done well again". It is about inclusiveness, needing to be valued, needing to be part of a family. This is a 'Del Boy' culture not a classroom culture; political/financial correctness will kill Site School for young offenders. Historians argue about the authenticity of Nelson actually putting his telescope to his blind eye, but what a great metaphor for the thinking that is required to help these youths. Old soldiers who 'went over the top' say they went because they could not let their mates down.

Meridian TV reported on 23.4.01 that Sussex County Council is offering £30 reduction in the Council Tax bill to any families with a baby, which switches from disposable nappies to reusable ones; the argument being that £30/year is the annual saving on the collection and disposal of disposable nappies. This positive financial discrimination is suggested for sites who take on Young Offenders, including the person directly responsible for the site, perhaps by waiving the National Insurance Contribution, or increasing the Personal Allowance. It is also proposed that the State should be responsible for personal accident insurance for the young offenders while on the site just as the State would be were the young offenders in a Secure Facility.

Chapter 10

Conclusions, recommendations and the future

For some years the writer has prayed for the wisdom to give employment to those youths who formerly would have found jobs in factories and heavy industry, but due to changes in the workplace are now roaming the streets: sometimes bored, sometimes suicidal, sometimes anti-social. This research - which is aimed at binding those youths into the construction industry, pulls together:

- lean thinking
- conservation of construction materials and fossil fuels
- conservation of plant and equipment and roads
- saving the rainforests
- sustainability in construction
- practical on-site hands-on training for youths
- use of retired construction workers as role models
- illustrated tips and techniques for those with reading difficulties.

This research shows that one person - with occasional help - can safely recycle housing i.e. deconstruct, recover, clean and store all materials. Neither plant nor building skips were used; the recycling of a two storey block of three flats was achieved using hand and small power tools only. The lessons learnt and techniques developed are given in the thesis as a reference for others embarking on a similar recycling exercise.

Some youths at whom Recycling Housing is aimed, may have reading difficulties; for these in particular, a set of illustrations - covering health, safety, and techniques in the use of hand tools - was developed (Appendix B). The illustrations are designed 'to entertain, educate and inform' (borrowed from the BBC's Charter); to educate in the sense that the size and selection of the larger words were chosen to teach a basic vocabulary linked to the workplace, thereby making the acquiring of reading skills, relevant to the youths.

As the recycling was completed by one person using only hand tools, it follows that the forms of waste - identified by Ohno [1988] as listed in Chapter 2 - have been minimised. The avoidance of the use of plant, and the recovery of materials for recycling, prove that the sustainability challenges reviewed in Chapter 2 have been applied to this research.

The writer hopes that the recycling work described in these pages will give employment to youths, and in addition he hopes that the recycling of housing - which has failed - will become a part of the 'sustainability in construction' movement, a subject which is of key importance to the Built Environment.

10.1 Farmers

It is recommended that farmers be given the opportunity of considering the storage and selling of recycled construction materials as a profitable use for 'set aside', or as a new type of crop which requires no chemicals.

10.2 Lean thinking construction

It is recommended that the systems and techniques developed and lessons learnt in the deconstruction of housing should be applied to further research entitled 'Lean thinking construction'. This further research should continue with the aim of on-site training of unemployed youths in the construction of new high-specification housing using at least 50% of recycled building materials.

10.3 Construction Industry Training

This research leads to the recommendation that housing which has failed should be deconstructed - and the materials stored - as part of construction industry training programmes. If the deconstruction cost for the housing is funded from the construction industry training and/or New Deal funds then Recycling Housing becomes financially attractive, and in consequence will have a major role to play in the 'sustainability in construction' movement.

Experience on No. 42 leads to the following recommendations on the choice of housing for deconstruction as part of a construction training programme. The brickwork should be set in cement:sand:lime mortar of strengths used before the last war. The external walls should be unrendered and the internal walls should be plastered with cement:sand:lime mortar and not with a modern high strength high bond render coat and finish plaster. Floors should be floorboards on timber joists rather than the modern chipboard or ply flooring.

Appendix C gives an overview of the legal obligations on a construction industry employer; construction industry training boards know about training and should be involved in any pilot project. It is recommended that Nottingham University act as a forum for the bringing together of:

- construction industry training boards
- New Deal
- a Local Authority or
- the residuary body for coal mines or
- a Youth Offending Team

for a pilot project using youths. To assist with the training on the pilot project, it is recommended that the set of illustrations given in Appendix B be expanded to say two hundred illustrations, and published as a book. The metaphor 'Sustainability in construction cake' is suggested for this project.

The ingredients

- 200,000 empty houses
- 50,000 jobless young people
- farmers looking for a use for set-aside or unused barns
- empty factories which would be suitable for the storage of recycled timber
- retired tradesmen (usually when their knees have gone)
- cheap tools and cheap vans
- illustrations of 'best practice' in recycling skills from this study
- money from New Deal and construction industry training funds.

Measuring out the ingredients

- take fifteen empty houses
- take ten jobless youths (for young offenders see Section 10.9)
- take one van
- take a wheelbarrow load of hand tools
- take one retired tradesman.

Mixing the ingredients

- go through the illustrations with the retired tradesman, set him up in one house with phone, first aid kit, cold tap, WC and temporary electricity supply of two 13 amp sockets from which trailing leads may be run to the other houses on the few occasions when power tools are necessary disconnect electricity and other services from the other houses
- start the young persons (two per house) removing fixtures and fittings, electrical switches and sockets, then plaster and plasterboard; then doors, door linings, skirtings and picture rails; then roofs and walls all in accordance with illustrations of 'best practice' given in Appendix B
- pay participants from New Deal and construction industry training funds.

Baking time for the cake

Allow:

- three weeks for gutting one house including the removal and storage of all fixtures and fittings, skirting boards & picture rails, plasterboard ceilings and wall plaster

- two weeks for the deconstruction of the roof
- five weeks for masonry deconstruction for one house including the cleaning of bricks
- six weeks for deconstruction and denailing and storage of all timber in one house including floors, partitions, stairs, doors etc.
- two weeks for other deconstruction for the house.

Repeat the above for the other fourteen houses.

The finished cake

A large supply of stored materials for sale, or for giving away for recycling within the area. A young workforce with general experience of the construction industry.

Improvements to the recipe

Recycling housing, as with any system, needs to be maintained. The experiences learnt must be edited, and added to the lessons learnt from the current study so that the body of knowledge may be increased and circulated to those interested.

10.4 Changes to brick shapes

So that brickwork may be deconstructed and the bricks reused at the end of the life of the wall, and because it is possible that modern extruded bricks are more difficult to clean for reuse than traditional bricks with or without frogs, it is suggested that one square metre of external wall be constructed from new bricks obtained from each of the major manufacturers, for comparison with traditionally made bricks. Each sample wall should be tested for lateral strength, and ease of deconstruction and ease of cleaning the bricks for reuse. A classification number could be proposed so that Building Regulations may discriminate in favour of bricks shapes that are easily recovered and reused at the end the life of the wall.

Although some recycled bricks are used in 'fair faced' work for aesthetic reasons, it is likely that most recycled bricks will not be suitable for such use, and in consequence external walls made from recycled bricks will be rendered. Research is proposed to see if modern renders which generally use a plasticiser in place of lime, are as good as traditional cement:lime:sand mixes, both for adherence and deconstruction.

10.5 Concrete made from recycled aggregates

The Government's recent consultation paper on sustainable development has involved consultation with different parts of British Industry. The Government proposes to introduce a tax on aggregate extraction and increase the tax on landfill, with a view to encouraging more recycling; aggregate producers say that they are recycling as much aggregate as is possible and available, and therefore the new taxes are unfair. There is considerable scope for using recycled aggregates in the concrete floors between flats (for which mass is required for airborne and impact sound suppression).

The writer recalls that his first reinforced concrete designs (based on CP114 1957) specified a 1:2:4 concrete having a cube strength of 3000psi (20 N/mm^2). Typical UK cube strengths used at the millennium are 30-40 N/mm^2 at 28 days, and BS8110 specifies a minimum strength of 25 N/mm^2 for normal weight concrete. A typical strength used at the millennium for masonry formed from clay bricks set in mortar designation 3 to BS5628 is 5 N/mm^2. Reinforced concrete having a characteristic strength of say 10 N/mm^2 would have general use internally in a large number of buildings, especially housing where weight is essential for sound requirements. A 10 N/mm^2 concrete would be much easier to demolish than the high strength concretes currently used, furthermore the reinforcing bars in such concrete could be recovered and recycled.

For houses constructed from clay bricks, there would be considerable savings in the volume of new concrete, by smashing broken and chipped bricks for use as aggregate with concrete mixed on site. A concrete cube strength of 10 N/mm^2 will be adequate for concrete used internally and this strength should be easily achievable using crushed brick aggregate. Before bricks or other bulk materials may be recycled as aggregates, the usage of any bulk material as an aggregate for reinforced concrete must be proved by making and testing cubes for their seven and twenty-eight day cube strengths and testing the concrete for durability. After crushing, half of the remains of the cubes should be left outside to investigate the long term effects of weather on the concrete, and the other half stored inside to see if there is any deterioration due to chemical action within the mix. If concrete made using smashed clay bricks proves to be a success, it is recommended that further research be undertaken for concrete using aggregates made from:

- other types of brick
- ceramic tiles with and without attached tile cement
- external and internal render
- mortars made using lime or admixtures
- plaster and plasterboard
- typical non-combustible rubble made from mixtures of the above.

The research would need to investigate the durability of the concrete for:

- induced freeze:thaw cycles on unreinforced concrete
- with non coated reinforcement
- with galvanised reinforcement
- with stainless steel reinforcement
- with various man made fibres
- with silicone and other coatings to the above, possibly soaking in monomer and polymerising with ultra violet light as used in the USA for improving the durability of bridges
- city centre exposure of the above
- to recommend exposure limitations e.g. internal use only, for input to the forthcoming review of the Building Regulations to take into account sustainability issues.

10.6 Reinforced concrete design for recycling

The Government's recent consultation paper on sustainable development was intended to promote discussion by those involved in the construction industry. The construction industry currently uses high-bond bent reinforcing bars in high strength concrete; the recycling of which is extremely difficult using hand tools. It is recommended that research entitled "The practicability of designing and building reinforced concrete beams, slabs, columns, foundations and other structural elements, which may be deconstructed by hand methods and recycled in their entirety" be undertaken in response to the Government's initiative.

For sustainability, objectives for the study should be:

- the reinforcement should be recoverable by normal hammer and cold chisel methods
- the reinforcement should be straight so that it can be reused in new construction - where necessary lapping short bars to make long lengths.

The satisfaction of the first objective given above implies:

- the concrete should have a strength no greater than that of masonry i.e. 5-10 N/mm^2
- the reinforcing bars should be debonded by some sort of coating so that they can be recovered cleanly when the concrete is broken open (this implies that the longitudinal bond requirements must be met by mechanical action rather than by friction e.g. the deformed profile of the reinforcing bars may have concentric rings or pimples to prevent the bar from pulling through).

The satisfaction of the second objective i.e. straight bars only, requires a rethink on just what can be designed e.g.

- beams limited to 'straight bars only' will look like lintels or masonry beams having just tension steel in the bottom with the shear strength of the beams controlled by concrete strength and the amount of steel provided

- slabs generally contain only straight bars and a limitation of stress in the order of 5-10 N/mm^2 would not be a problem
- columns with only vertical bars are common in the USA (see ACI 530-95 /ASCE 5-95/TMS 402-95 & ACI 530.1-95/ASCE 6-95/TMS 602-95)
- foundations can always be designed as mass concrete 'pads' making allowance for jacking in areas where subsidence is known, and 'tanking' in soils containing high levels of sulphates.

The scope of the above is wide, as a first step towards sustainable reinforced concrete, it is proposed that the study looks at simply supported slabs with reinforcing bars having mechanical bond but zero friction bond. The slabs would be tested to destruction and then broken open to recover the reinforcement, put in a vice and straightened where necessary before the reinforcement was recycled.

10.7 Timber for recycling

In the present study, nearly all of the timber has been recycled for use as formwork to support new concrete floors. Each piece of timber was inspected and unsound timber was burnt. Timber recycled as formwork was treated with preservative to protect against the effects of woodworm and wood rot.

The structural use of timber requires that timber be stress graded, see Table 7 of BS5268. It is therefore recommended that research be undertaken to provide an on-site method for the stress grading of recovered timber, such that the timber may be recycled as timber complying with current British Standards and Building regulations. The method needs to be simple and conservative, so that it can be applied on-site, and cover:

- inspection for the presence of wood rot and wood boring insects
- criteria for acceptance of the timber for designed structural members
- use as formwork above ground
- use as formwork below ground
- recommended timber preservatives for each of the above usages

- strength classification.

On the subject of strength classification, it is known that the strength of timber generally increases with an increase in the modulus of elasticity of the timber. The modulus of elasticity of the timber can be assessed from the deflection due to bending of the timber under a known loading regime. For the on-site strength classification of recycled timber it is proposed that:

- a ten stone man be used as a point load (he can always hold a few bricks to make up his weight) on a piece of timber spanning between two bricks placed on a floor at a fixed distance for the size of timber being tested
- to avoid stability problems each piece of representative timber to be tested should be loaded so that the timber bends about its weak axis
- the central deflection caused by the standard man should be measured and from a chart corresponding to the timber size, the strength class to be used in the design will be read directly.

10.8 Programme for future research

Postgraduate research is recommended covering the three main house building materials: masonry, concrete and timber. Suggested subject titles and aims follow.

Bricks shapes for deconstruction

Aim: to find the best brick shape and mix for mortar and render for: strength, ease of construction and deconstruction. It is suggested that this research be carried out in conjunction with the Brickwork Development Association. Section 10.4 gives notes including the suggestion to compare the ease of deconstruction of walls built with traditional bricks with frogs, with modern extruded bricks.

Concrete made from recycled aggregates

Aim: to assess the practicability of using recycled material from the demolition industry to make reinforced concrete suitable for internal use e.g. in floor slabs where a cube strength of 10 N/mm^2 would be adequate. It is suggested that this research be carried out in conjunction with the British Cement Association. Section 10.5 gives notes including the suggestion to look at the problem of durability.

Reinforced concrete design for recycling

Aim: to assess the practicability of recovering reinforcement for reuse as reinforcement. It is suggested that this research be carried out in conjunction with the British Cement Association. Section 10.6 gives notes including suggestions for research to find the best deformation pattern for the reinforcement for ease of recovery of the bars, and a study to see just how much reinforced concrete can be designed using straight bars only.

Grading and usage of recycled timber

Aim: to assess the practicability of using recycled timber in new construction. It is suggested that this research be carried out in conjunction with the Timber Research And Development Association. Section 10.7 gives notes including a suggestion for simple on-site stress grading.

10.9 Programme for young offenders

Young offenders (see Sections 8.6 and 9.5) are a special case and should be treated differently to that of unemployed male youths. Following a discussion with Peter Minchin of the Youth Justice Board, it is recommended that Youth Offending Teams of Local Authorities be approached with the aim of establishing a prototype 'Site School' at a suitable deconstruction of housing or other construction site, so that the Courts may be given the opportunity of offering Site School to Young Offenders from the age of 14 (or younger in exceptional circumstances) as an alternative to a custodial sentence. Section 9.5 proposes that two young offenders should be offered Site School, and that positive financial discrimination should be offered as an inducement for a contractor to become involved, and that the State should be responsible for personal accident insurance for the youth while on the site just as the State would be were the youth in a Secure Facility.

No system is perfect, but it is inconceivable that the proposed system will fail to give Young Offenders a greater stake in society than the present system of incarcerating them in a Secure Facility; and it is inconceivable that the proposed system will cost the taxpayer more than the present cost of £153,000/offender/year.

Chapter 11

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Appendix A

Correspondence

Appendix A contains copies of correspondence. Only covering letters are included, the accompanying information was several hundred pages long, and has been omitted for reasons of space.

DETR
ENVIRONMENT
TRANSPORT
REGIONS

CATHY JENKINS
DEPUTY BUSINESS MANAGER
SUSTAINABLE CONSTRUCTION TEAM
CONSTRUCTION INNOVATION AND RESEARCH

DEPARTMENT OF THE ENVIRONMENT
TRANSPORT AND THE REGIONS

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FAX: 0171 - 890 - 5759
GTN CODE: 3533 5717
EMAIL: CJENKINS@DETR-CIRM.DEMON.CO.UK

10 FEBRUARY 1999

Mr D W Brown
Beaverlake
Crow Hill
RINGWOOD
Hants
BH24 3DE

Dear Mr Brown

SUSTAINABLE CONSTRUCTION

Thank you for your letter of 27 January pointing to some of the benefits of 'recycling housing'. The work you are involved with sounds valuable and interesting and I am grateful to you for bringing it to our attention.

Our Opportunities for Change consultation paper raised a number of questions relating to recycling and reuse. I also enclose a copy of the executive summary taken from the analysis report of some 260 responses we received during the consultation period (we received nearer 300 in all). The full analysis report is available on the construction pages of the DETR website at http://www.detr.gov.uk. The consultation was very well received and showed a widespread desire for change. The responses - and letters such as yours - have provided us with a huge pool of ideas from which to draw in developing a sustainable construction strategy. We are now working closely with the industry to develop a strategy which the industry can deliver against indicators of progress.

You may like to see the enclosed copy of the recently published annual report of the Construction Innovation and Research Programme which explains how the Department is supporting research and projects under a number of business plans. Further information is available on the website where you can browse through the business plans themselves (and see that reducing the use of primary resources and increasing reuse and recycling is a key theme for the sustainable construction business plan) and also a compendium of projects summarising work in hand and recently completed. You may find some of this data helpful in your continuing research. You may also find the Materials Information Exchange useful - and I enclose a leaflet explaining this scheme for information.

Yours sincerely

Cathy Jenkins

DETR
ENVIRONMENT
TRANSPORT
REGIONS

DEPARTMENT OF THE ENVIRONMENT,
TRANSPORT AND THE REGIONS

ELAND HOUSE
BRESSENDEN PLACE
LONDON SW1E 5DU

TEL: 0171 890 3011
FAX: 0171 890 4399

OUR REF: PT/PSO/2693/99

Douglas W Brown Esq
Beaverlake
Crow Hill
Ringwood
Hants
BH24 3DE

- 1 MAR 1999

Dear Mr Brown

The Deputy Prime Minister has asked me to thank you for your letter of 4 February inviting him to visit your initiative to recycle a two storey block of three flats about which you have written a detailed research report.

I am afraid that the Deputy Prime Minister is unable to accept your kind invitation due to existing diary commitments. The construction industry is going through an exciting time of great opportunity as it addresses the issue of sustainability and adapts to the challenge of "Rethinking Construction" issued by Sir John Egan's taskforce. Encouraging the construction industry to get involved in the issues of sustainability and competitiveness at individual, sectoral and industry-wide levels is vital if the construction industry is going to make real progress now and in the future. Demonstration projects such as yours are a very valuable contribution to that process

We are working with the construction industry on a strategy, which we hope to launch later in the year, to take forward the sustainable development agenda in this sector. Whilst I understand that officials here are already aware of the scope of your project, you may care in due course to let your contact Cathy Jenkins have a report of the outcome of your project with a view to using it as a possible case study in the strategy.

Yours Sincerely
Maria Langton

MARIA LANGTON
Private Secretary

The Diocese of Durham
THE BISHOP OF DURHAM
Auckland Castle Bishop Auckland Co Durham DL14 7NR

THE CHURCH OF ENGLAND

Mr Douglas Brown
Beaverlake
Crow Hill
Ringwood
Hants. BH24 3DE

13 April 1999

Dear Mr. Brown

I have now had the opportunity to look carefully at your dissertation on recycling housing. I found it absolutely fascinating. It is a visionary concept which is well worth pursuing.

You ask, how do you get started. I would have thought that a number of people with a variety of skills from the construction industry, management, finance and personnel, need to get together to discuss how such a venture could gain its initial funding and how it could be properly set up and managed. It seems to me to be the ideal kind of programme for people about your own age who are perhaps recently retired and want to bring something back into the community.

I am afraid that, at this distance, I cannot help you, even if I had the skills and the time, neither of which are available to me. It is precisely, perhaps, something that I will be keen to get involved in when, eventually, retirement comes.

I would encourage you very much to persist and to share your idea with many others.

With good wishes,

Yours sincerely

Michael Dunelm

Telephone 01388 602576 Fax 01388 605264 E-mail bishdur@btinternet.com

Legal & Administrative Services

Head of Legal & Administrative Services (City Solicitor):
Mark Webster LLB

Town Hall · Sheffield · S1 2HH
Tel: 0114 273 6641 · *Fax: 0114 273* 4429
Email:

Sheffield
City Council

Chief Executive's Directorate

CMU/PMC/CD

17 December 1999

Douglas W Brown
Beaverlake
Crow Hill
Ringwood
Hants
BH24 3DE

For the attention of D W Brown Chartered Engineer

Dear Sir

HOUSING DEMOLITION CONTRACT 2000/2001: REF NO 59

I welcome your expression of interest for the above contract and enclose an application form for you to complete.

Please note that the completed application form is to be returned by **Friday 14 January 2000** to the address shown on the front of the form.

The application form and supporting information requested will be used to assess your general eligibility, technical capability/suitability and financial standing.

Failure to return the application form, duly completed and with all supporting information will prevent the Council from making an assessment of your organisation's suitability for consideration for this contract.

If you require further clarification on this matter, please contact my Principal Contracts Officer, Paul McCormick.

Yours faithfully

City Solicitor

Enc

The Officer dealing with this enquiry is: Paul McCormick

pmc/HsgDemo59

Legal & Administrative Services

Head of Legal & Administrative Services (City Solicitor):
Mark Webster LLB

Town Hall · Sheffield · S1 2HH
Tel: 0114 273 6641 · Fax: 0114 273 4429
Email:

Sheffield
City Council

Chief Executive's Directorate

Your Ref:-

Our Ref:- CCC/PMC/CD

18 May 2000

D W Brown Chartered Engineer
Douglas W Brown
Beaverlake
Crow Hill
Ringwood
Hants
BH24 3DE

Dear Sir

Sheffield City Council
Housing Demolition Contract 2000/2001

Thank you for your application for inclusion on the list of tenderers for the above scheme.

Unfortunately, on this occasion, you have been unsuccessful and will not be included on the list of tenderers for this year.

The number and quality of the applications was exceptional and explains the time taken to determine the selectlist. I would hope that you will consider applying for this contract again next year.

Yours faithfully

City Solicitor

Paul McCormick

The Officer dealing with this enquiry is:

unsucchsg

Appendix B

Deconstruction illustrations

The health and safety tips, tools and techniques, and lessons learnt which are documented in chapter 6 are illustrated together with words, for the benefit of those who are not good readers. The set of illustrations contains innuendo and double entendre (the stuff of much humour). The writer is aware that innuendo and double entendre will not appeal to some readers, but hopes that the illustrations will appeal to the target audience (male youths engaged on recycling housing projects).

The writer has employed the services of Roger Penwill (professional cartoonist) for doing the illustrations. Other examples of Roger's work can be found on www.penwill.com. The ideas, captions, messages and picture descriptions are entirely the work of the author.

After scanning the illustrations, they were edited by the author using Paint Shop Pro 5 to add the captions and messages. The font chosen was True Type 'Comic Sans MS' as this looked more in keeping with the illustrations than more normal fonts such as Roman, Courier etc.

To save paper, two illustrations were tried on each page. It was found that the illustrations competed with each other for the eyes' attention and that the captions and messages became jumbled, especially when presented as portrait, where the caption beneath the top illustration could be mistakenly associated with the lower illustration; therefore only one illustration per page was chosen. The work of Glenn Doman in his kit of five graded vocabularies of 104 words and 28 phrases for teaching reading skills greatly influenced the final presentation. 'Less is more' borrowed from the architectural profession also had an influence in that the original idea to label tools such as 'hammer' and 'shovel' - as a means of teaching some words - was abandoned when it was found that the labels 'cluttered' the illustrations.

Forty one cartoons are given in this Appendix; it is suggested that the number be expanded to two hundred to make a full set for teaching purposes. It is hoped that even non readers will learn the words of every caption by association with the picture above and thereby learn approximately one hundred words. Glen Doman used two inch high text for non readers; the nearly half inch high text used for the captions was chosen as the largest that did not overwhelm the illustrations. It is hoped that the quarter inch high text used in the message, can be 'picked up' by those who already have some reading ability, and thereby learn approximately a further two hundred words.

The caption, message and description of each picture, which were provided by the writer as a specification for the cartoonist, now follow. They are given in the order in which the cartoons are presented; reference numbers are avoided as they spoil the cartoons.

Of course there are many other illustrations which would be useful for example: several covering the use of pliers; denailing long pieces of timber; cleaning up bricks - start by turn the bricks to get the best edge face down; how to hold a hammer etc. In all the illustrations best practice is shown.

Caption Don't breathe.

Message Avoid breathing dust; do another job until the air clears.

Picture Shows chap leaving very dusty room (with plasterboard ceiling partly removed and bits of the plasterboard hanging down) and going into an adjacent room to work at a bench (with a piece of timber with lots of nails sticking out held in a vice).

Caption Dusty break.

Message Avoid breathing dust; do dusty jobs before a tea break.

Picture Shows chap leaving very dusty room (with plasterboard ceiling partly removed and bits of the plasterboard hanging down) and going into an adjacent room where a chap is sitting on a stool having a mug of tea.

Caption Don't mess with asbestos.

Message Do not touch asbestos, get a specialist to deal with it.

Picture Shows one chap unravelling fibrous pipe lagging, causing fibres to be present in the air and a skull & cross-bones, and a specialist (possibly listening to the Asbestos with a stethoscope) attending to the Asbestos.

Caption Mind your back.

Message Hold a shovel properly.

Picture Shows one chap holding a shovel correctly with his left hand down near the blade and his right hand on the handle.

Caption Leg over.

Message Use your foot to push a spade or shovel into the ground.

Picture Shows one chap holding a shovel correctly and using his inner thigh to push the shovel into a pile of rubble.

Caption Aroma therapy.

Message Turn gloves inside out for airing overnight.

Picture Shows a pair of rubber coated gloves turned inside out and 'nasty niffs' coming off them.

Caption You need your knees.

Message Use a kneeling mat, and keep moving your position.

Picture Shows one knee up the other down and vice versa; and arm used as a prop when both knees down.

Caption A bit at a time.

Message Do a big job in stages, Rome was not built in a day.

Picture Shows a chap using a hand saw to cut through an enormous sheet of plywood - sweat pouring off his brow.

Caption Brains save energy.

Message Use your brain to save your energy; use the right tool for the job.

Picture Shows a chap with a pick axe in one hand and a shovel in the other puzzling over (? above his head) which to use for digging a hole (or repairing a watch).

Caption Mind your head.

Message Never pull the crow bar in the direction of your head.

Picture Shows chap levering out a large nail with a crow bar and pulling the bar towards his head, with the nail about to come out and the crow bar about to hit the chap in the face.

Caption Steps downfall.

Message Do not work leaning over the side of steps.

Picture Shows chap leaning over the side of steps and using a claw hammer to pull a nail out of a wall (possibly showing a sheet of glass leaning against the wall just beneath the chap).

Caption Four for stability.

Message When you loose your balance drop down onto all fours.

Picture Shows chap on all fours on a pile of brick rubble and looking at a large object which he was carrying now flying through space.

Caption Know your stairs

Message Count the stairs for carrying safety.

Picture Shows chap coming down the stairs (like the ones Kenny Everett used to draw for his mime sketches - pinched from Marcel Marceau) and carrying a big box - so he cannot see where he is going - with a thought bubble saying '1 2 3 4' (assuming he is on the fourth step from the top).

Caption Left hand down a bit.

Message Try to use your left hand for half the time, great footballers can score equally well with both feet.

Picture Shows chap driving large nail when holding hammer in his left hand.

Caption Knuckle duster.

Message Wear thick gloves to cushion your knuckles.

Picture Shows left hand of chap wearing a knuckle duster (my OED says 'metal instrument preventing knuckles from injury in striking') which is about to be hit by the hammer which has missed the cold chisel.

Caption Dodge the dodgy.

Message Things which look dangerous, usually are dangerous.

Picture Shows skinny buckling timber prop supporting the end of an enormous steel beam which was formerly supported by a brick wall which is partly demolished.

Caption Enjoy the trip!
Message You will not enjoy the trip; keep floors clear.
Picture Shows chap carrying large heavy box an about to trip over a brick.

Caption Be aware.
Message Eyes in the back of your head. Keep looking around, be attentive at all times.
Picture Shows chap with eyes in the back of his head lifting a heavy box and about to straighten up and collide with a ladder carried on the shoulder of another chap who has just come into the picture.

Caption Fatal attraction.
Message The attraction of gravity can kill.
Picture Shows chap about to fall off a ladder because he is looking at (or wolf whistling) a female (called 'gravity'?) and has not noticed a missing rung in the ladder.

Caption Electric circus.
Message Don't mess with electrical circuits.
Picture Shows chap standing up in a dodgem car using a screwdriver to fiddle with the top of the conductor pole near where it is flashing.

Caption Rocket silence.
Message Do not leave projectiles sticking out.
Picture Shows chap carrying timber, having just had his manhood dented when he walked into a sticking out shelf bracket. Chap is shouting expletives !!¡¡*??¿¿

Caption Up before the bench.
Message Clean up before using the bench.
Picture Shows bench full of tools including an electric drill and cable which is about to be cut by chap as he saws through a piece of wood.

Caption Shocking weather.

Message Do not use power tools in the rain.

Picture Shows chap in a downpour using an electric saw to cut through floor boarding and getting a violent electric shock which has caused his hair to stand on end.

Caption The Bucket residence.

Message Throw nails or screws into a bucket for recycling, or put them on a window sill if a bucket is not near.

Picture Shows chap lobbing nails into a bucket.

Caption Vice withdrawal.

Message Clamp head of nail in vice and lever timber away.

Picture Shows vice gripping head of large nail and chap levering timber away from the vice and in consequence nail being removed.

Caption Rolling bar.

Message Roll the crow bar against the vice when nails to be withdrawn are at an angle.

Picture Shows vice gripping a piece of timber which has a nail coming out the side at 45°, the crow bar is shown rolling across the vice as the nail is withdrawn.

Caption Look out below.

Message Before picking up a pair of steps, look to see what is on the top.

Picture Shows chap lifting up a pair of steps with a sledge hammer about to fall from the top of the steps onto his head.

Caption April in plaster of Paris.

Message Floors get slippery when wet so be careful in April showers.

Picture Shows chap, carrying a large pile of timber, doing the splits with left foot straight forward and right foot doubled up underneath him.

Caption Buckling force.

Message Hold the nail with pliers to prevent the nail from buckling.

Picture Shows piece of timber clamped in a vice with chap holding the shaft of the nail with pliers and driving the point of the nail with the hammer so that the nails is driven back through the wood.

Caption Flight path.

Message When you drop a nail, program yourself to follow its flight path as it will be much easier to find the nail.

Picture Shows chap standing on the stool levering out a nail from the ceiling and the nail falling to the floor and bouncing, with the chaps eyes following the nail (a dotted line from the chaps eyes to the final position of the nail).

Caption Rusty nails.

Message When nails are very rusty it is often easier to pull them through the timber rather than driving them back through.

Picture Shows piece of timber clamped in a vice with head of nail just visible beneath timber and point projecting above timber and chap using pincers to grab nail and pull it through the timber.

Caption Rusty screws.

Message If cannot be budged with screwdriver or brace and bit, try pliers and finally drill holes around screw to loosen it.

Picture Shows head of screw just visible and head held by the side of pliers and the pliers being rotated in an anti-clockwise direction.

Caption Fillet and chips.

Message Hold fillet gently in the vice to avoid chipping the edge.

Picture Shows 50 x 50 mm timber fillet held in the vice with one side of the right angle against one set of the jaws of the vice and the head of a nail pointing upwards which is being driven back by a claw hammer.

Caption Hammer house of swings.

Message Hammer skills are 'on par' with those of a good golf swing; denailing improves hammer skills.

Picture Shows a claw hammer striking the head of a slightly bent nail and driving it back through the timber.

Caption Bar bruising.

Message Roll the crow bar against a timber pack to avoid bruising.

Picture Shows 150mm nails being withdrawn from 150 x 50mm joist with a 50 x 50mm pack beneath a 900mm long crow bar.

Caption Removing picture rails.

Message Put the claws of the crow bar into the top back of the picture rail and lever up from below.

Picture Shows chap pushing up chisel end of crow bar and picture rail coming away from the wall.

Caption Removing skirts.

Message Drive a cold chisel into the plaster behind the skirting to make a space for the chisel end of the crow bar.

Picture Shows chisel end of the crow bar inserted into the back of the skirting and chap pushing down on claw end (claws nearest wall) and skirting coming away from the wall.

Caption Head banger.

Message Do not use a demolition hammer above waist level.

Picture Shows chap holding a demolition hammer at shoulder level with the chisel end at the top course of an 8ft high wall and block about to fall on him. (In all pictures featuring a demolition hammer, the chap should be wearing goggles and ear defenders.)

Caption In line stability.

Message Chisel along th the length of the wall to avoid pushing the wall over.

Picture Shows chap holding the demolition hammer with the chisel cutting into the mortar joint pointing along the length of the wall.

Caption Move along now.

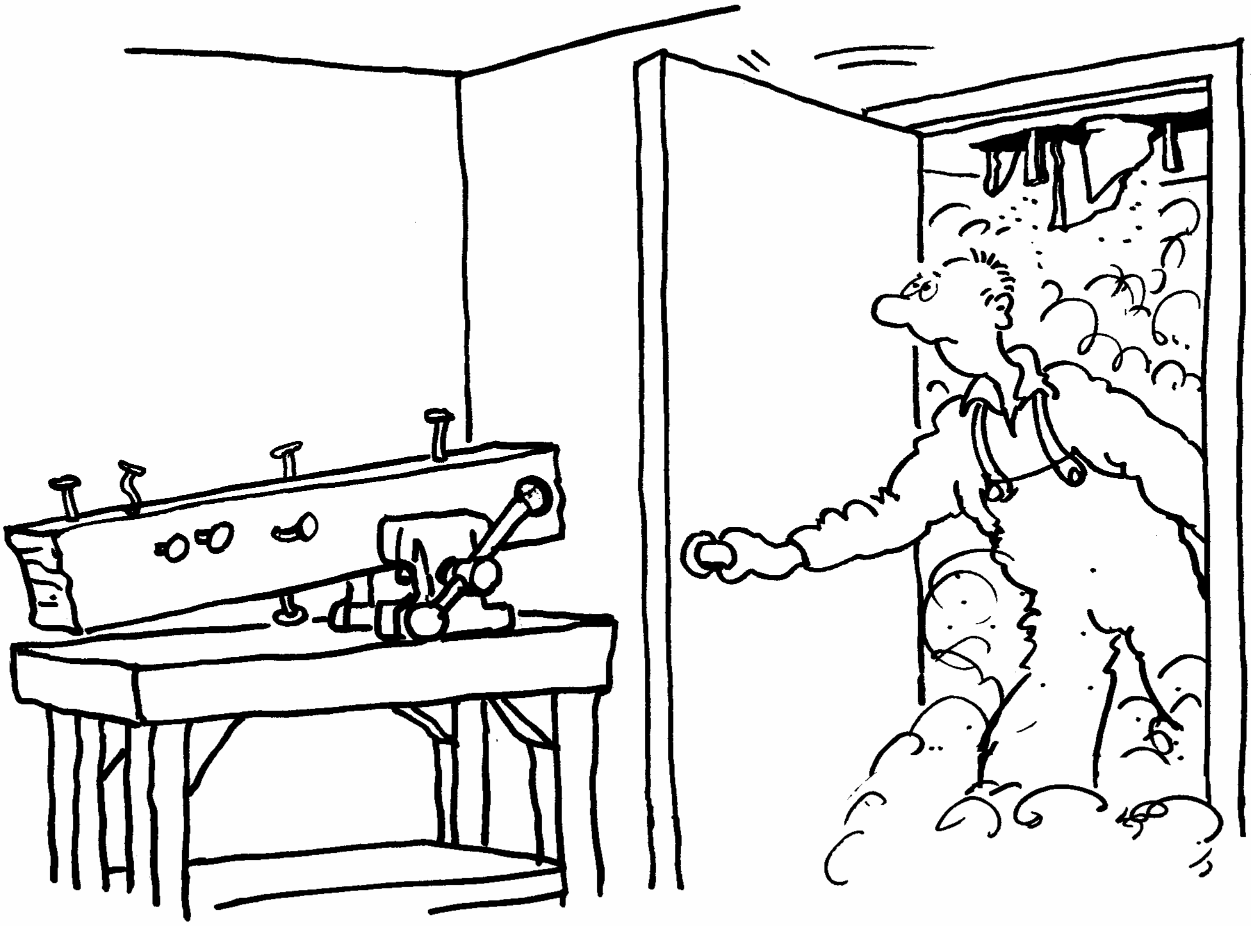
Message When one brick or block comes free, place it on the wall behind the demolition hammer. When one complete course has been freed, clear bricks or blocks from the top of the wall.

Picture Shows chap moving a block from the front of the demolition hammer to the rear.

Caption In the groove.

Message Insert the chisel into the mortar joints to free bricks or blocks.

Picture Shows chap holding the hammer pointing vertically down with the chisel end going into the mortar joint and one block moving away as the chisel penetrates the joint.

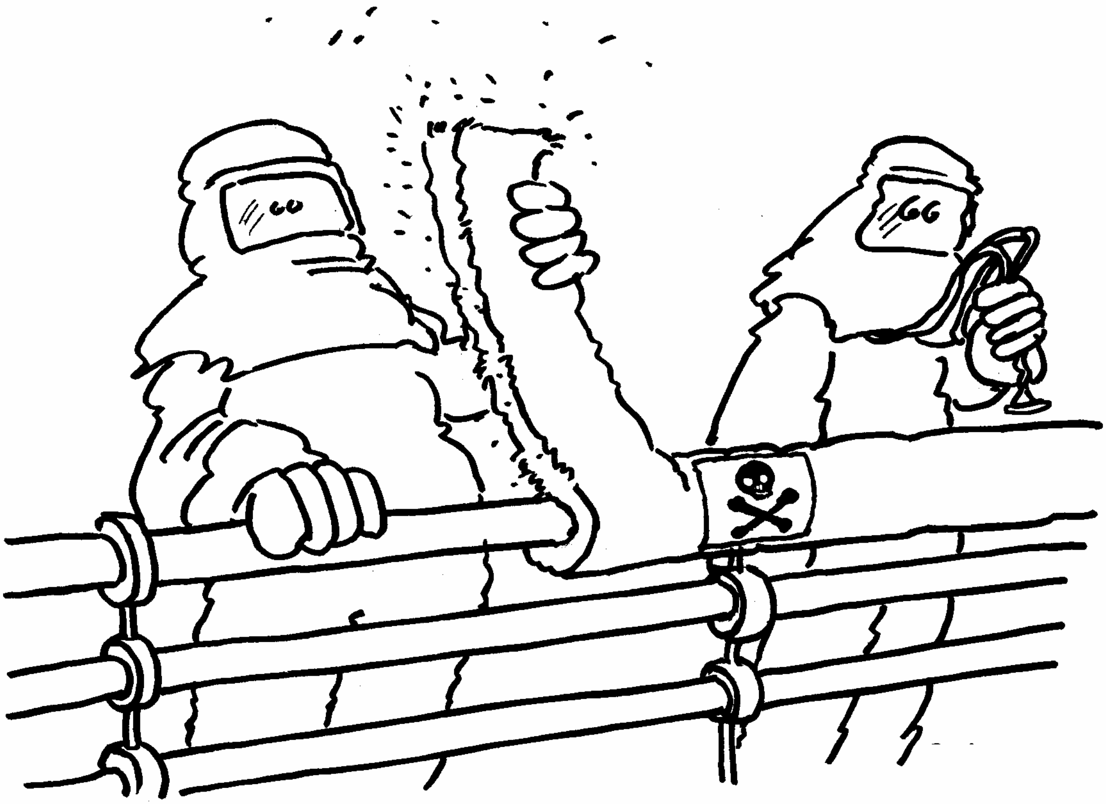


Don't breathe.

Avoid breathing in dust, do another job until the air clears.

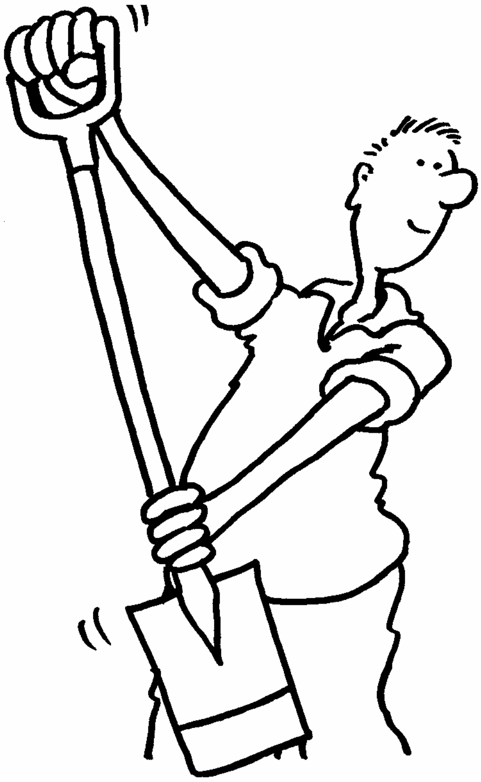
Dusty break.

Avoid breathing in dust, do dusty jobs before a tea break.



Don't mess with asbestos.

Do not touch asbestos, get
a specialist to deal with it.



Mind your back.

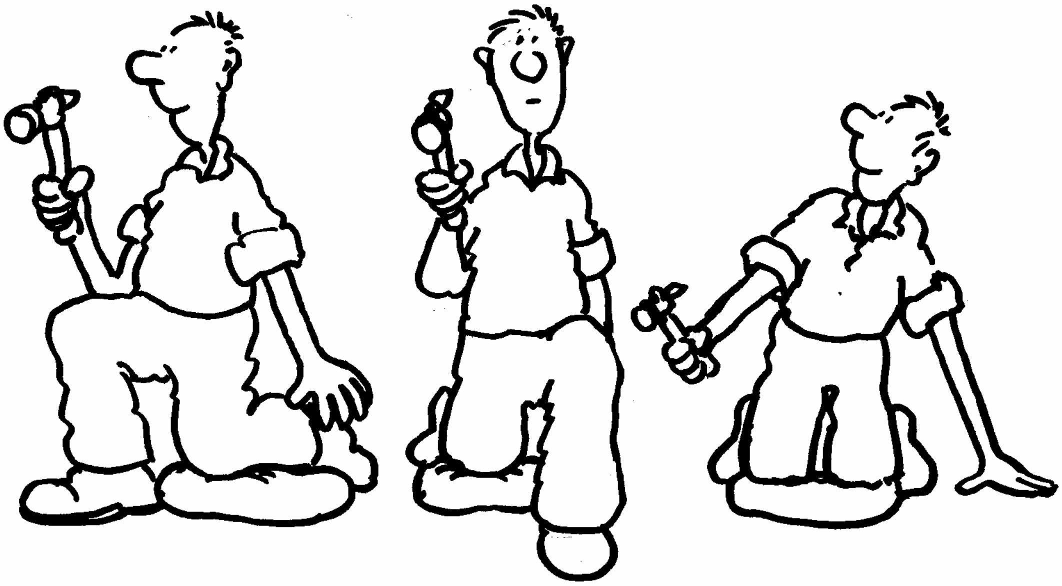
Hold the spade or shovel with one hand near the blade and the other on the handle; use the inside of a knee to help push the blade along the ground into a pile of rubble.

Leg over.

To save your back, get your leg on top of a spade and use your weight to push the spade into the ground.

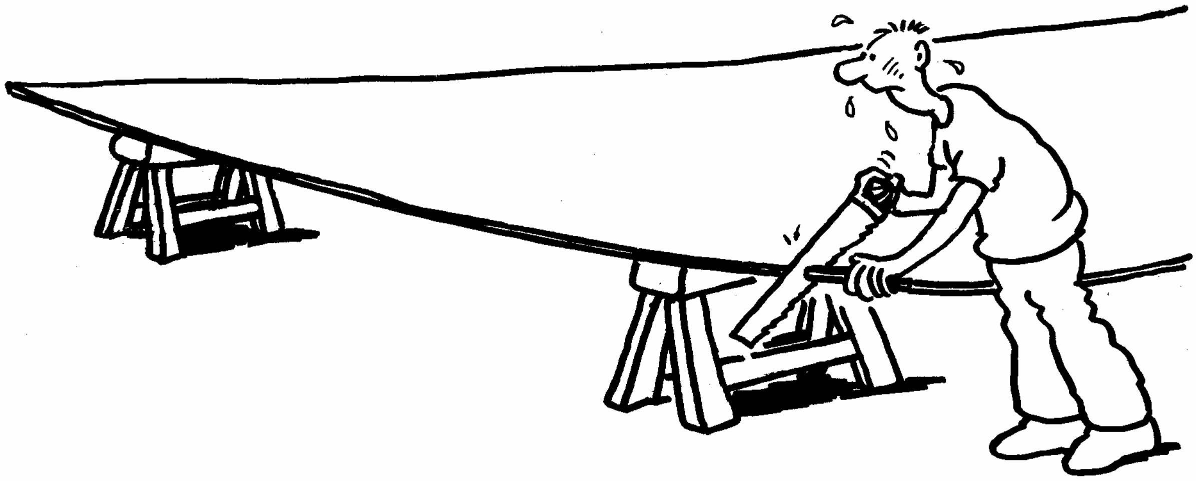
Aroma therapy.

Turn gloves inside out
for airing overnight.



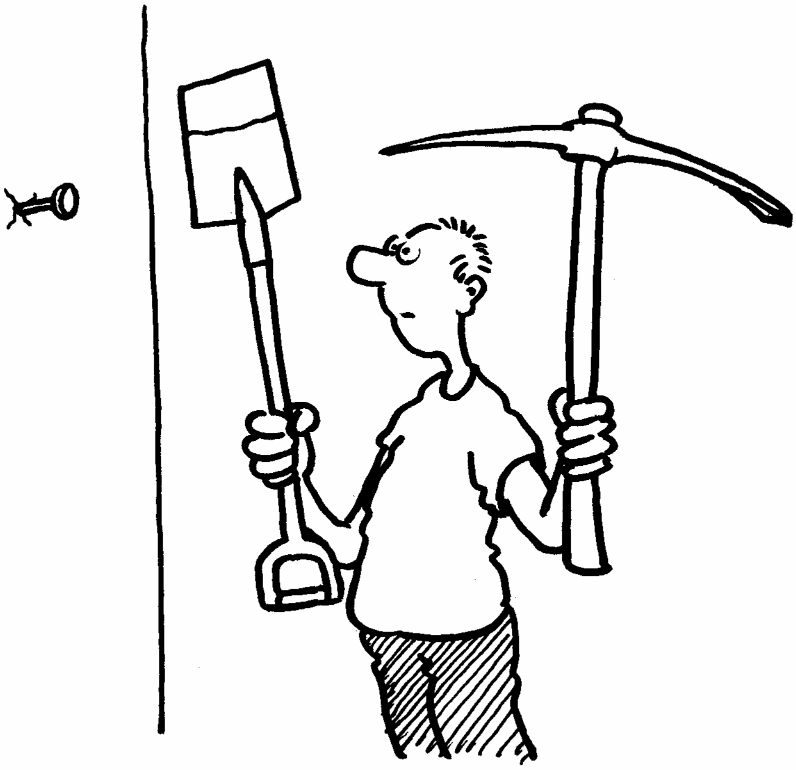
You need your knees.

Use a kneeling mat and keep moving your position with one knee up the other down and then change around.



A bit at a time.

Do a big job in stages;
Rome was not built in a day.

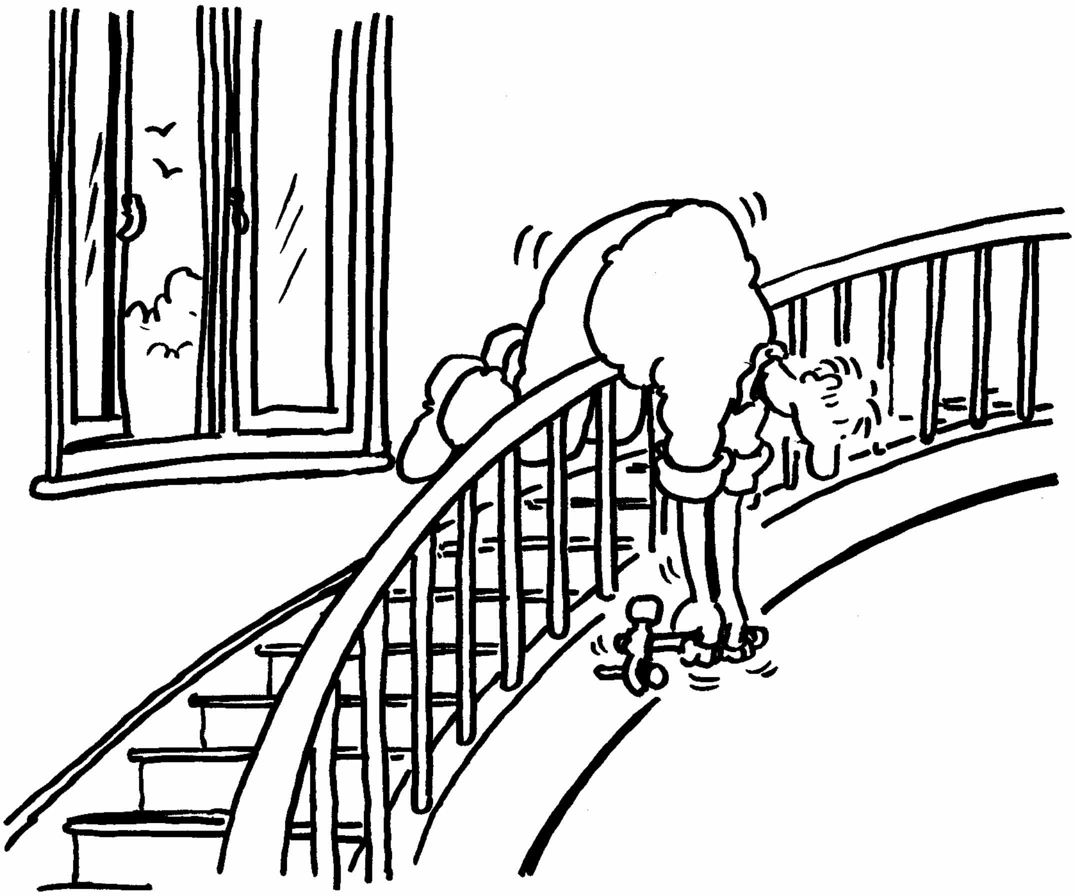


Brains save energy.

Use your brain to save your energy; make sure you are using the right tool for the job.

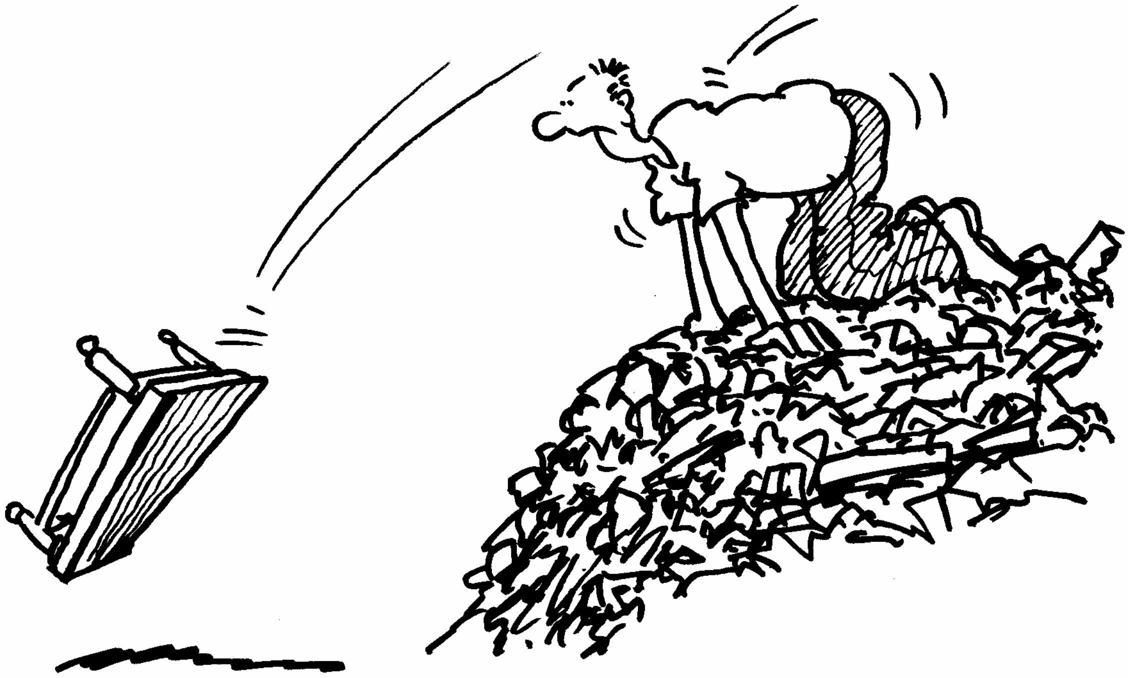
Mind your head.

Never pull the crow bar in the direction of your head.



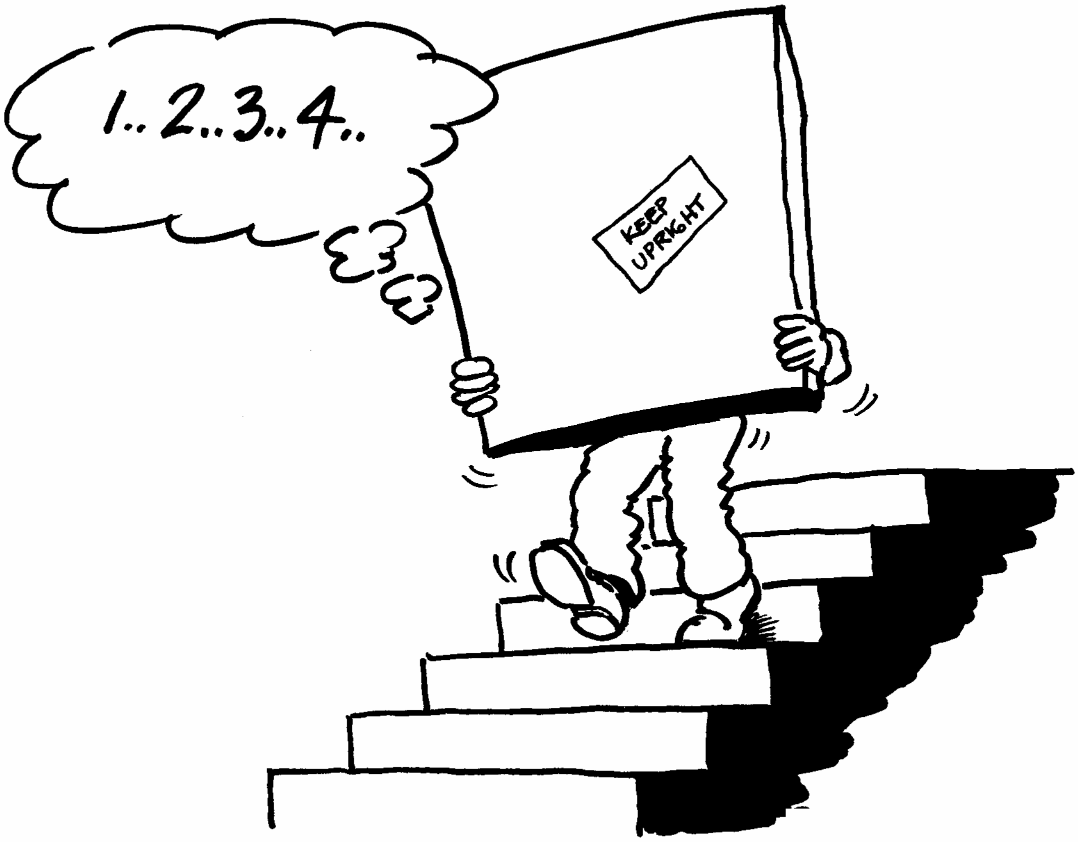
Steps downfall.

Do not lean over the side
of a step ladder or stairs.



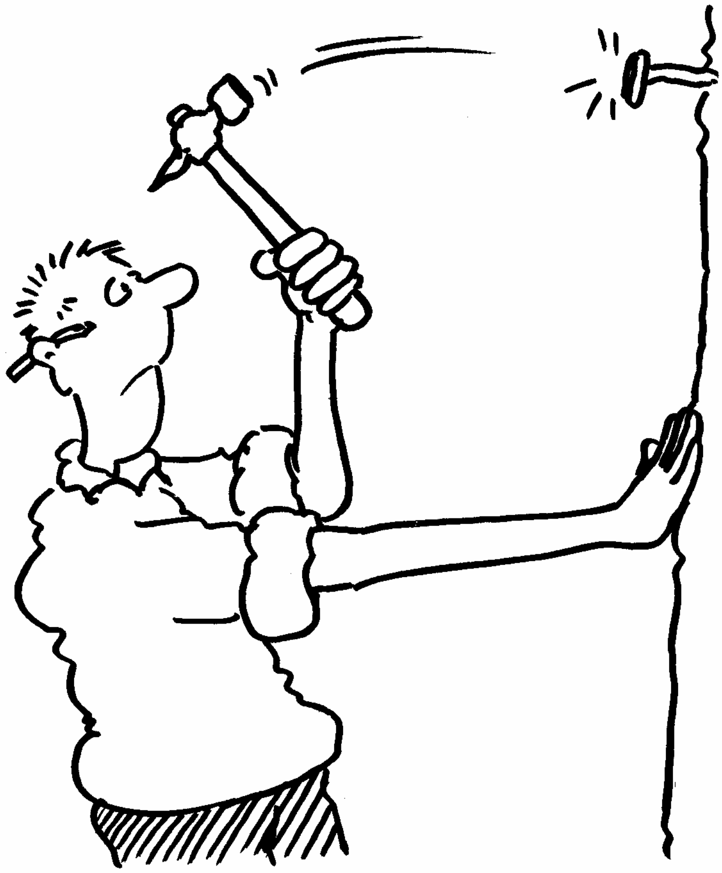
Four for stability.

When you loose your balance,
drop down onto all fours.



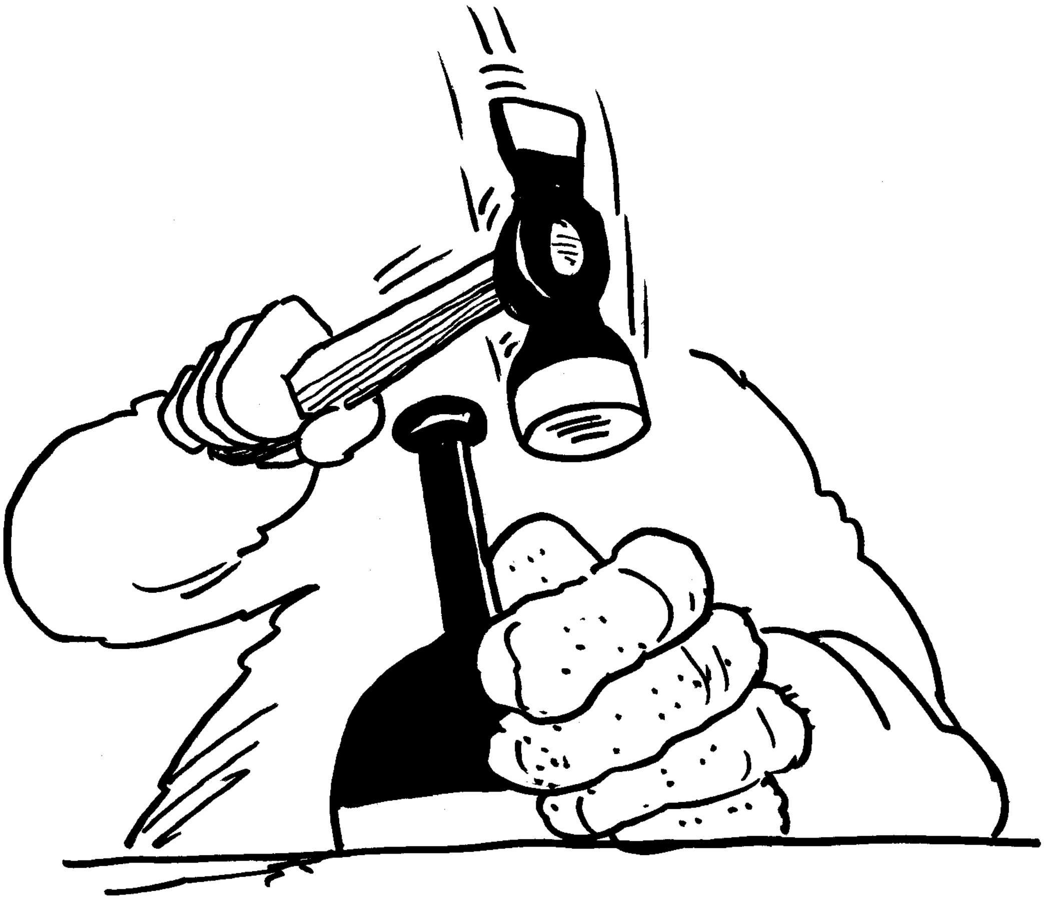
Know your stairs.

Count the stairs
for carrying safety.



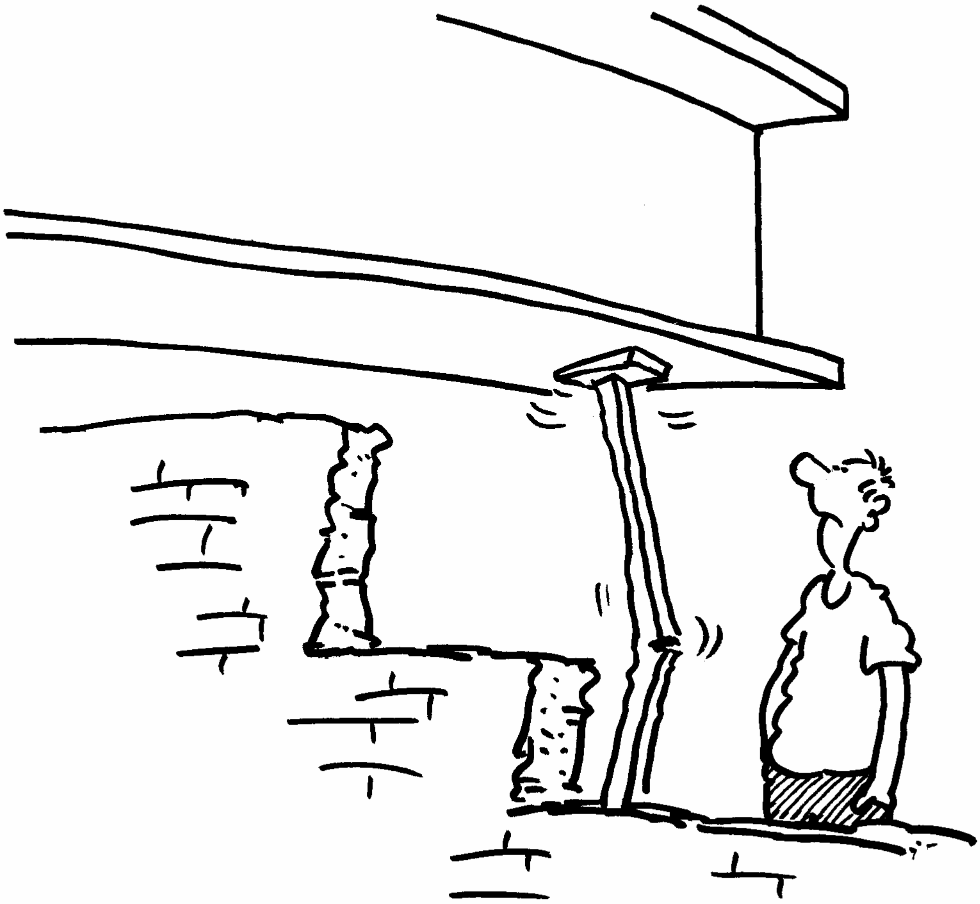
Left hand down a bit.

Try to use your left hand for half the time; great footballers can score equally well with both feet.



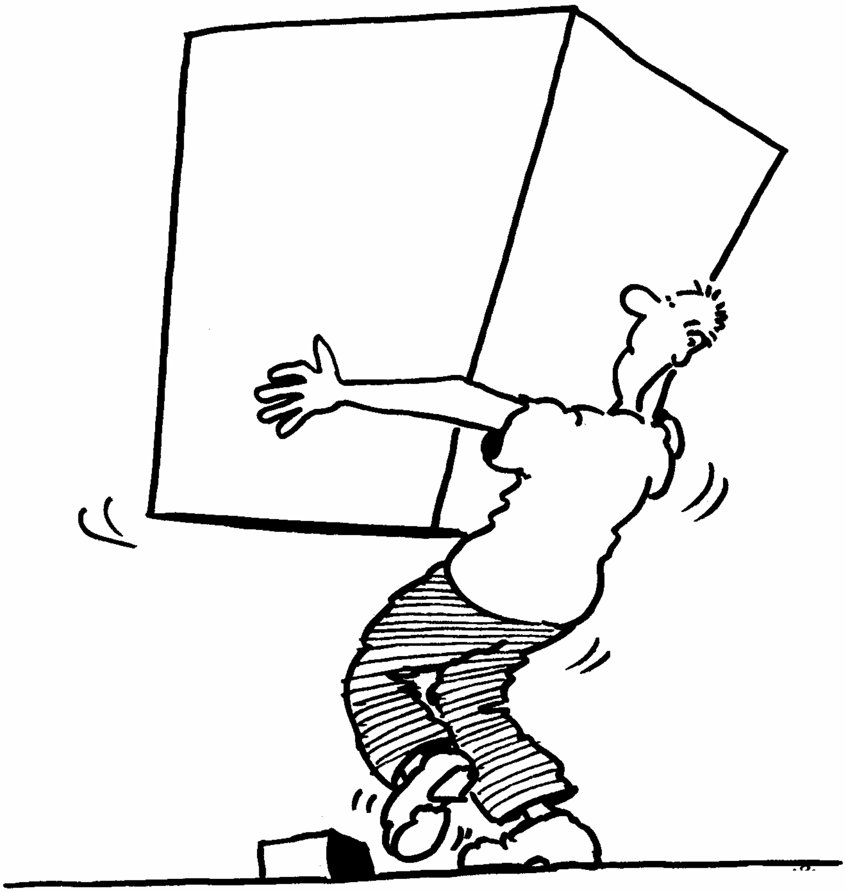
Knuckle duster.

Wear thick gloves to cushion your knuckles.



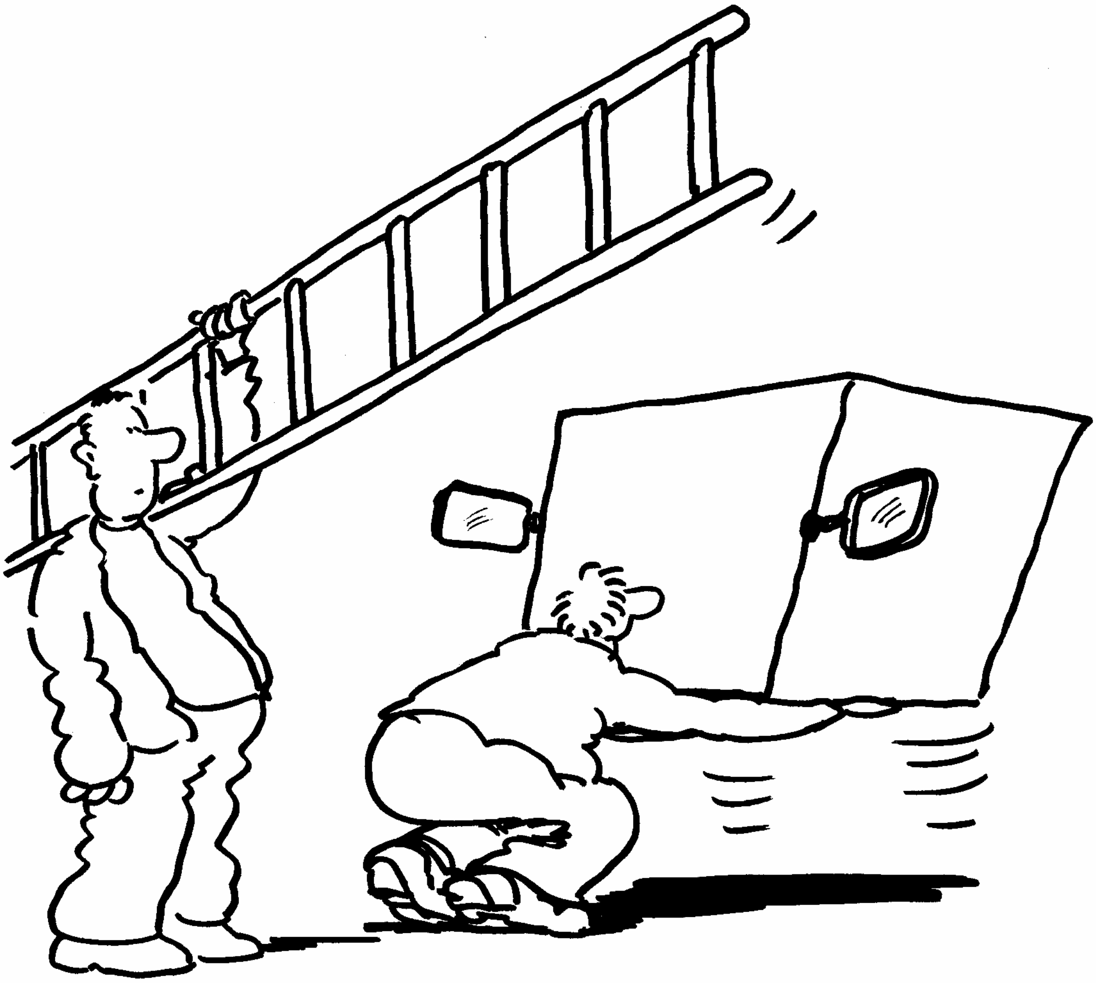
Dodge the dodgy.

Things which look dangerous, usually are dangerous, so get help.



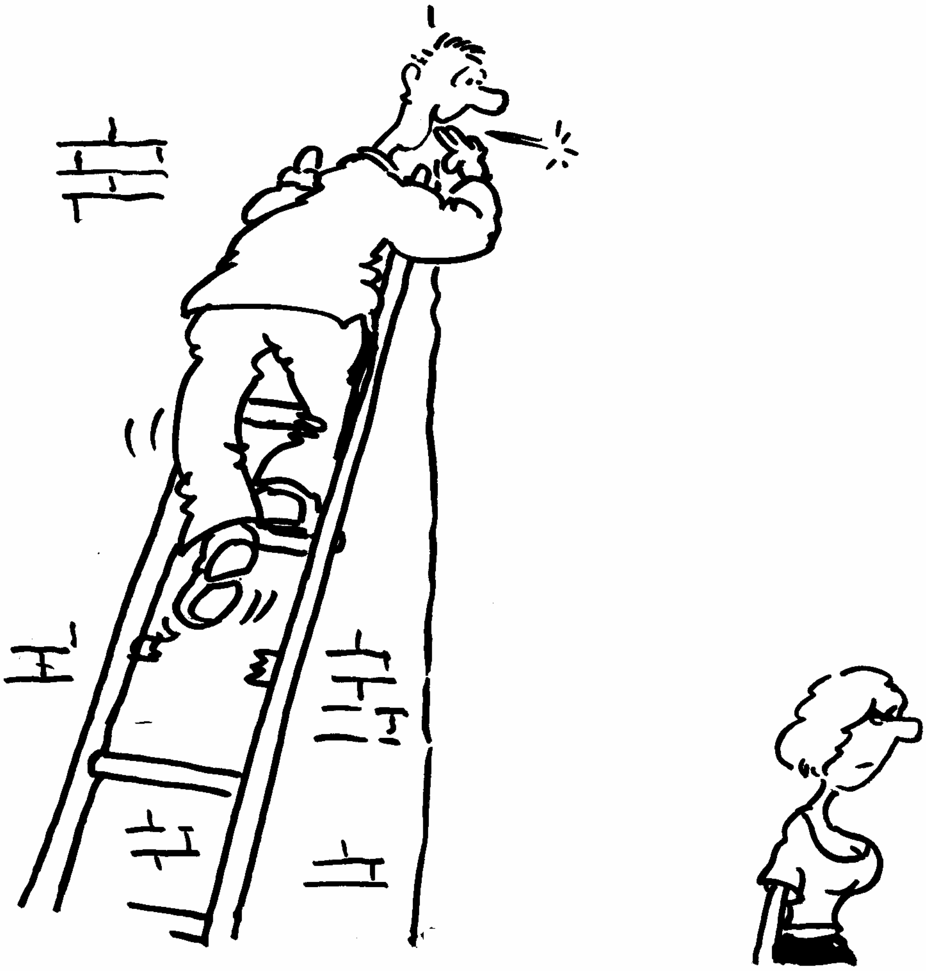
Enjoy the trip!

You will not enjoy the trip, so keep floors clear.



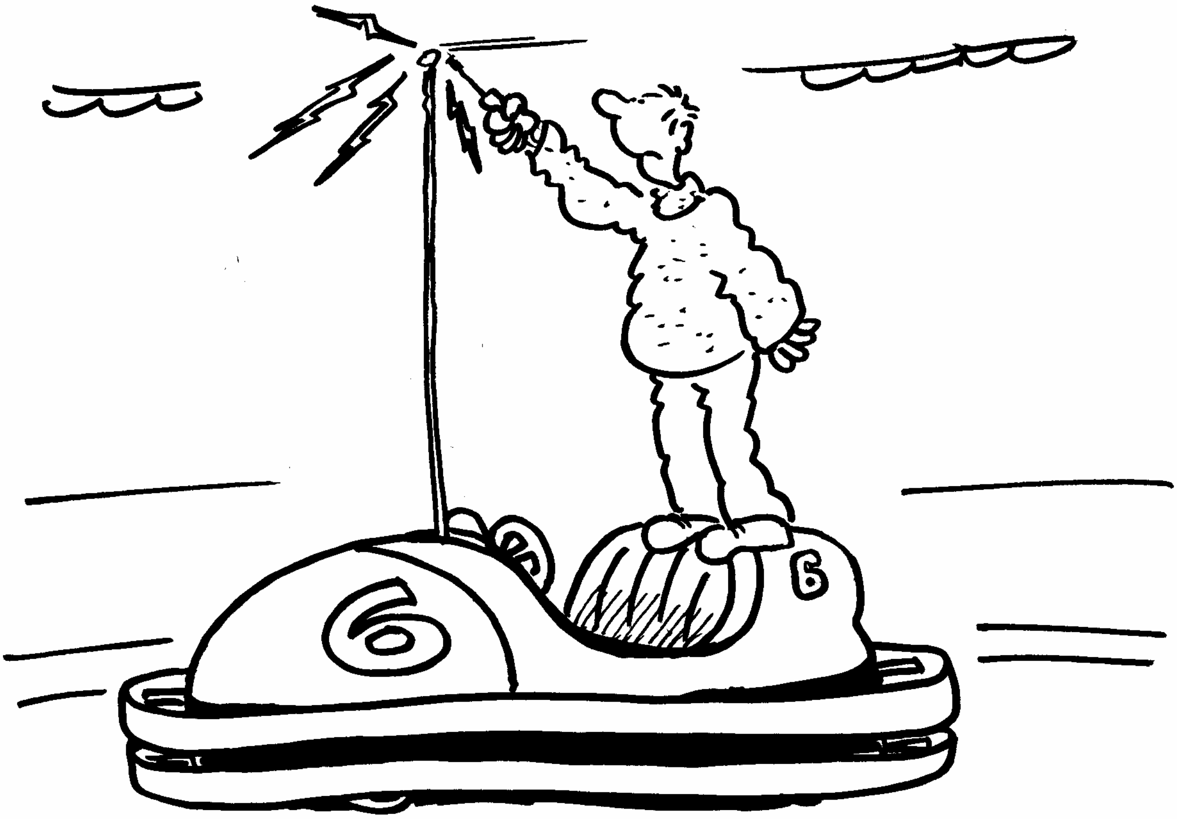
Be aware.

You need eyes in the back of your head, so keep looking around.



Fatal attraction.

The attraction of gravity can kill,
so pay attention to your work.



Electric circus.

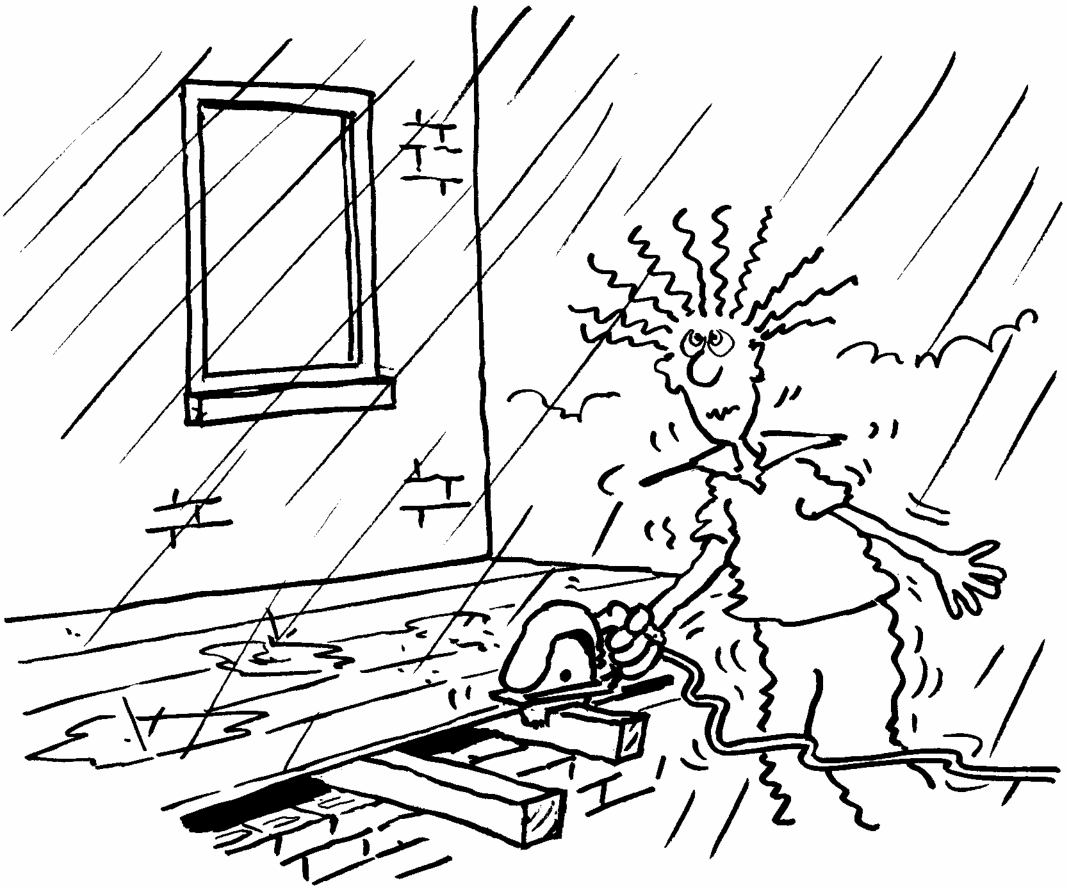
Don't mess with electrical circuits.

Rocket silence.

Do not leave projectiles sticking out.

Up before the bench.

Clean up before using the bench.

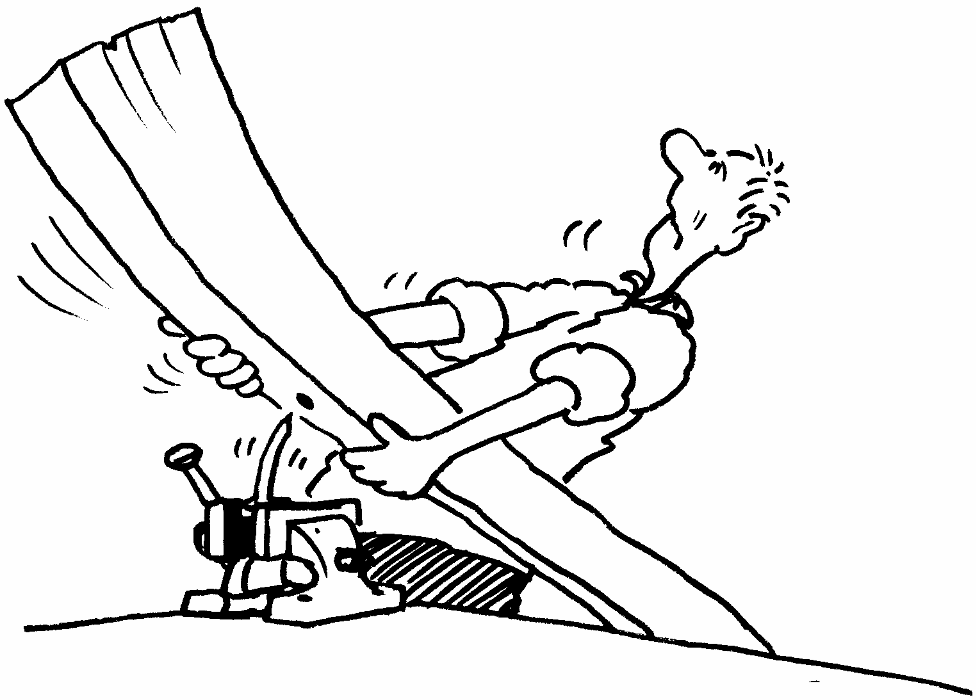


Shocking weather.

Do not use power tools in the rain.

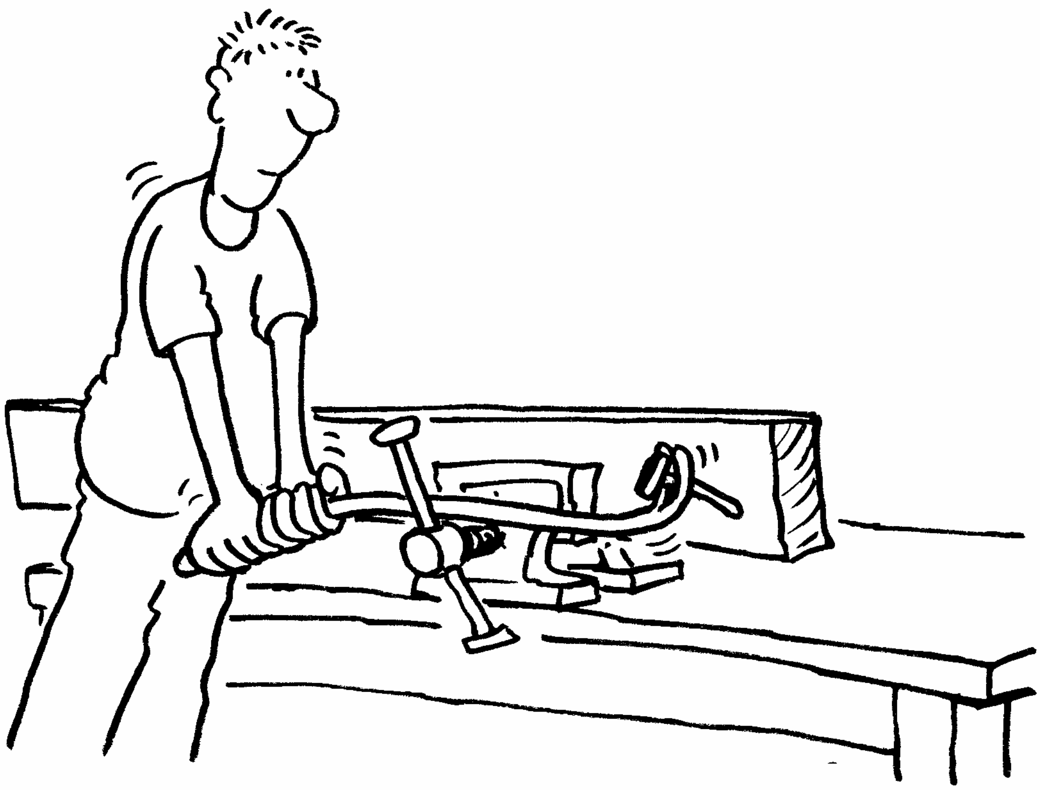
The Bucket residence.

Throw nails or screws into a bucket for recycling, or put them on a window sill if a bucket is not near.



Vice withdrawal.

Clamp head of nail in vice
and lever timber away.

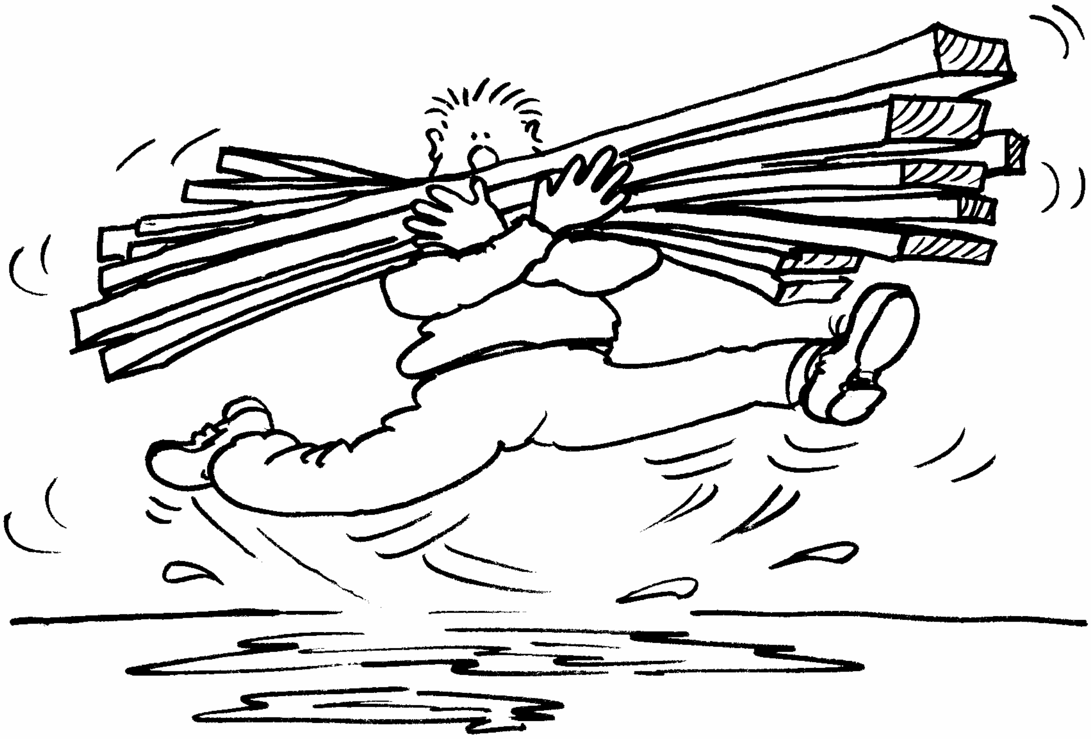


Rolling bar.

Roll the crow bar against the vice when nails to be withdrawn are at an angle.

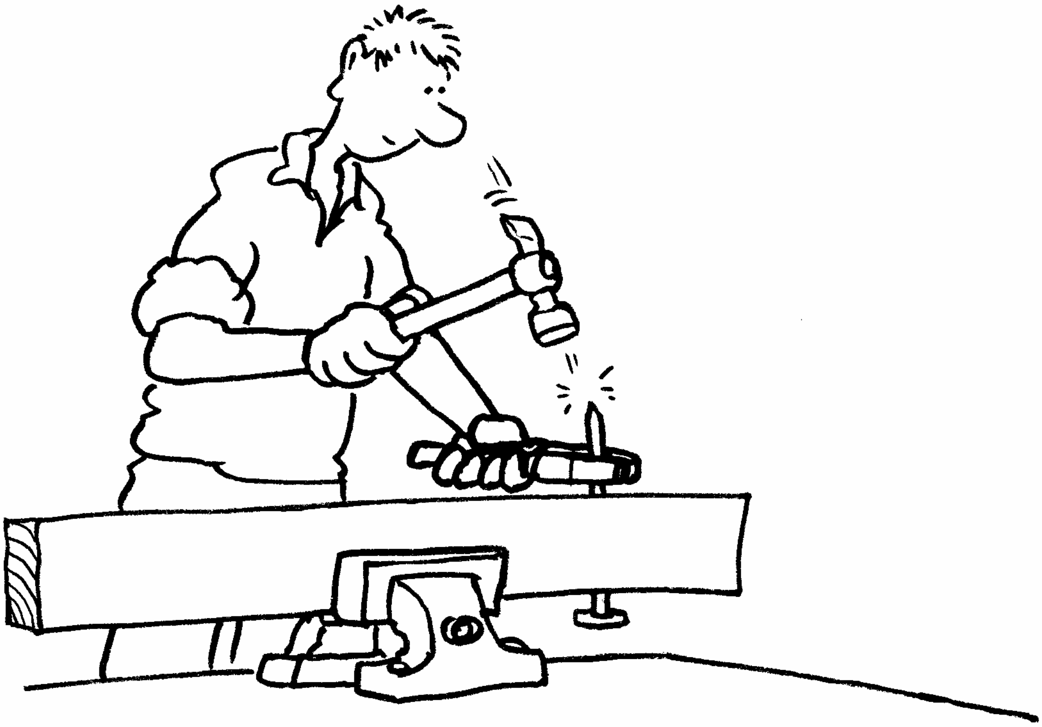
Look out below.

Before picking up a pair of steps, look to see what is on the top.



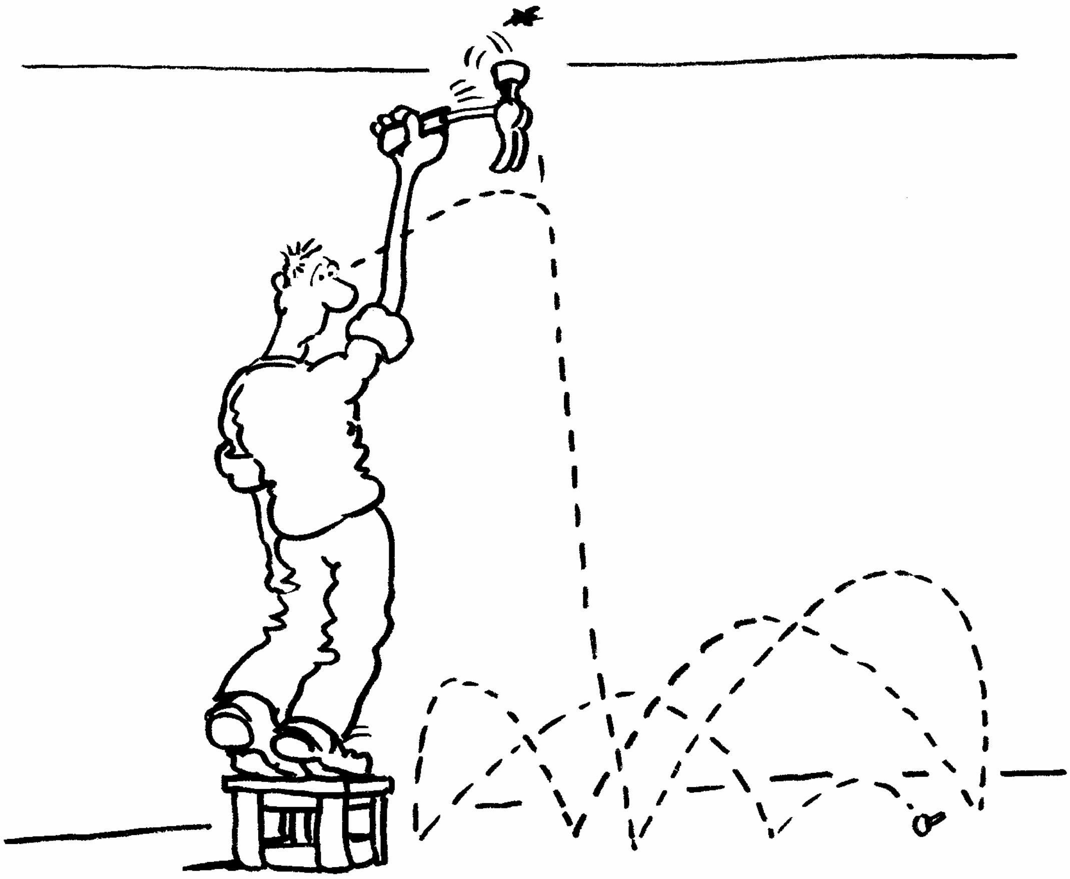
April in plaster of Paris.

Floors get slippery when wet,
so be careful in April showers.



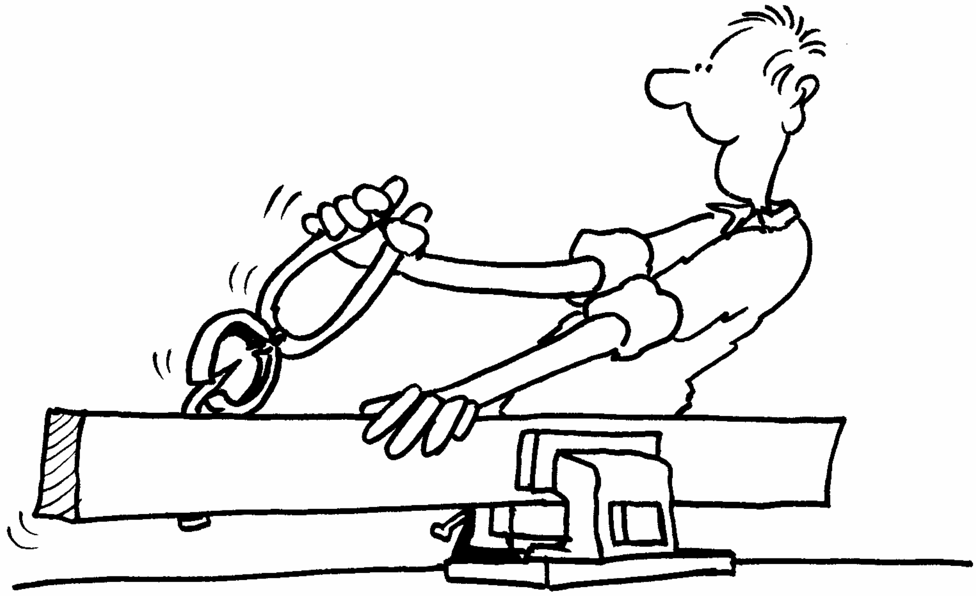
Buckling force.

Hold the nail with pliers to prevent the nail from buckling when driving it back through the timber.



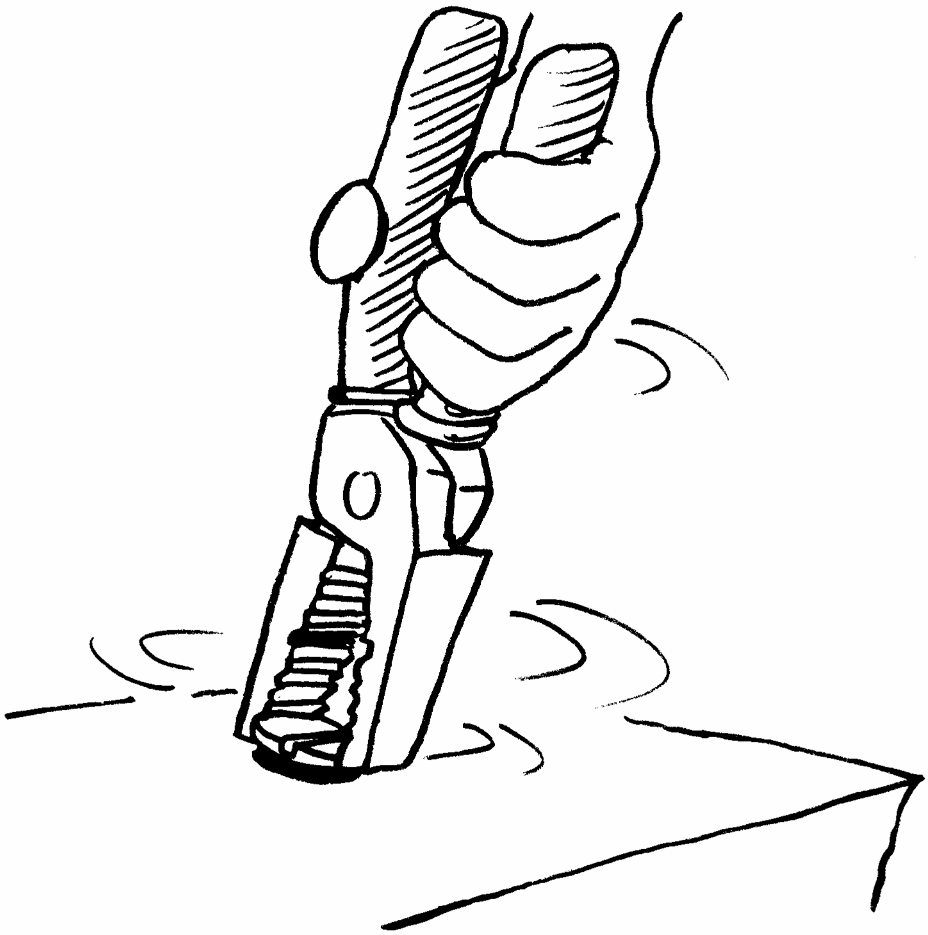
Flight path.

When you drop a nail, program yourself to follow its flight path as it will be much easier to find.



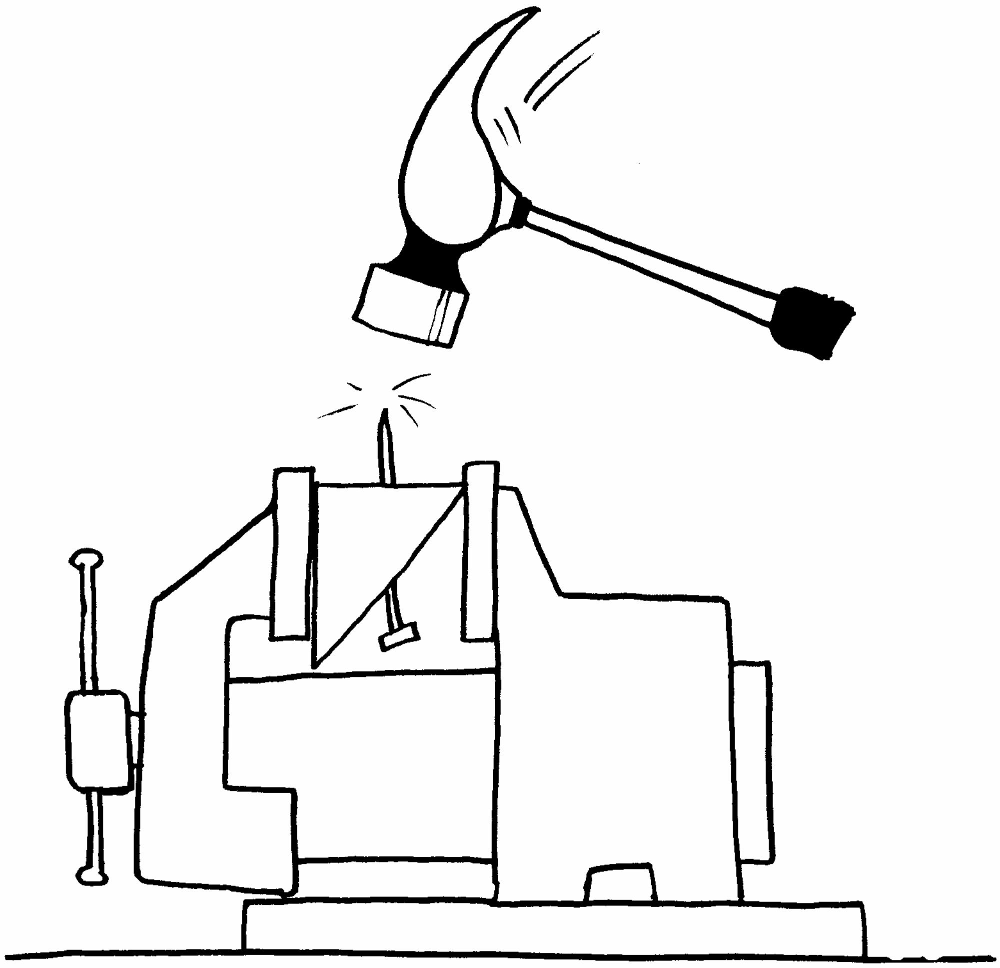
Rusty nails.

When nails are very rusty it is often easier to pull them through, rather than driving them back through.



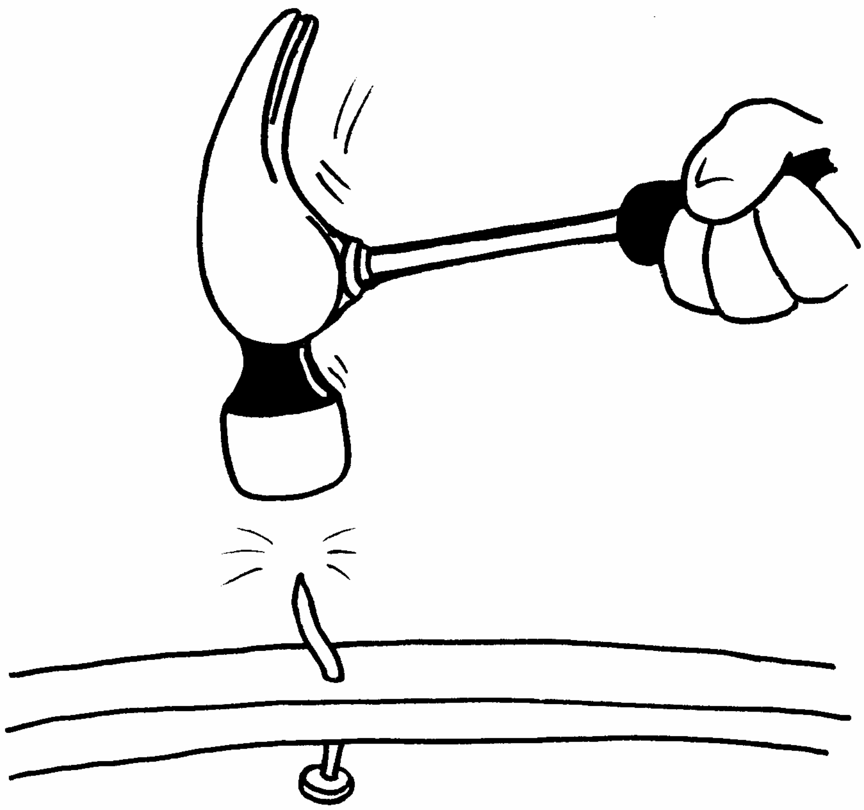
Rusty screws.

If a screw cannot be budged with a screwdriver or brace and bit, try the pliers head-on or side-on, and finally drill holes around the screw to free it.



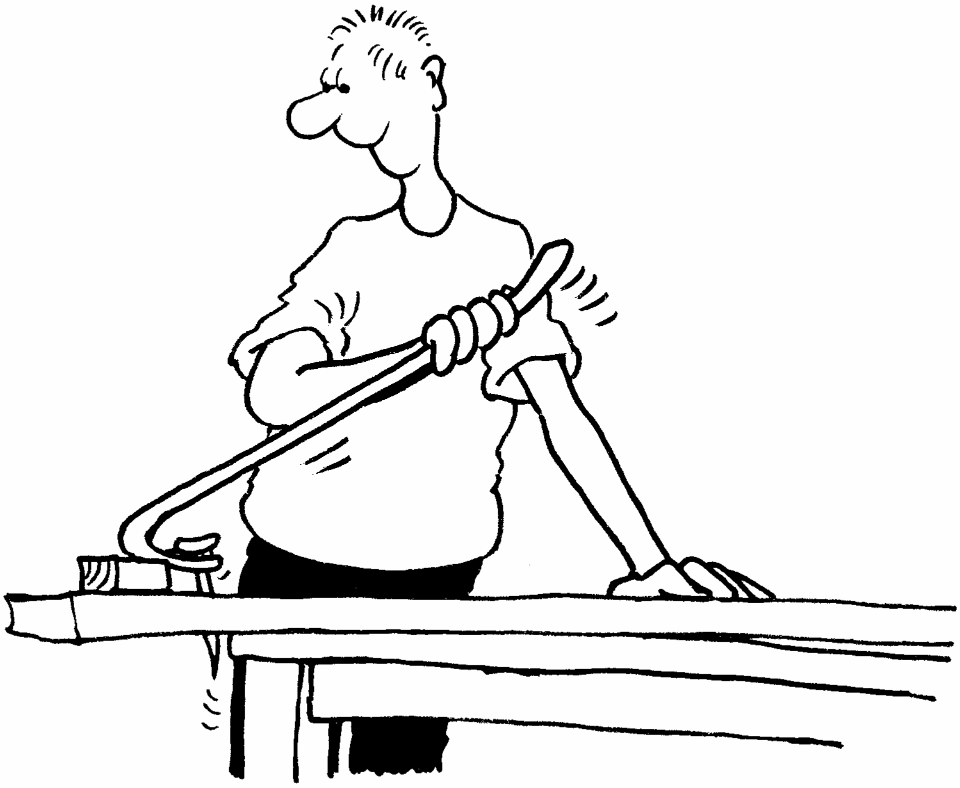
Fillet and chips.

Hold fillet gently in the vice
to avoid chipping the edge.



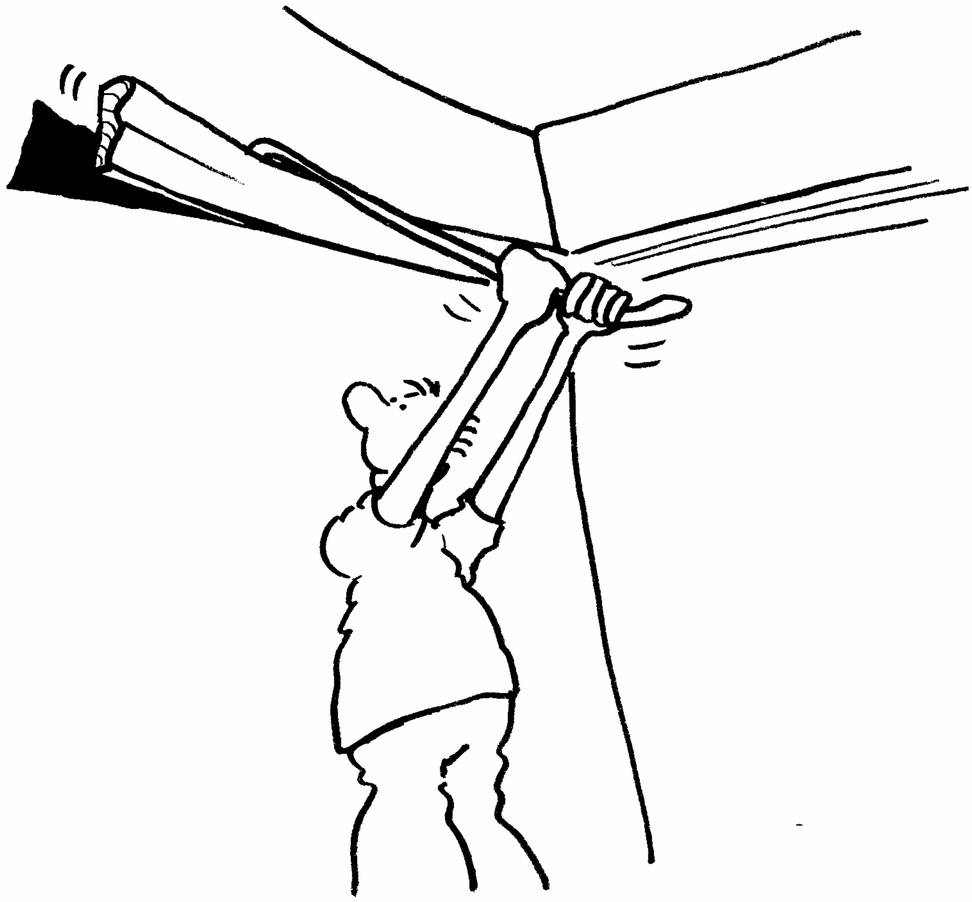
Hammer house of swings.

Hammer skills are 'on par' with
those of a good golf swing;
denailing improves hammer skills.



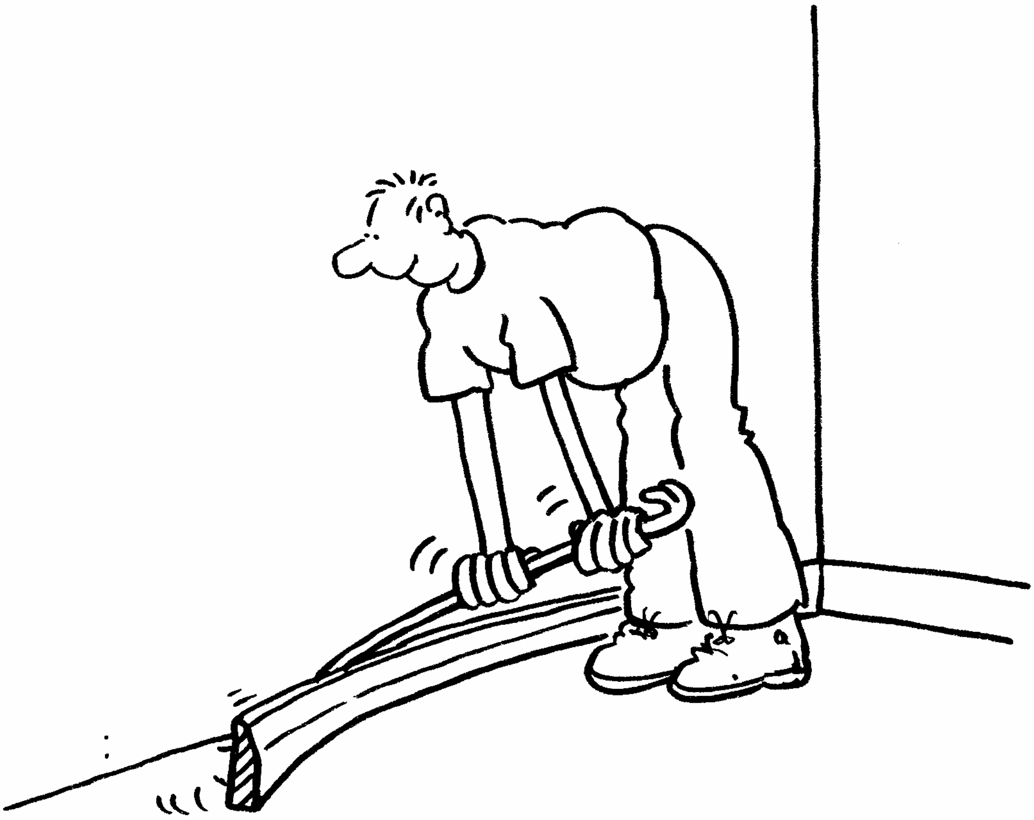
Bar bruising.

Roll the crow bar against a timber pack, to avoid bruising.



Removing picture rails.

Put the claws of the crow bar into the top back of the picture rail and lever up from below.

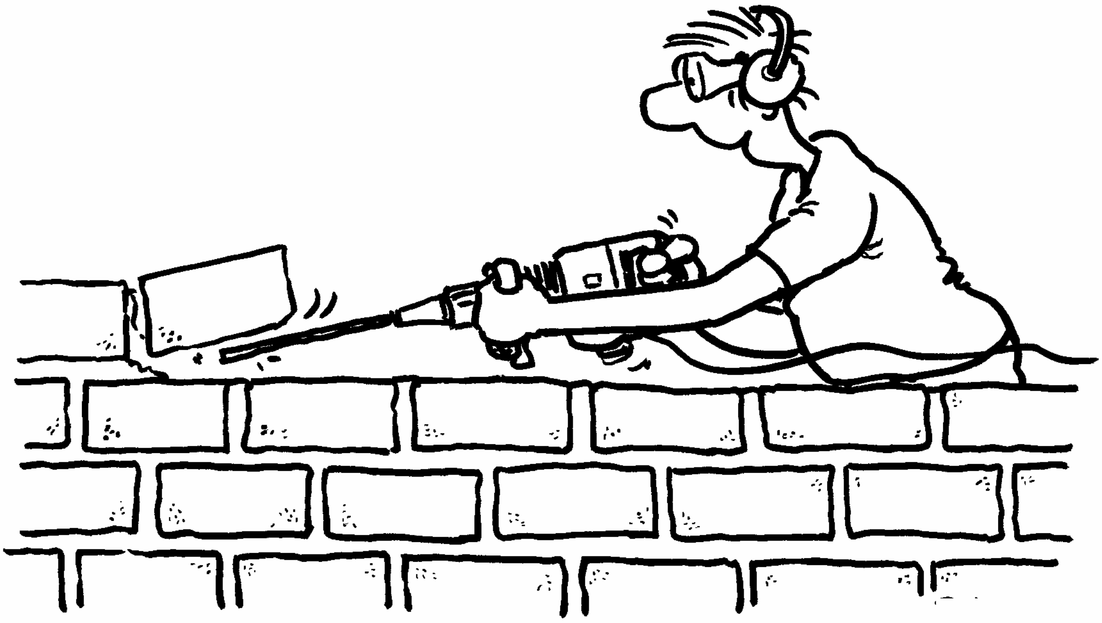


Removing skirts.

Drive a cold chisel into the plaster behind, insert the chisel end of the crow bar and push down.

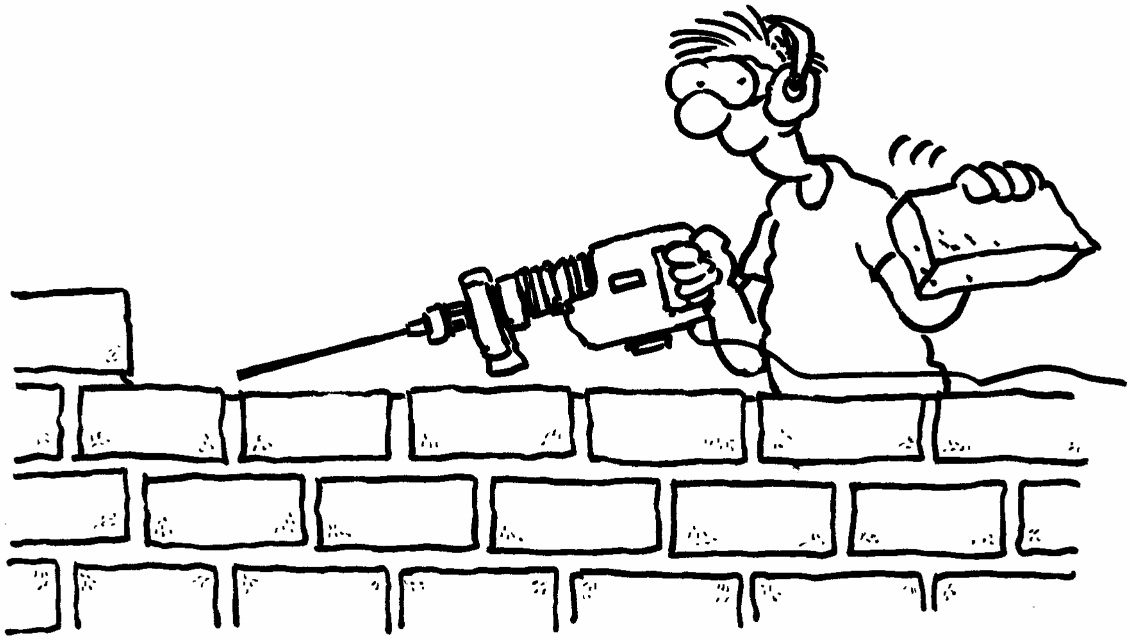
Head banger.

Do not use a demolition
hammer above shoulder level.



In line stability.

Chisel along the length of the wall to avoid pushing the wall over.



Move along now.

When one brick or block comes free, place it on the wall behind the demolition hammer.

In the groove.

Insert the chisel into the mortar joints to free bricks from the top of the wall.

Appendix C

Full scale recycling

The practical research work by the author on Recycling Housing has shown that housing which has failed, can be deconstructed using hand tools only, and the building materials recovered, cleaned and stored for recycling. This Appendix considers various matters relating to the employment of youths on a housing recycling project.

Client

The army could be an appropriate organisation to get the system going. Although the army has sold thousands of 'married quarters' into the private sector, it is believed that the army still has many thousands of married quarters suitable for recycling. Local authorities and the coal board residuary body are other organisations to which marketing may be directed in the hope of finding a client. The writer made a pre-tender submission to Sheffield City Council in connection with its 10 year housing stock reduction programme, and although he was not shortlisted for the 2000/2001 contract, he was informed that he could re-apply in future years. Thus the employment of youths as part of a housing stock reduction programme, seems a possibility.

The housing charity called Empty Homes Agency, campaigns to get empty homes back into use and therefore knows of suitable housing for recycling. Ashley Horsley, chief executive says "The poor quality of many of the buildings ... encourages petty crime, vandalism and drug abuse" (The Times 6.2.99).

Finance

Some sources include:

- New Deal
- Construction industry training schemes
- Developers and building firms
- Farmers
- Housing trusts
- Coal Board Residuary Body
- Home Office
- Local authorities if central Government permits.

Contractor/labour

Some type of Firm is required to collect £60 per week from New Deal for each youth engaged in Recycling Housing and perhaps another £60 per week from construction industry training funds and pay the youths and any retired builders supervising the recycling, and purchase hand tools and hire the occasional power tool.

There is always a feeling by those working on site, that head office overheads are too large. Overheads vary widely from 20% to 80% and more of the wages bill, depending on the ratio of head office staff to those employed on site. Some contractors are successful in getting one in three of the contracts for which they quote, others budget for one in fifteen. There is no doubt that were a Recycling Housing project being run by a contractor, then the same administration procedures and costings would be applied as for any other project, and in consequence head office overheads of say 50% would be added to each person engaged on Recycling Housing, for this reason it is not recommended that contractors be approached to organise a full scale project with youths.

A small limited company could be a vehicle for running a Recycling Housing project, but the writers experience is that a small limited company - especially one connected with the construction industry - would be perceived as a vehicle for making profits at the expense of the taxpayer; for this reason a small limited company is not recommended.

When a local council wants to be free of its council housing, it approaches two or three housing associations who make bids for taking over the housing stock and administering the collection of rents, paying the maintenance and so on. Housing Associations are part of the 'internal deregulated market' receiving most of their funding from central government; they operate competitively one with another and are expected to make a profit. They already have a 'Foyer' project which is intended to give youths an introduction to work. An approach to one or two housing associations along the line 'we have a project which may be of interest to you as a Foyer Project' could well be worth pursuing. A housing association is one of two organisations recommended as the vehicle for running a full scale Recycling Housing project.

The Brits keep thousands of charities going by giving their free time and donations, therefore in the eyes of the public, Charities are worth supporting. The media are always happy to promote the work of charities, as charities are perceived as contributing to the general quality of life. Now that charities are able to receive National Lottery funding, it could be well worthwhile making a bid for lottery funds using a Recycling Housing platform. A charity is one of two organisations recommended as the vehicle for running a full scale Recycling Housing project.

A new charity would have the advantage that a full scale Recycling Housing project could be controlled (e.g. by incentives) to make sure - as far as possible - that the project succeeded. A housing association would have the advantage that if a full scale Recycling Housing project was run by the association and failed, for whatever reason, then there would be less egg on the faces of Nottingham University and the writer. Whichever approach is made, it would be well worthwhile getting the local technical college's building department involved; not only would they be of great help, at no charge, it would make far more sense if their students trained on deconstruction work which was needed, rather than on work which was knocked down so that the next intake of students could repeat the exercise.

The law

"Protecting the public - your next move" published by the Health and Safety Executive - HSE Books ISBN 0-7176-1148-5 covers: what the law says; provisions for the site perimeter and other boundaries; and security precautions.

Any employer has a legal obligation to comply with the Race Relations Act 1976 and therefore must not treat one group of people less favourably than others because of their colour, race, nationality or ethnic origin in relation to decisions to recruit, train or promote employees. Additionally any employer must observe as far as possible the Commission for Racial Equality's Code of Practice for Employment, as approved by parliament in 1983, which gives practical guidance to employers and others on the elimination of racial discrimination and the promotion of equality of opportunity in employment, including the steps that can be taken to encourage members of ethnic minorities to apply for jobs or take up training opportunities.

Health and safety

"Health and Safety in Construction" published by the Health and Safety Executive - HSE Books ISBN 0-7176-1143-4 covers: scaffolding; rules to prevent falls; and general health and safety matters. Throughout the following, the pronoun 'he' should be interpreted as 'he/she'.

Whichever organisation is chosen to run the pilot project, they must satisfy the following, which have been based on a pre-tender submission to Sheffield City Council made by the writer in connection with their 'Housing Demolition Contracts 2000/2001':

- a Director, Partner, Manager or Senior Executive must be named as being responsible for ensuring that health and safety policy is carried out in practice

- a health and safety policy document must be available
- the above named person must be able to explain how he ensures the effective implementation of the policy's requirements
- the risks involved in Recycling Housing must be assessed and evidence provided that they have been assessed and arrangement made for the effective organisation, control, monitoring and review of the risks
- if the risk assessments identified the need for health surveillance, then details of the surveillance must be provided
- details of the practical arrangement that will be implemented to accommodate the Construction (Design and Management) Regulations 1994 must be provided and include proof of training and expertise
- details of the practical arrangement that will be provided for protecting children from the dangers of construction work must be provided
- all employees must be provided with information, instruction and training on matters relating to health and safety and proof that the information is sufficient for Recycling Housing must be provided
- when required information relating to health and safety performance must be provided and include non personalised health surveillance records, records of tests, inspections, maintenance and accident records
- a named person must have responsibility for security and/or hold confidential information during the course of any contract and undertake to work within all the security precautions required by the client.

Incentives

Site labour is generally paid a bonus. One of the writers jobs when employed as a site engineer with George Wimpey, was to do the weekly measure (of how much brickwork, concrete etc. had been constructed); from the weekly measure the bonus was computed. Each task is given a 'target' rate e.g. 36 bricks per hour in 225mm solid walls, if 72 bricks are laid at 72 per hour then 100% of the bricklayers hourly rate would be paid as bonus on top of the basic rate. The bonus scheme was a lesson in the non-linearity of human decision making. When the tradesmen could double their wages they worked extremely hard, when they found that the targets were so high that they could only 'make 40% bonus', they grumbled and stopped making an effort and thereby did not make any bonus. There is no reason to assume that the employment of youths on recycling housing will be any different to the employment of other labour on construction projects; if there are no incentives the workrate will be low.

It is suggested that after completion of one month, the youth be given one 'credit' and when he has accumulated 10 credits, his 10 credits are exchanged for a fixed bonus and a certificate saying he has completed training in basic building construction. Even at this early stage he will probably be a better carpenter than many of the cowboys which let down the building industry. It is suggested that the process of collecting 10 credits begins again but this time the credits are called 'advanced credits' and involve the youth attending a trade course at the local technical college in addition to Recycling Housing work. It is suggested that at the end of the second 10 month period, the youth exchanges his 10 advanced credits for a further fixed bonus and a recognised trade certificate, saying that he has completed basic training in his chosen trade.

The way ahead

One proposal - there are many others - for the way ahead:

- keep the work within the Built Environment Department at Nottingham for Recycling Housing belongs within that Department
- form a Recycling Housing charity which includes local qualified people
- take on one retired builder as advisor and two trainees
- select a Nottingham student who is interested in construction and who is about to complete an MEng to do the training using this research
- the charity to approach a local council or housing association known to be considering - or have started - a housing stock reduction programme and offer to recycle one or two traditionally built houses.

Appendix D

Photographic record

The extensive photographic record is provided for the benefit of those who may undertake a similar recycling project. It is hoped that the record will give a feel for the effort involved.

Camera and photographs

The camera used was a Nikon Coolpix 600 digital camera. The digital images were stored on computer and viewed for suitability before selecting those for inclusion.

Approximately 300 digital images were taken, the 66 plates and their notes contained in this appendix were selected from them.

Chapter 5 shows the ground and first floor planning of Flats 1 to 3 to which the plates refer.

Learning lessons

Each photograph should be viewed with the lesson learnt which follow in this Appendix. Those involved in any recycling project must continually ask themselves why the structure is the way it is, for example

- why hardboard has been fixed to the floor in the corners of some of the rooms
- why some doors do not have lintels
- why plaster has been forced into cracks in the walls
- why chicken wire has been draped over floor joists and filled with concrete
- why steel beams have been painted in some places but not others
- why steel beams have corroded and why the nature of the laminations
- why masonry is cracked or collapsing
- why there was is a single breeze block course at skirting board and picture rail level.

Plate 1

No. 42 - south east elevation

The picture shows the south east elevation just after the start of deconstruction. Starting from the right and working to the left at ground floor level:

- the trellis (looks like two vertical ladders) is attached to the garage which opens onto the road to the north of No. 42.
- the large east facing window to the left of the trellis is the living room of Flat 2
- the white door to the left of the living room window give access to the porch
- once inside the porch, Flat 2 is accessed by a door on the right, Flat 3 is accessed through a door straight ahead
- the small window just to the left of the porch is the east facing window of the living room of Flat 1
- the next three windows (on the curve) and the patio doors give a view to the south from the living room of Flat 1
- the door to the left of the patio doors gives access to Flat 1 (this door had a porch which had been deconstructed before the picture was taken)
- the windows to the left of the door give a view to the south from bedroom 2 of Flat 1
- Flat 3 occupies the entire first floor.

This view of No. 42 was that seen from the old road until the old road was made into the promenade, and a new coast road was built to the north of No. 42 the pavement of which can be seen in the next plate.

Plate 2

No. 42 - north west elevation

The picture shows the north west, the west elevation being in sunlight when the picture was taken, the north elevation being in shadow.

The door on the north elevation gives access to Flat 1, all the ground floor windows to the right of the door are those of Flat 1, the two ground floor windows to the left of the door are those of Flat 2. The door behind the car gives access to the garage.

After the 1939-45 war, extensive sea defence works removed the cliff edge road and following construction of Southbourne Coast Road to the north of the house, the north elevation - in shadow and containing all the drainage pipes and clearly not designed to be seen - became visible from the road.

Plate 3

Flat 1 - wall between bedroom 1 and bathroom

As the plaster was removed, the poor state of the walls beneath became obvious and it was thought prudent to leave the plaster which can be seen in the picture attached to the wall to provide some strength and stability.

The red spot to the right of the picture marks a bricked up 'servery' from the original kitchen (now split into kitchen and bathroom). The timber lintel over the servery can be seen. The servery has created a weakness in the wall; the stepped cracking up and to the left from the top left corner of the servery is typical.

One of the requirements of good masonry design is that the mortar has a lesser strength than the bricks or blocks so that any cracking follows the mortar joints and thus can be repointed easily. This requirement has been met reasonably well except for the cracking below the red spot at the left of the picture where the crack goes completely through the bricks. The next plate shows a closeup on this particular crack.

It can be seen from the general pattern of the cracking that the outside wall (on the extreme left of the picture can be seen a window) has subsided and pulled down and away from the wall seen in the picture.

Plate 4

Closeup on crack shown in previous plate

The picture shows a closeup on the crack with the left red spot in the previous plate. The cracking goes through the bricks themselves. In the bottom right corner it can be seen that the plaster had been forced into the crack before the wall was replastered. A casual visitor to the house would not have been aware of the failure of the loadbearing wall shown, until seasonal variations in temperature especially freeze/thaw cycles have opened up the crack. Structural failure can be hidden in the short term but not in the long term.

Plate 5

Flat 1 - wall between kitchen and bathroom

The picture shows that the wall construction is a 'stud partition' (100x50mm timber 'studs' with plasterboard on both faces).

The red spot marks where the plasterboard sheets meet and have been taped. The tape used is made from flax or hemp fibres; current practice uses glass fibre self adhesive tape, to tape the joints between plasterboard panels.

The grey colour is that of finishing coat plaster ('finish' for short). On top of the finish white comb marks of tile cement can be seen, showing that the wall had been tiled.

Although this wall was not a loadbearing wall (it had not been part of the original design but added later to 'partition' the original kitchen into a new kitchen and new bathroom), due to the structural distress of the loadbearing walls, this partition was left in to provide support to the floors above.

Plate 6

Flat 1 - loadbearing wall in kitchen

The wall between the two windows carries loading from the floor above, the roof at second floor level, and the external wall itself. Above each window will be a lintel to take the loading away from window and deposit the loading onto the masonry at the ends of each lintel. Just below the position where the lintels bear on the masonry between the windows, the fitter who installed the boiler has broken through the masonry to insert a balanced flue to the outside. On site inspection shows that most of the masonry surrounding the square duct has been removed.

All that was needed was a hole of the diameter of the circular pipe, smashing a hole large enough to contain the rectangular duct has removed 90% of the load carrying capacity of the masonry; the wall is still standing because the sides of the window frames have now become structural compression members.

It is important that those employed in the construction industry have a general knowledge about building construction, and do not just ply their own trade regardless of any effect their actions may have. The experience gained by those engaged in recycling housing will develop a more general knowledge of building construction than time spent working in just one trade.

Plate 7

Flat 1 - floor in NW corner of bedroom 1

The red arrow points to a hidden detail to level up the floor in the north west corner of bedroom 1 of Flat 1, to hide the evidence of appreciable subsidence.

The timber strips in the picture are 50mm deep at the corner tapered to 3mm deep at a distance of 1200mm from the corner. To the left of the tapered timber strips can be seen the hardboard covering which was nailed to the top of the tapered timber strips.

Above the hardboard had been a thick carpet on top of a thick underlay. The only way subsidence could be detected when the house was fully furnished, was to put a spirit level along the top of the skirting. All those carrying out housing surveys should make extensive checks on levels using a spirit level. The checks take very little time and should include:

- the tops of all doors
- all floors by sliding a 900mm spirit level along the (usually carpeted) floor with a foot and checking as the spirit level is moved
- lintels over windows
- floor joists in the roof space.

If all readings from the above show zero slope then subsidence is not likely to be a problem. If just one reading shows that the bubble has moved away from the centre of the spirit level, then further investigation will be required.

Plate 8

Flat 1 - lintel over door to bedroom 1

The red spot to the right of centre, marks the end of a timber lintel supporting masonry which in turn supports floor joists, seen at the top of the picture.

The subsidence of foundations has caused the very severe cracking both above and below the end of this lintel. The plaster with the red spot on the white paint was left on both sides of the wall to help with the stability of the masonry. There is a high risk that the masonry below the lintel will fall away, thereby causing a local collapse of the masonry and floor above the lintel.

The strength of plaster is not taken into account in the structural design of walls, nevertheless plaster does make a contribution to the strength of masonry.

Plate 9

Flat 1 - connecting door with Flat 2

The red spot marks a blockwork wall and the foot of the stairs between Flats 1 and 2, photographed from Flat 1 looking into Flat 2. When first constructed, this wall did not give access between Flats 1 and 2. At a later date the door opening was made and the door lining, which can be seen in the picture, fitted without the benefit of a lintel over the opening.

The gap between the door lining and the blockwork was not filled in, merely hidden by the architraves.

Plate 10

Flat 1 - living room curved bay

The picture shows the effects of rising damp just two years after replastering the curved section of the wall and redecoration. The joint between the painted wallpaper has opened up as the wallpaper peeled away from the wall once it became saturated. The blackish marks are due to moulds, possibly feeding off the wallpaper and wallpaper paste.

The picture proves that it is futile trying to hide rising damp by replastering and redecoration; the source of the dampness must be located and eliminated.

Plate 11

Flat 1 - south west corner of bedroom 2

The picture shows the ceiling to bedroom 2 after the plasterboard had been removed.

Timber joists on both sides of the RSJ are notched such that the soffit of the timber joists is flush with the underside of the flange of the RSJ. Timber joists to the far side of the RSJ support the balcony of Flat 3, those to the near side of the RSJ support the conservatory floor of Flat 3.

The rusting of the RSJ is probably due to water penetration from the balcony above. The severe cracking of the masonry support to the RSJ is due to the combined effects of water penetration and subsidence. The next plate shows the cracking in the masonry more clearly.

Had the RSJ been painted with red lead - as was the normal practice before the war but now banned for health reasons - then the RSJ would be 'as good as new' even after 65 years of load carrying service.

When, in 1986, the new conservatory was submitted for building regulation approval it became subject to the impact and airborne sound transmission requirements then in force. The chicken wire, seen draped between the floor joists was lined with polythene and filled with a mixture of plaster and sand in order to increase the weight of the floor for the satisfaction of the sound requirements of the regulations. No regard was made to the poor state of the RSJ's and their supporting masonry when all the extra weight was added.

Plate 12

Flat 1 - SW view on SW corner of bedroom 2

The picture shows the ceiling to bedroom 2 after the plasterboard has been removed looking along the RSJ - see the previous picture - to show that the supporting brickwork has failed.

The plaster to the right of the window has been left on in the hope that it will assist in the prevention of complete collapse of the brickwork and RSJ.

The circular patches in the far wall keyed the plaster to the brickwork. Due to constant dampness of the wall, and consequent loss of bond between the plaster and the wall, there was a risk that the whole of the plaster would fall away from the wall. Inspection and removal of one of the patches revealed that some years ago a workman had:

- cut the circles through the original plaster to the brickwork
- driven masonry nails into the brickwork within the circular patches
- filled the circles with neat cement mortar.

Plate 13

Flat 1 - South view on SW corner of bedroom 2

The picture shows the side view on the RSJ shown in the previous two plates.

Failure of the bottom flange of the RSJ can be seen at the position where the flange supports the timber joist.

Plate 14

Flat 1 - Living room - N view on 8″ x 5″ RSJ

The picture shows the side and underside of an 8″ x 5″ x 18 lbs. RSJ supporting timber joists which carry the floor above.

The flange of the unpainted RSJ can be seen to have corroded to produce 'laminations' typical of severe corrosion in rolled steel sections. The laminations are due to the thin layer of lubricant applied in the rolling mill.

The lower half of the timber joist on the left of the picture can be seen to have been attacked by both wood borers and by wood rot. It is noted that although the timber joist is in poor condition, it has fared better over its 65 years as a structural member then has the unpainted RSJ. The lesson must be to preferably galvanise, or as a minimum paint all structural steel sections even if the sections are for internal use.

Plate 15

Flat 1 - Living room - N view on 8″ x 5″ RSJ

The picture shows the side of the 8″ x 5″ x 18 lbs. RSJ in the previous plate. It can be seen that laminations are not restricted the flanges, but also affect the web. The picture shows a large lamina separating away from the web of the RSJ.

Plate 16

Flat 1 - Living room - NW corner of ceiling

The picture shows the north west corner of the ceiling after plaster has been removed. The detail shows a 6″ x 5″ RSJ being supported on the bottom flange of the 8″ x 5″ RSJ shown in the previous plate. In the centre left of the picture can be seen the soffit of an insitu concrete slab. In the top right of the picture can be seen a timber joist in an advanced state of decay with visible spores and holes from wood boring insects.

Plate 17

Flat 1 - Living room - severely attacked timber

The picture shows the soffit of a timber joist which has obviously been attacked by wood boring insects and bacteria causing wood rot.

Current building regulations require that all structural timber members such as floor joists be pressure treated to prevent infestations such as those shown in the picture. In 1935 when the house was built, there was no requirement that any timber be so treated; indeed with the exception of creosote, wood preservatives were unknown in 1935.

The continuous updating of the building regulations to the latest 'good practice' has extended the life of buildings constructed in accordance with the regulations.

Plate 18

Timber ready for denailing

The picture shows a pile of timber won from the two roofs which were over the living room of Flat 2. The bench and vice can be seen in the bottom right corner of the picture.

Plate 19

Flat 2 - Bedroom after gutting

The picture shows four sections of a tower scaffold erected behind a thick plywood panel to prevent trespassers from entering the flat through the doorway behind the plywood.

The scaffolding was braced from the masonry wall to the left and off the picture. The stool beneath the yellow bucket was built as a cube, and made from recycled timber. The cube design gave more secure support on uneven surfaces than that of a normal stool. To the left of the stool are two of Waitrose's free banana boxes, the boxes proved invaluable for carrying plaster, render, small bits of wood and the like from the inside to off-site storage.

Plate 20

Flat 2 - toilet - recycling a WC pan

Even with great perseverance it may not be possible to recycle some fixtures and fittings. The WC pan had been fixed to the floor with very large screws which had become rusted-in and could not be shifted. The pan was fixed to a very hard concrete floor, quarry tiled at the front of the picture. After half an hour with a club hammer and cold chisel, a demolition hammer was used to break up the concrete. At the time the picture was taken, it was still not certain that the WC pan would be retrieved intact.

Plate 21

Flat 2 - door between living room and bedroom

It can be seen that the door opening has been cut through the original wall; the living room of Flat 2 was originally a garage and had no access to the house. The wall cavity can be seen between the two red spots with an electrical cable passing down the cavity. New building regulations prohibit the use of wall cavities as pathways for building services.

The wall end with the left red spot shows that the wall has been smashed to make the door opening, leaving very rough jagged brickwork. Good practice would have been to have used a masonry drill as a router to follow the mortar toothing from top to bottom of the wall, and then close the cavity with bricks, toothed into the wall, to give a straight vertical edge to which the door lining could be fixed.

It can be seen at the top middle of the picture that there was no proper lintel over the door, just a timber frame made from 100x50mm timber to which plasterboard has been nailed.

The timber prop to the right of centre, with the red spot, was wedged in to stop the masonry above collapsing; the plywood to the right of this prop does not form part of the structure, it is there to keep out trespassers, and is held in place by a scaffolding erected behind it.

To the lower left of the picture can be seen wallpaper which is peeling from the blue painted plastered wall. There had been wood panelling on the section of the wall above the plastered lower half. The lesson is to beware of panelling, it may well be that it has been used to hide a distressed structure.

Plate 22

Downward view after deconstructing Flat 2

The picture was taken from the balcony of Flat 3 looking down the side of the west wall to the site of the living room of Flat 2.

The white painted end wall of the living room seen in the lower left quadrant of the picture, facing the viewpoint, was constructed from dense concrete, and quite unexpected. The boardmarks of the formwork (shuttering) could still be seen on the concrete.

Inspection of the 1935 drawings (see Section A-A in Chapter 5) showed that the floor was a 100mm thick insitu suspended reinforced concrete slab. The architectural influence of the great liners of the thirties with their curved walls had - by 1935 - hastened the acceptance of reinforced concrete as a material which could be used in house construction. Section A-A also shows that in the original scheme, there were garage doors where now stands dense concrete, possibly the builder who poured the concrete for the end wall had found the reinforced concrete slab and thought he should use the same material for the construction of the end wall.

Plate 23

Flat 2 - wall plate after living room deconstructed

In the bottom left corner can be seen the top of the door opening shown on Plate 21.

The timber wall plate which supported the joists of the original roof can be seen painted white on the left of the picture and unpainted on the right. The original timber joists which were nailed to the wall plate projected from the wall; the holes in the wall out of which the joists projected can be seen, the nearest hole is approximately in the centre of the picture.

The original timber roof supported a dense concrete screed laid to falls with a bitumen waterproofing. The original roof had failed at some time and a new roof had been constructed over the top of the original roof probably in the seventies. Timber joists for the new roof were supported by stiff joist hangers, the row of slots supporting the top flange of the joist hangers can be seen as short black lines cut into the render approximately 150mm (two brick courses) below the top of the flashing level.

Remains of the felt flashing can be seen hanging from the wall below the window just to the left of the centre of the picture.

The projecting brickwork to the right of the picture was left to give some help to the stability of the masonry at this corner, and will be dismantled when walls have been deconstructed down to first floor level.

Plate 24

Flat 2 - junction after living room deconstructed

The detail shows the junction between four masonry walls at the southern end of Flat 2; the holes for the timber joists referred to in the previous plate can be seen between the grey bricks to the right of the picture, and the slots cut for the new roof over can be seen as black lines in the top right of the picture.

The middle of the picture shows the remains of a complicated masonry junction between:

- the brickwork coming out of the picture which sat on top of an insitu reinforced concrete lintel now removed and leaving the large hole next to the door
- the wall over the door which shows clay bricks which have been used to fill in around the roof joists to the substantial porch/conservatory which was above the door
- the wall behind the centre of the picture and going into the picture
- the wall to the right of the picture which supported a new roof over the original roof.

Plate 25

Flat 2 - air vent in west wall of kitchenette

The detail shows the projecting brickwork which was left to provide stability to the north east corner of the building.

Beneath the wall plate which supported the original roof, it will be seen that a sealant tin has been plastered into the wall to fill the space previously occupied by an air vent. This detail shows 'cowboy' building at its worst; when two different materials are built together, then they will expand and contract at different rates and eventually the bond between them will break down.

Plate 26

Flat 2 - after living room deconstructed

Just to the left of centre can be seen the white plastic box which houses the gas meter, the gas supply is through the white pipe which can be seen beneath the box on the left, Transco disconnected the supply in the pavement just to the right of the picture leaving the box but taking away the old meter.

The three rusty looking bars lying on top of the bricks on the right of the picture are I-sections which were used as reinforcement in the lintel above the door at the south end of the living room (originally a garage).

Plate 27

Flat 3 - Landing at top of stairs

The picture shows the landing at the top of the stairs after gutting. The stairs and the balustrade remained in place as long as possible so that they provided access.

Plate 28

Flat 3 - adjacent to entrance to conservatory

The picture shows the floor to the west of the entrance to the conservatory at first floor level. The large holes in the floor boards indicate that the corner once contained a hot water cylinder or tank.

In its 65 years of life, No. 42 has had its building services changed considerably on at least one occasion.

The course of breeze blocks at the bottom of the brick wall, was provided to facilitate fixing of the skirting board, it is easier to drive nails into breeze block than it is to drive them into brick.

Plate 29

Flat 3 - east wall of bedroom 1 - hidden door

The picture was taken from the landing adjacent to bedroom 1. The red spot shows a timber lintel over a blocked up doorway. When the plaster was removed from the wall to expose the doorway, it was found that the plaster across the doorway was identical with the plaster on either side; the conclusion being that the original construction made provision for a door to be constructed at some later date.

In its 65 years of life, No. 42 has had its room layout replanned considerably on at least one occasion, but it is probable that nobody realised that provision had been made for a door at the position shown.

Above the lintel can be seen cracks through the blocks and bricks; the provision of the opening required that the 'stretching bond' generally used in single skin walls, be omitted from the blockwork to the left of the opening and the brickwork to the tight of the opening. The loss of bond at the opening has greatly reduced the strength of the wall to resist forces due to subsidence, and in consequence cracks have appeared at the top of the opening.

At the top of the picture 'herringbone strutting' can be seen bracing the timber joists to each other. Modern practice is to use short lengths of the joist section itself for bracing purposes (referred to as solid strutting); although the modern practice uses much more timber, it is quicker and requires less skill than herringbone strutting.

The course of breeze blocks on either side of the timber lintel, was provided to facilitate fixing of the picture rail.

Plate 30

Flat 3 - tie down of conservatory roof

The lower half of the picture shows the steel beam which supports the roof of the conservatory. The building surveyor's drawings specified:

- 152 x 89 (17) RSJ welded & bolted to RHS columns
- Metal cleats welded to beam and bolted to joists.

After the plasterboard ceiling was removed it was found that there were no cleats connecting the timber joists to the RSJ. As the roof was in danger of blowing away during the winter gales, G clamps were used to clamp the rafters to 50x50mm short vertical stubs and another set of G clamps to clamp the stubs to the RSJ, thereby providing a tie between the rafters and the RSJ and hence a tie to the supporting columns.

Builders cut corners and omit to do things that they should do.

Plate 31

Flat 3 - new conservatory plaster to original wall

The picture which was taken from within the new conservatory looks back through the door into the original house part of Flat 3. Wallpaper has been removed from the wall and in the top left corner of the picture, above the window, can be seen evidence of damp where the new conservatory joined the original house.

Wherever possible, all plaster was removed from the walls of No. 42 while the house still had a roof, as it was considered easier to separate the materials in an orderly manner as deconstruction proceeded rather than wait until there was a very large pile of bricks all mixed up with render and plaster. An unsuccessful attempt was made to remove the plaster from the wall; the red spot shows where the attempt was made. The thickness of plaster on the face of the wall is approximately 40mm (less on the wall in the door opening) and the plaster could not be removed sensibly by club hammer and bolster. Modern plaster specifications for housing alterations, such as: Finish on Browning on Bonding on Unibond are much stronger and much more difficult to remove than plasters used between the wars.

Plate 32

Flat 3 - cupboard wall adjacent to the bathroom

The top red spot marks a timber lintel supporting masonry above. The lower red spot marks the lintel supporting the masonry over the door opening; the door opening can be seen in the bottom right corner of the picture. The timber which can be seen between the two red spots, giving only partial support to the top lintel, is a 4″ x 2″ vertical.

Underneath the lower lintel is a void, so some of the load from the top lintel gets carried by the lower lintel which has a void beneath it and receives only partial support from the timber stud to which it is nailed. The picture has been included to show that bad building construction existed in the thirties and therefore is not a modern phenomenon.

Plate 33

New garage - joint with old garage

After the extensive sea defence works and the consequent moving of the cliff edge coast road to the north of No. 42; a new garage was constructed to the north of the old garage, and a new access was formed between the new garage and the new road. The picture shows the wall between the old and new garages, the side door of the new garage is the dark area to the right of the picture.

The wide gap from top to bottom just to the right of centre of the picture is a joint between the old and new garages. When the new garage was constructed the builder decided wrongly that the new wall should be keyed to the old wall, the middle of the picture shows that the masonry key has been broken. It is probable that the joint opened up soon after construction of the new garage and that the freestanding column of mortar at the top of the picture was filled in to close the gap; since the filling was done, the gap has widened further, and in places is sufficiently wide for a hand to be inserted.

Pictures such as this, which are of no interest to the lay person, have a story to tell to all those involved in construction. Each such detail is a bit like an Agatha Christie novel with the difference that the question the detail poses is 'what did it' rather than 'who did it'.

Plate 34

Garage - front of garage after deconstructing

The reinforced concrete lintel which was above the up-and-over garage door can be seen in the middle of the picture. The lintel supported a brickwork end wall of 1.5m height, the remains of the brickwork can be seen in the front of the garage.

As the deconstruction proceeded, the concrete blocks from which the walls were constructed were taken away for recycling. One or two pieces of broken blocks can be seen in the picture; one piece can be seen at the bottom left of the picture. The bottom two courses of blocks, rendered and painted with black bitumen had not been deconstructed at the time the picture was taken.

Plate 35

East wall - cracking caused by new porch

The boarding to the left of the picture is that of a substantial porch giving access to Flats 2 and 3. The significant cracks in the original wall - rendered and painted cream - are seen to emanate from the junction between the new porch and the old wall. When the wall - to which the new porch is fixed - was deconstructed, it was found that the reinforced concrete lintel - at the level of the cracking - was in danger of collapsing due to corrosion of the reinforcement and consequent spalling of the concrete.

Whenever a new structure is tied in any way to an existing structure the connection between them should:

- be designed to accommodate movements caused by subsidence and thermal effects
- take into account the strength of the existing structure.

Plate 36

West wall - damp caused by bricked up stack

The stack can be seen in the centre of the picture; halfway up the stack it can be seen that the render has spalled.

The stack is on the west wall which receives the prevailing south westerly storms; the building has an exposure rating which is 'severe'. Due to the subsidence problem, walls of the house have many hairline cracks in addition to the visible ones. The downstairs fireplace has been bricked up, without an air vent. Little wonder that the wall inside 'runs' with water after heavy rain. Chimney stacks and any other voids must be properly ventilated.

Plate 37

Roof & balcony drainage hopper on SW corner

The curved wall to the right of the hopper is the balcony wall at first floor level. The square plastic pipe feeding into the hopper drains the balcony, not simply the rain falling onto the balcony, but also that from the downpipes from the gutters of the new conservatory to Flat 3.

The staining to the wall above the hopper is from rusting of the 'New mild steel railings' installed in 1986, aided and abetted by the prevailing south westerlies. Mild steel should not be specified for external use in severe exposure conditions especially at sites which are drenched by sea spray. The prevailing south westerlies ensure that throughout winter storms, the corner shown is running with water; little wonder then that the water will find its way through the cracks causing the dampness in bedroom 2 of Flat 1.

Plate 38

North wall - cracking

The west half of the north wall shows how cracks in a wall branch between the weakest parts. The fact that the crack branched to the 40mm plastic waste pipe would suggest that the opening up of a hole in the wall for the waste pipe caused far more damage than the outside appearance of the wall would suggest.

Plate 39

West wall - water penetration at ground level

In the middle of the picture it can be seen that the coating has spalled from the render beneath. To the right of the spalling a crack can be seen going up and to the right through the air vent. The crack has been filled - as can be seen in the picture - and then painted over. This hiding of the crack lasts for about a year, then - because of seasonal expansion and contraction - the crack will appear again.

Plate 40

Going, going

The picture shows the flats after removal of the roof parapet, and half of the first floor walls. The vertical slots seen at the top of the highest masonry wall were those for the support of the roof joists.

All deconstruction of the external walls was done from inside the building - either working from floor level or from a 4ft platform made from mobile scaffolding; thereby using the external wall as a parapet - see also Plate 42.

A neighbour found some students wandering around the garden and filming the block near the time the picture was taken. On questioning them, they replied that they were from Bournemouth University and doing a project on Nuclear Winter.

Plate 41

Storage of timber for recycling

The picture shows just a small part of the huge amount of denailed timber ready for recycling into new construction.

It is important that denailed timber be stored in the dry. If more than one house is to be recycled then plan the recycling to keep one of the houses for the storage of timber, or use an unoccupied factory.

Plate 42

Mini scaffolding

The picture shows an extensive platform at a height of 4ft above first floor level. The platform was formed two 4ft high mobile scaffolding with infill floor planks to extend the area.

The mobile tower scaffolding system had a 7ft x 7ft plan size; the smallest height which could be built, used four sections each of 2ft height, with the lower two of the sections going in one direction and the upper two locking into the lower two. The height of 4ft was found to be ideal for the removal of ceiling joists and masonry and lintels above the windows.

The extensive platform was ideal for supporting the 'stout stool' (shown in the centre of Plate 19); standing on the top of the stool allowed the head and shoulders to go through the roof or ceiling above. No. 42 was deconstructed without any external scaffolding or external ladder work; for safety, access to all roofs was through the ceiling of the room below. The picture shows the windows and brickwork walls acting as a parapet to the platform.

Plate 43

First floor timber joists

The picture shows the timber floor joists at first floor level after removal of all first floor masonry and partitions and floor boards. Steel conduits can be sticking up from the floor; the conduits contained the original 1936 electrical wiring, all of which had been replaced over recent years.

Near the top left corner of the building can be seen part of the cast iron waste stack. The joints between sections of this stack had been made from pouring molten lead; as the cast iron stacks were cracked at most spigot & socket positions, no attempt was made to recycle them and they were removed by hitting them with a sledge hammer.

The considerable amount of notching and holes through the floor joists are evidence of at least three major replacements of the electricity and water services over the lifetime of the building.

Plate 44

First floor timber joists

The picture shows the north east corner of the building at first floor level after removal of most of the first floor timber joists.

The working platform can be seen to the right of the picture in the hole left by the removal of the first floor timber joists. The external wall to the right of the picture can be seen as being of eleven inch cavity construction; the inner skin being formed from calcium-silicate brickwork, the outer skin being formed from a more dense calcium-silicate brick.

Plate 45

First floor construction

The picture shows first floor construction beneath the new conservatory at the south of the building.

The new conservatory was built in 1986 and subject to the building regulations then in force which required that weight be added to reduce the sound transmission between the flats. This was achieved by taking up the old flooring, laying chicken wire over the floor joists to support polythene sheeting which was lined with mortar and infilled with a mixture of sand and mortar. The picture shows the polythene sheeting after it (and the chicken wire) had been cut along its length to remove the added mass. The added mass endangered the structure as the timber joists were supported on steel beams which had corroded completely through near the supports.

Above the polythene sheeting, new 50x50 timbers which supported the flooring can be seen. The steel beam with upstand cleats was added to the floor when the conservatory was built; this beam - which ran for the full width of the building - supported four steel columns which in turn supported a full length steel beam at second floor level.

Plate 46

Levering up floor timbers

The picture shows the writer levering up a first floor timber using a wrecking bar. Floor boards and the timbers shown in the picture are nailed to joists beneath. A short piece of stout timber is placed such that it spans across the joists beneath; the operative then inserts the wrecking bar above the stout timber and under the timber to be 'levered up' and pushes down on the end of the wrecking bar. Nails, which are extracted in the process, are thrown in the bucket.

Access to first and second floors was from the inside using a platform formed from a mobile scaffolding as the suspended floors. The writer is standing on a concrete floor at first floor level but came up through the floor to his left. The reason that the writer was not wearing a safety helmet was that this project was research and there were no people working above him; on any Recycling Housing project, safety helmet and goggles must be worn at all times.

Plate 47

The block of flats reduced to one storey

The picture shows the southern elevation following deconstruction of the single storey construction (formerly on the right of the picture) and deconstruction of the first floor. It will be evident from the picture that a lot of bricks were produced from the deconstruction process. One third of the bricks were cleaned up and stacked off-site, and on-site for recycling. Many of the bricks in the outside leaf of the rendered external wall could not be cleaned up for reuse as removal of the render generally needed such force that the bricks broke. These bricks were recycled as hardcore, they can be seen beneath the wheelbarrow; considerable care was taken in the selection and laying of the bricks to provide a smooth surface for the support of the single sized pebbles to be used as a finish (not shown). To prevent weeds from growing up through the brick base, roofing felt (recycled from the first and second floor roofs) was laid between the brick courses in the base - the front wheel of the wheelbarrow just touches a strip of the recycled roofing felt.

In the lower right corner of the picture - next to the grass - can be seen reinforced concrete lintels which are to be recycled in non critical locations due to the uncertainty concerning the strength of the lintels. Just behind the lintels can be seen breeze blocks, aerated concrete blocks and dense concrete blocks which will also be recycled in non critical locations.

Plate 48

Rubble

The picture shows a pile of rubble hard against the patio windows and across the corner of the door. During the deconstruction of 42 Southbourne Coast Rd there were four break-ins to the premises, two of which were through the door in the centre of the picture and one through the patio doors. The rubble was deliberately piled across the doors to make the burglars have to work with their hands to gain access in the hope that this would be a deterrent. The pile of rubble remained in place until the ground floor walls were deconstructed and during this period, no further break-ins took place.

Rubble is merely a collection of mixed construction materials which - when mixed - have little use in the construction process. When the materials are separated into their component parts e.g. timber, bricks, tiles, slates, steel joists, lintels, render and so on, then the rubble disappears and is replaced by materials which may be recycled.

Plate 49

Brickwork removal getting easier

The picture shows the south elevation where the brickwork above the door and windows has been pushed away allowing it to fall to the ground.

Removal of external brickwork at second floor level and in the parapet above the second floor was one brick at a time using a demolition hammer. The temptation to push the wrecking bar into the cavity at second floor level and lever sections of the wall away was resisted for three reasons:

- uncertainty of just how much wall would fall away
- avoidance of dangerous collapse of part of the building
- avoidance of breakage of the bricks.

Plate 50

Second floor steelwork

The picture shows the full length second floor beam - which supported the conservatory - after cutting with an angle grinder into four pieces. Each of the four pieces will be recycled as ground beams spanning between the mass concrete pad foundations, and encased in concrete to carry the dense concrete perimeter blockwork wall below ground floor level.

Plate 51

Denailing floorboards

The picture shows the writer driving a floorboard nail back through the floorboard. Once the point of the nail has been driven flush with the board, the board is pushed along the bench and the process repeated for the next nail until all nails have been driven back. The board is then turned over and the nails withdrawn using pincers - which can be seen lying on the bench - having red handles. On a proper construction site, the operator must wear safety helmet and glasses.

Plate 52

Site storage of materials

The picture shows site storage of dense & light blockwork, concrete paving slabs, floor tiles, timber staircase (to the left) all supported on a base made from recycled bricks.

It is sensible to store on site only those materials which are unlikely - because of their weight - to be stolen. Cleaned up bricks left near the front of the site were stolen on two occasions; after the second theft, all cleaned up bricks for recycling were stored at the back of the site which meant that any thief would have to carry the bricks at least 30m.

Plate 53

First floor steelwork

The picture shows part of the first floor steelwork which comprised mains beams with secondary joists spanning onto the bottom flange of the main beams. Between the steel joists can be seen rolled steel angles used as reinforcement for the infilled concrete. Concrete can be seen embedded within the flanges of the rolled steel joists; all this concrete had to be broken out so that the rolled steel angles - used as reinforcement - could be removed.

Plate 54

Sharp edges

The picture shows part of the first floor steelwork which comprised mains beams with secondary joists spanning onto the bottom flange of the main beams. Between the secondary joists were rolled steel angles used as reinforcement for the infilled concrete.

The main beams spanned 10m and weighed approximately 300kg. As the deconstruction was being carried out using only hand tools (to avoid the expense of hiring plant) the main beams were supported using short scaffolding towers or stout stools allowing the steel beams to be cut using an angle grinder (Bosch GWS 20-230). Cut steel beams leave very sharp edges and corners - even when the burrs have been removed - so any ends which may be 'bumped-into' were padded as shown in the picture.

Plate 55

First floor steelwork

The picture shows part of the first floor steelwork which comprises mains beams with secondary joists spanning onto the bottom flange of the main beams. Between the secondary joists were rolled steel angles used as reinforcement for the infilled concrete.

The picture was taken after the concrete and rolled steel angles had been broken out. The time taken to break out 10m2 was approximately 60 hrs.

Plate 56

First floor steelwork

The picture should be viewed as a landscape. The picture shows part of the first floor steelwork which comprises mains beams with secondary joists spanning onto the bottom flange of the main beams. Between the secondary joists were rolled steel angles used as reinforcement for the infilled concrete.

The picture was taken after the concrete and rolled steel angles had been broken out, and shows the Bosch demolition hammer, ear-defenders and goggles used. As the concrete was broken out, the planks shown in the picture were moved to provide a working platform. This work was being carried out at first floor level standing on a platform supported on the ground floor.

Plate 57

Corrosion of first floor steelwork

The picture shows a typical end support of the first floor steelwork after removal of all the first floor walls. The corrosion of the beam was so severe that the 'laminations' could be picked out by hand.

Plate 58

First floor steelwork connections

The picture shows a typical cleated connection between the primary and secondary beams. One or two of the bolts could be removed by box spanner, but most were severely corroded and for these the nut was cut through by an angle grinder.

Plate 59

Removal of bolts

One or two of the bolts could be removed by box spanner, but most were severely corroded and for these the nut was cut through by an angle grinder. The picture shows the chisel end of a crow bar being inserted into the cut formed by an angle grinder. The crow bar was levered up and down until the two halves of the nut broke free from the bolt.

The staining around the bolt holes was caused by the application of WD40, copiously applied over a couple of days to assist the frequent attempts to remove the nuts by spanner; successful for the left hand nut but not for the right hand nut.

Plate 60

Removal of floor boards

The picture shows an electric circular hand saw being used to cut through the tongued and grooved floor board joints. This was a tedious process and was only undertaken after many unsuccessful experiments in removal of the floor boards without cutting through the joints.

The kneeling mat used by the operative was found to be more convenient than a pair of proper knee pads. With a little practice it becomes second nature to kick the kneeling mat to its next required position. Although knee pads undoubtedly have their uses, they are not very comfortable when moving around or frequently getting up and down.

Plate 61

Chimney flue

The picture shows the flue in the external wall leaf viewed from the inside at the ground floor level. It was apparent that the form of construction was to build a recess in the outside wall and then construct the flue as needed using broken bricks as infill masonry and finally construct the inside wall. Generally the wall ties were at 450mm centres; they had been galvanised and were in reasonable condition - they can be seen to the side of the flue. There were no wall ties in the area of the flue itself, so it is guessed that the inside wall was omitted in this area until the flue was built (normally in pre-war cavity construction it would be expected that the two leaves would be built at the same time).

Plate 62

Reinforced concrete wall

The picture shows part of a small reinforced concrete wall which gave considerable difficulty in its removal.

Few houses over sixty years old will not have had changes to the construction at some time. The small reinforced concrete wall formed part of an infill wall at the southern end of the original garage. It was plastered and painted; finding it came as unwelcome surprise.

'Sustainable construction' requires that all structural engineers think as much about how their structure will be deconstructed as they think about how it will be built.

Plate 63

Bricks recycled as hardstanding

The picture shows the use of a spirit level and timber plank to level the surface of the recycled bricks so that the surface will form a temporary hardstanding for the storage of construction materials, followed by use as a permanent hardstanding to support a surface of single sized pebbles which will be dressed into the elevated existing pond and rockery behind the operative.

The bricks marked with a red spot are the 'benchmarks' for the levelling process.

Plate 64

Angle grinder and Tee

The picture shows an angle grinder being used to cut through a rolled steel joist so that the pieces may be used in the foundations to support the external wall below ground floor level.

The angle grinder is bolted to a Tee (made from two pieces of recycled steel angle welded together - welding cost £3 from Sopley Forge). The operative stands on the bar of the Tee thereby constraining the blade to the plane of rotation, and avoiding 'kick backs'.

Plate 65

Breaking out the old concrete foundations

The picture shows the use of the demolition hammer to break out the old concrete foundations. Beneath the old concrete foundations there is a 600mm thick layer of topsoil - hardly surprising then that the block of flats had severe settlement problems.

Plate 66

Cleaned up bricks

The picture shows the pile of cleaned bricks - stored on site - ready for recycling. A greater sized pile of cleaned up bricks was stored off-site for recycling into other construction.

As no bricks were taken away to landfill, it follows that 100% of the bricks were recycled in some way or other.

About this pdf file.

Pdf file produced from Doug's originals by Ian Brown, February 2008.

The thesis was written using WordStar 6.0 for DOS. To convert to pdf, the thesis was first printed using the printer option LASER, but with filenames given for the "Redirect output to port" option. This produced PCL files which were converted to pdf files using ghostpcl available from http://www.ghostscript.com/awki/Ghostpcl.
(a typical command line follows: pcl6 -dNOPAUSE -PPCL5E -J"@PJL SET PAPER=A4" -sDEVICE=pdfwrite -sOutputFile=mphil.pdf mphil.pcl) The font NimbusRomanNo4-Lig.ttf used by ghostpcl was edited to reduce the size of the block character, as the block character was far too large.

Page numbers were superimposed on the pages with images, by first splitting the pages using pdftk available from http://www.pdfhacks.com/pdftk, and then superimposing the numbers page-by-page using pdftk's background function, and finally recombining the pages back into one file.

Vertical lines in the margin were created using Fitzroy Systems' TAPE drawing package to print a vertical line to a pdf file, this was then superimposed over the page of text using pdftk.

Black and white images were scanned at 300dpi monochrome, tidied up with PaintShopPro, assembled together using Microsoft Word, and printed to pdf with Acrobat Professional 6.

Colour photos were assembled together using Microsoft Word, and printed to pdf with Acrobat Professional 6. The images were then optimised to 100dpi low quality jpegs using Acrobat's file optimisation to reduce the file size.

Once the final document was assembled using pdftk, Acrobat Professional 6 was used to strip out all extraneous tables to reduce the file size.