BRE Building Elements series

ROOFS AND ROOFING

Performance, diagnosis, maintenance, repair and the avoidance of defects

THIRD EDITION

H W Harrison, P M Trotman and G K Saunders

IHS
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CONTENTS

PREFACE TO THE THIRD EDITION

The third edition of this book is being published at a time when the UK construction industry is facing a significant reduction in its work load, and nearly a decade after the second edition was prepared. That decade has seen massive changes in public awareness of the need for sustainability in construction, and the introduction of the Code for Sustainable Homes in November 2006, which since May 2008 has formed a basis for assessment of the acceptability of the design of new housing in England and Wales.

But similar needs exist for the whole of the UK's future building programme, new-build hospitals, factories, educational buildings and other long-life buildings which will provide challenges to designers in meeting the conditions brought about by anticipated climate changes and the need to be carbon-neutral and to conserve our dwindling natural resources. There have also been significant changes in British Standards which increasingly reflect those taking place in Europe.

However, the UK cannot afford year-on-year to renew more than a very small percentage of the stock of existing buildings, and the need for intelligent conservation and upgrading of the old stock is arguably of equal if not more importance.

It is against this background that this third edition of *Roofs and roofing* has been prepared. In addition to thorough revision of the chapters on the more traditional forms of construction, such as tiling and slating, completely new chapters have been prepared on:

- extensive lightweight green roofs,
- modern methods of construction,
- roof-mounted photovoltaic systems,
- thermal insulation in lofts,
- loft conversions,
- single-layer membranes.

New sections have been introduced as appropriate into existing chapters, including:

- new forms of metal roofing,
- siphonic roof drainage,
- new materials technologies,
- improved protective finishes for timber, metals and concrete.

Where appropriate, each chapter now contains a section dealing with provisions that may become necessary to accommodate climate change (eg increased rainfall, stronger winds and higher temperatures).

There have been considerable changes too in the standards covering roof drainage which have been reflected in the revised text.

Approximately one-quarter of the photographs are new to this edition.

HWH
PMT
GKS
June 2009

3 SHORT-SPAN DOMESTIC PITCHED ROOFS

Short-span roofs are normally defined as being of less than 8–9 m span. Pitched roofs are conventionally defined as those roofs with slopes greater than 10°, whereas roofs of slope 10° or less are defined as flat.

For the purposes of this book, pitched roofs have been categorised into those covered in relatively small overlapping units, dealt with in Chapters 3.1, 3.2 and 3.6, those covered in sheet materials, dealt with in Chapters 3.3–3.5, and thatch, which forms a category of its own, dealt with in Chapter 3.7.

Small overlapping units consist of the following types:

- clay tile,
- concrete tile,
- natural slate,
- manmade slate,
- shingles.

Figure 3.2 shows the current market share held by the first four categories. Following increased appreciation of the need to protect the environment, there has been limited use of recycled materials such as rubber. The increased popularity of PV systems is envisaged which will affect the type of roofing chosen to support them.

Some general information about defects in pitched roofs in housing can be found in *Assessing traditional housing for rehabilitation*[1].

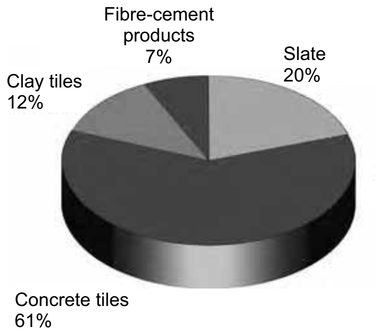

Figure 3.2: Roof tile market by value, 2006. Data from *Roofing Market Report*[2]

Figure 3.1 This steeply pitched plain tiled roof was built in 1880 but re-covered after bomb damage in the 1939–45 war

***Box 3.1:* Calculations of rainwater run-off from short span domestic roofing and gutter size**

Using Figure 3.25, the effective catchment area that will discharge to each gutter is:

- for the slope of a pitched roof, the plan area, A (m^2), plus half the elevation area, B (m^2) (Figure 3.25a),
- for a pitched roof abutting a wall, the plan area, A, plus half the elevation area, B, plus half the wall area, C, above the roof slope (Figure 3.25b),
- for a flat roof, the relevant plan area.

The run-off rate to each gutter is the total catchment area for the gutter divided by 48. This produces the run-off in litres per second using the recommended rainfall (thunderstorm) rate of 75 mm/hour.

The size of the guttering is shown in Table 3.5 using the flow capacity that will accommodate the run-off rate. As part of this process, the number of outlets should be considered: more outlets from a run of guttering spreads the total loading on the gutter, but the loadings will vary according to where the outlets are positioned (Figure 3.26).

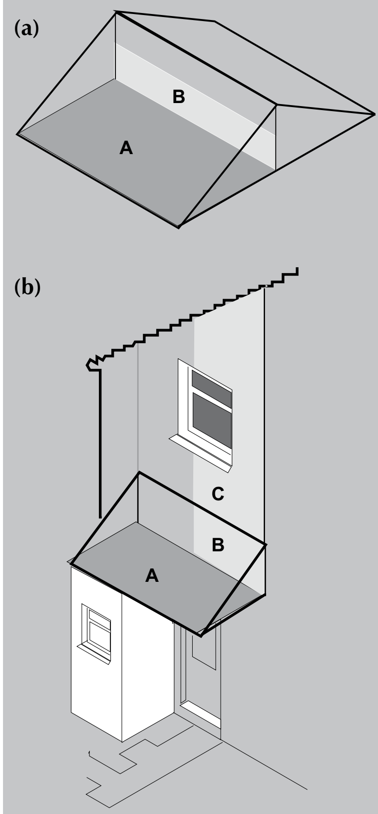

Figure 3.25: Catchment areas for calculating rainwater run-off

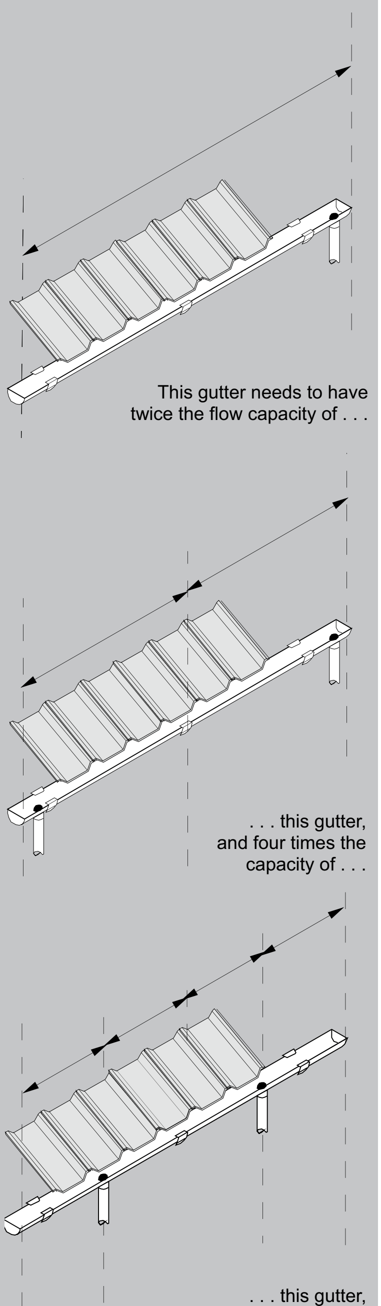

Figure 3.26: Spacing between outlets to reduce water load on gutters

***Table 3.5:* Flow capacities of standard eaves gutters (when level)**

Size of gutter (mm)	Flow capacity (litres/sec) True half round	Nominal half round
75	0.38	0.27
100	0.78	0.55
115	1.11	0.78
125	1.37	0.96
150	2.16	1.52

BRE site inspections. Drawings have been seen that specifically state that the design of gutter systems should be left to the site staff to sort out! The pitch of valley gutters is less than the pitch of the roof they join, and valley gutters on pitches of less than 20° are particularly prone to leaking. Poor detailing was commonly found in the BRE quality assessments.

BRE site inspections revealed a number of cases where gutters had not been installed on porches and bay windows: decisions which may be marginal where the drips cause no inconvenience to the occupants, but less acceptable for doorways (Figure 3.27).

A room in the roof

Where a room is formed within a pitched roof void, it is sometimes difficult to achieve adequate ventilation for the roof to the outside (Figure 3.28). BRE Defect Action Sheets 118[22] and 119[23] deal with this problem, particularly where it involves the careful placing of thermal insulation to ensure an adequate ventilation gap. *Thermal insulation: avoiding risks*[24] is also helpful. The most important points to watch are:

- that a vapour control layer (eg of at least 500-gauge polyethylene) is installed in the sloping part of the roof under the insulation,
- that a vapour permeable sarking is used in new construction,
- that cupboards should be within the insulated envelope, ensuring continuity of the lining.

MAIN PERFORMANCE REQUIREMENTS AND DEFECTS

Choice of materials for structure

Timber has been used as the main structural material in the vast majority of tiled roofs: those dating from before the early 1960s for the most part designed with strutted purlins (Figure 3.29), more recent designs using trussed rafters. The structure of most of these is in good condition (only 1 in 8 of these structures being reported as faulty[5]), provided attention has been paid to routine maintenance of the covering.