GOSS'S ROOFING READY RECKONER

FROM TIMBERWORK TO TILES

Fifth Edition

C. N. Mindham

WILEY Blackwell

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FROM TIMBERWORK TO TILES INCLUDING METRIC CUTTING AND SIZING TABLES FOR TIMBER ROOF MEMBERS

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This edition first published 2016

Registered office
John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom.

Editorial offices:
9600 Garsington Road, Oxford, OX4 2DQ, United Kingdom.
The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom.

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Library of Congress Cataloging-in-Publication Data

Names: Mindham, C. N. (Chris N.), author. | Goss, Ralph. Roofing ready reckoner.
Title: Goss's roofing ready reckoner : from timberwork to tiles.
Other titles: Roofing ready reckoner
Description: 5th edition / C.N. Mindham. | Oxford, United Kingdom : John Wiley & Sons, Inc., 2016. | Includes bibliographical references and index.
Identifiers: LCCN 2015044551 (print) | LCCN 2015045710 (ebook) |

ISBN 9781119077640 (pbk.) | ISBN 9781119077664 (pdf) |
ISBN 9781119077657 (epub)
Subjects: LCSH: Roofs–Handbooks, manuals, etc. | Carpentry–Mathematics–Handbooks, manuals, etc. | Roofing–Handbooks, manuals, etc. | Engineering mathematics–Formulae–Handbooks, manuals, etc.
Classification: LCC TH2401 .G67 2016 (print) | LCC TH2401 (ebook) |
DDC 694/.2–dc23
LC record available at http://lccn.loc.gov/2015044551

A catalogue record for this book is available from the British Library.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

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Introduction and Acknowledgements

The aim of this book, when first published in 1948, was to provide quick reference tables for the length and angles of cut for timber members in a traditional cut roof construction. Today, when many houses use trussed rafters for their roof construction, there is still a need for some parts of those roofs to be built using traditional methods, especially with the ever-increasing use of attic roof structures. The renovation of older roofs, extensions and conversions all require knowledge of roofing from wall plate to ridge, and the correct detailing of the roof covering materials themselves.

Relaxation in planning controls has allowed a wide range of smaller buildings to be constructed without planning permission. These include sheds, garages, garden office buildings and workshops. New information on the limitations of building profile and construction is included in this edition, together with some helpful drawings.

This book assumes that a basic architectural design of the roof to be constructed is already completed, that is, the span, pitch, length and any additional supporting walls. Guidance is given on how to calculate the size of individual roof member timbers, the cutting length, the angles and the compound cuts. The tables shown are based on BS5268 ‘Structural use of timber’ and a comparison of timber sizes using Euro code 5 ‘Design of Timber Structures’ is shown as both design documents are currently acceptable by building control regulations. The book now also includes all aspects to be considered when choosing the roof covering, including the suitability of the tiles or slates for the pitch and exposure of the roof concerned, the choice of a ‘warm’ or ‘cold’ roof, the considerations to be given to the correct insulation, and the possibilities and avoidance of condensation within the roof space by dealing correctly with ventilation.

Solar panels, now frequently fitted to both new and existing roofs, impose different loads on roof structures and these have been addressed in a new chapter.

Finally, Health and Safety matters are addressed, including the ‘Working at Heights Regulations’, loading the roof structure with the roof coverings, lifting components, and the correct use of preservative-treated timber.

Acknowledgements

My thanks are due to all the manufacturers who have allowed me to use their product illustrations. I am particularly indebted to Robinson Manufacturing Ltd, for the help they have given on engineering timber components, and especially for help on spandrel panels. Thanks are also due to Kier Living Ltd for access to their construction site for photography for the cover of this book.

The Trussed Rafter Association helped with solar panel fixing research, and Anthony Gwynne kindly contributed with his overview of the building regulation requirements with regards to thermal performance.

2
Roofing terminology

The main terminology used for roofing is listed below (see Figures 2.1–2.4).

Wall plate The ‘foundation’ of the roof, usually 50 × 100 mm wide, must be bedded solid, level and straight on the top of the wall, or nailed to the timber-framed panel and strapped in place to prevent movement from the structure.

Purlin The member carrying part load of the long common rafters, traditionally placed at rightangles to the rafter but now more commonly fixed vertically.

Pitch The angle made by the slope of the roof with the horizontal. This may be stated in degrees on the drawing, it may have to be measured by protractor from the drawing, or it may have to be calculated by measurement if the new work is to match an existing roof.

Ridge The timber at the top of the roof where the rafters meet, giving a longitudinal tie to the roof structure, commonly 38 mm thick, and of a depth equal to the top cut on the rafter plus approximately 38 mm. This depth will depend on the pitch of the roof and the tile batten thickness.

Common rafter The timber running from the ridge, down over the purlin if fitted, over the wall plate, and to the back of the fascia.

Jack rafter The timber running from the hip rafter down over the purlin if fitted, over the wall plate, and to the back of the fascia.

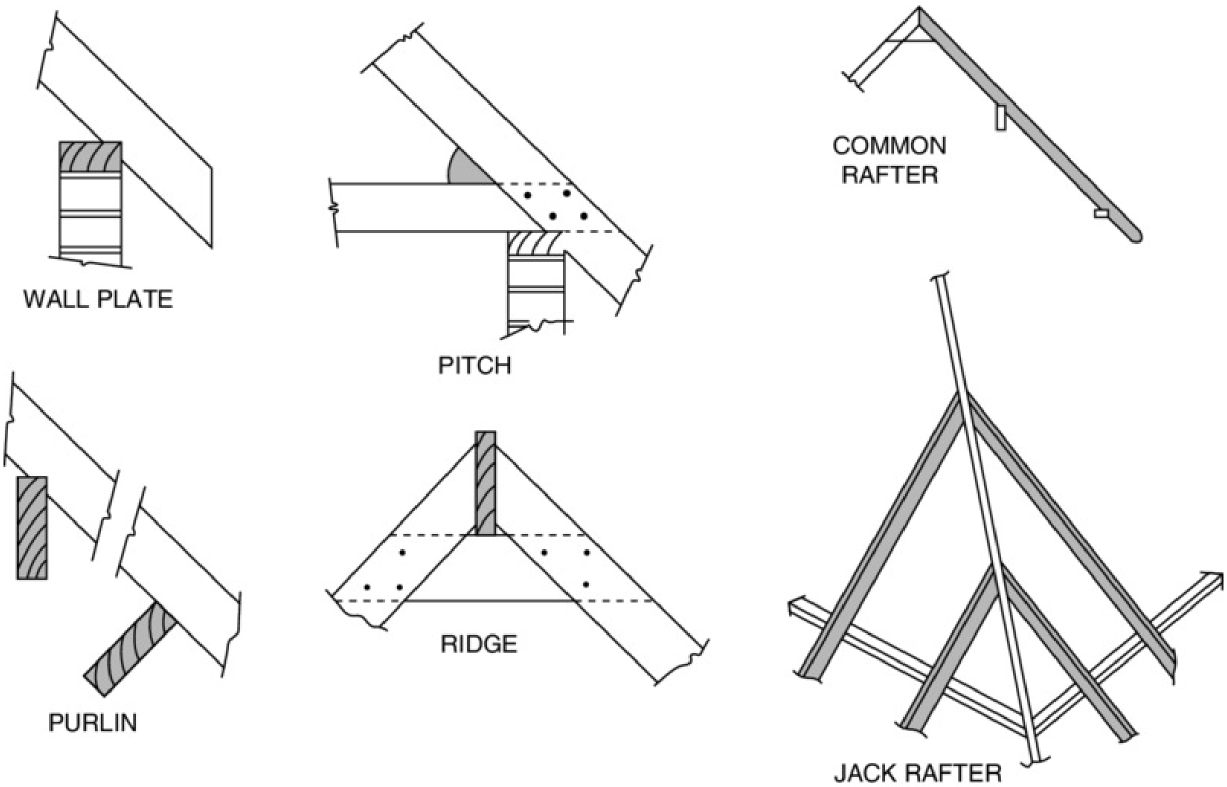

Figure 2.1 Illustration of terms used in chapter.

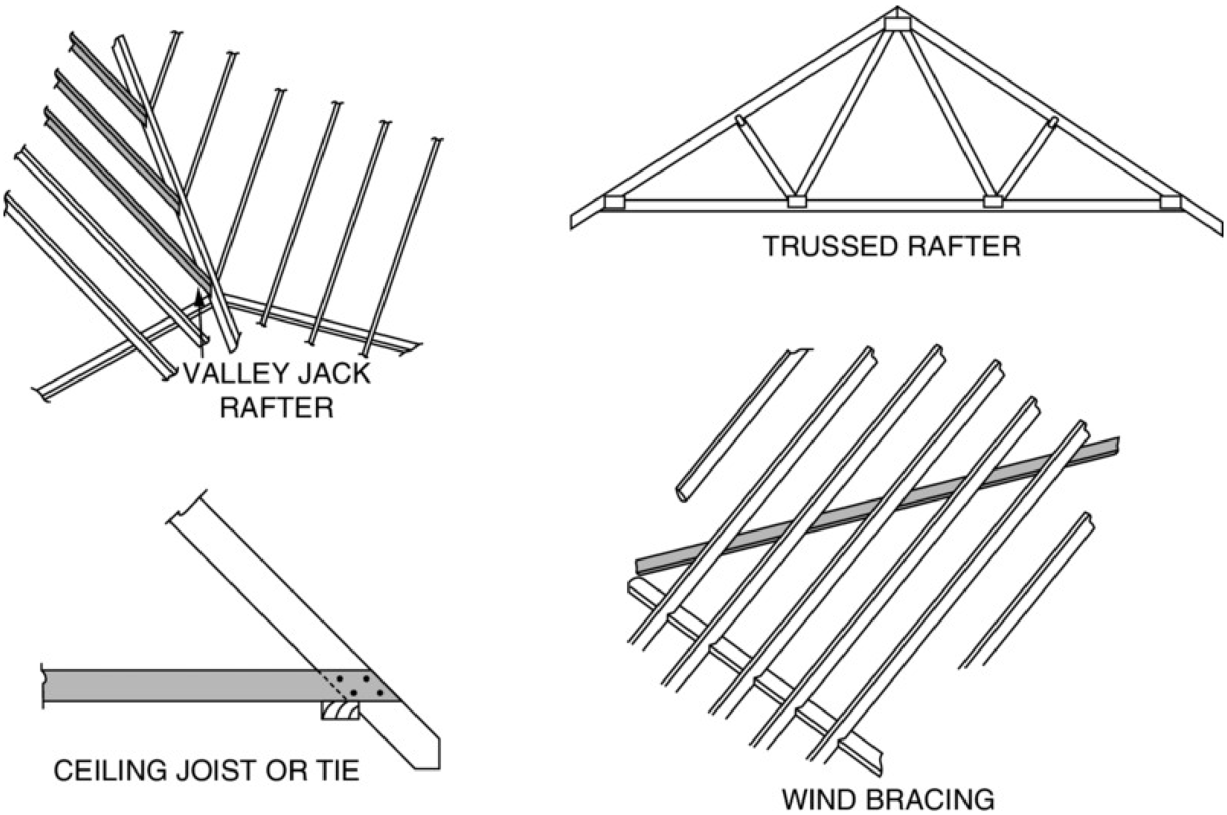

Figure 2.2 Illustration of terms used in chapter.

Valley jack rafter The timber running from the ridge, down over the purlin, down to the valley board or rafter.

Trussed rafter A prefabricated framework incorporating rafter, ceiling joist (or tie), and strengthening webs forming a fully triangulated structural element.

Ceiling joist or tie Timber supporting the ceiling of the building, but often importantly 'tying' the feet of the common and jack rafters together thus triangulating and stabilising the roof.

Wind bracing Usually 25 mm × 100 mm timber nailed to the underside of rafters and trussed rafters running at approximately 45. to them, to triangulate and stabilise the roof in its vertical plane.

Attic or room-in-the-roof truss or trussed rafter This popular truss shape allows the use of steeper pitch roof voids for habitable accommodation. There are no set minimums for dimensions H and W, but 2.3 m and 1.2.1.5 m are practical recommended minimums unless the room is to be restricted to storage only (see Fig. 2.3)

Longitudinal bracing Usually 25 mm × 100 mm timber nailed to the underside of rafters and trussed rafters both at the ridge position on a trussed rafter roof, and at ceiling joist level on all roofs, to maintain accurate spacing and stiffening of the members to which it is fixed (Fig. 2.4).

Hip or hip rafter This is a substantial timber member running from the corner of the roof at wall plate level to the end of the ridge. In some designs the hip may stop lower down the roof, producing a small gable at high level (Fig. 2.4).

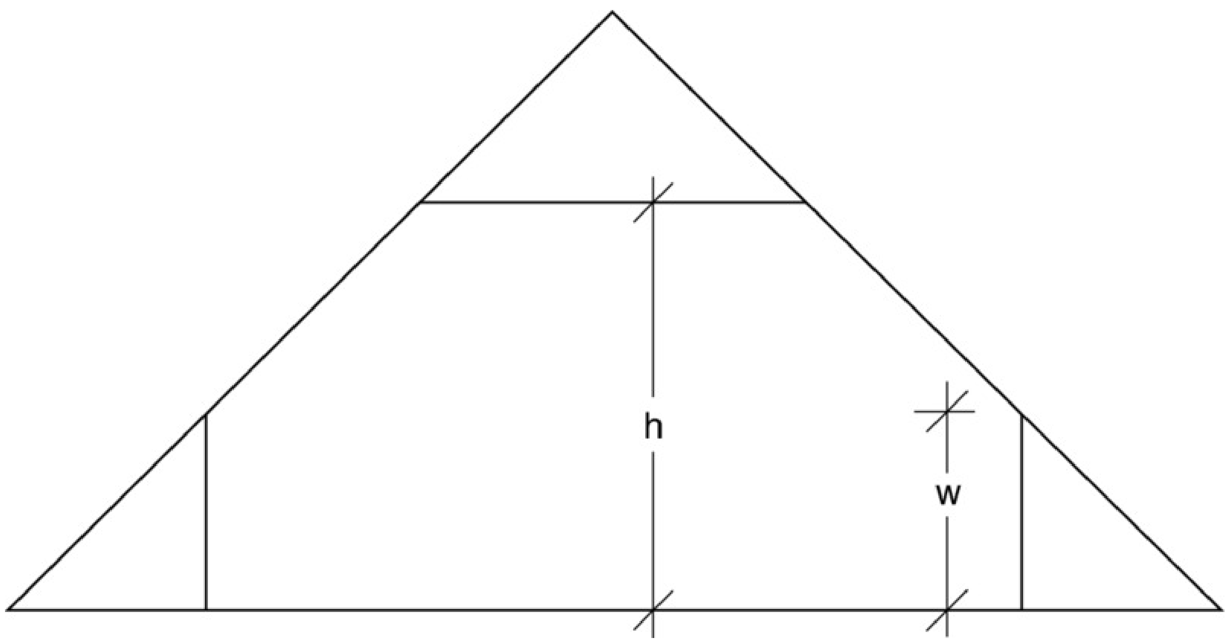

Figure 2.3 Attic or room-in the-roof truss.

Birds mouth The cut in rafters at the fixing point to the wall plate and/or the purlin (where purlins are fixed vertically); this should leave at least 0.7 × the depth of the rafter to give the strength necessary for the rafter to continue to provide an overhang to the roof. If a common rafter is fitted as part of a trussed rafter roofing system, then the 0.7 × the depth of the rafter must be the same as the depth of the rafter on the trussed rafter component. (Fig. 2.4)

Fascia Board fixed to the rafter feet, supporting both gutter and soffit (Fig. 2.4).

Soffit Timber board or sheet material used to close off the overhang between the back of the fascia and the wall. This soffit may have a roof ventilation system built into it (Fig. 2.4).

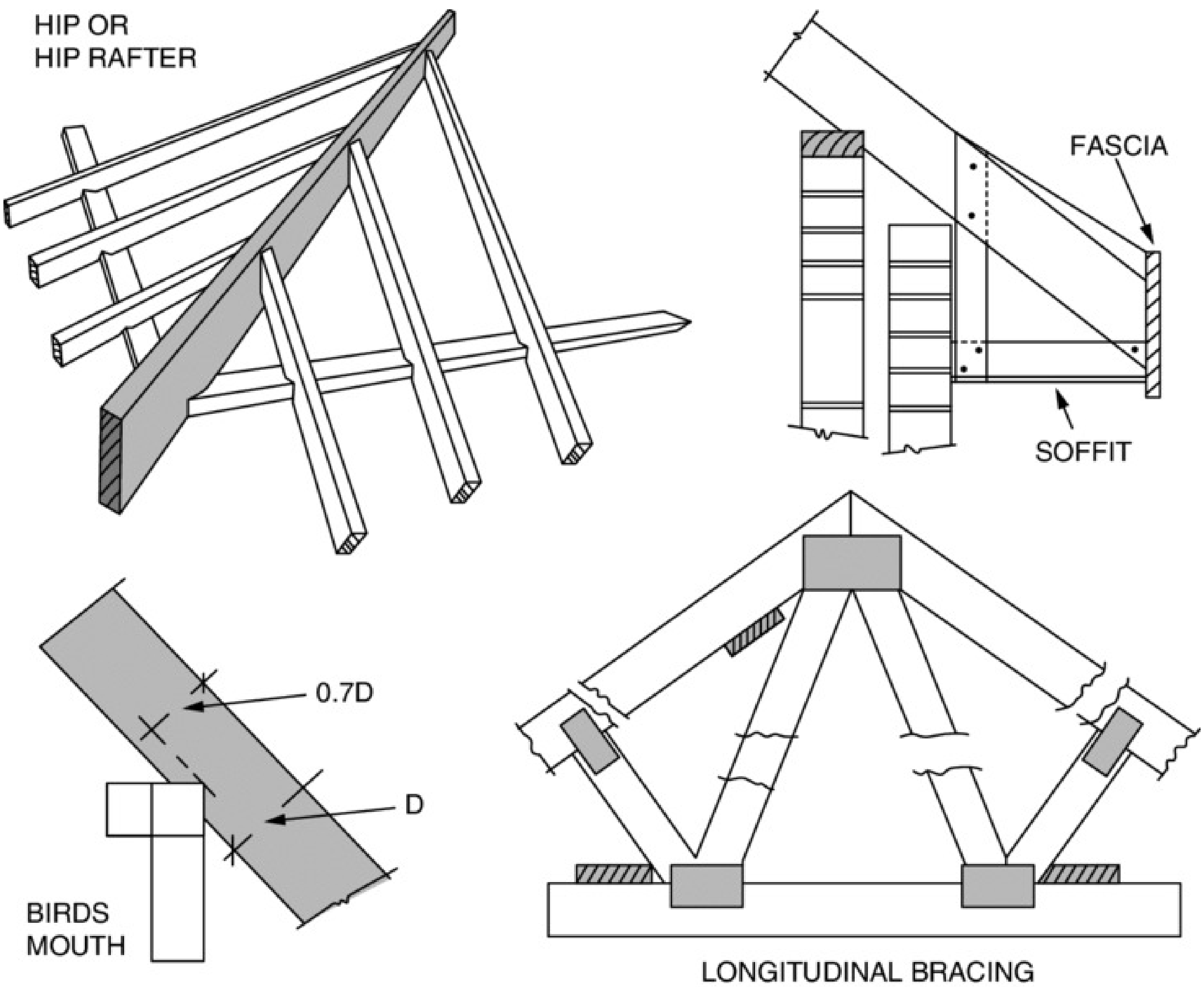

Figure 2.4 Illustration of terms used in chapter.

3
Calculating the size of timber members

Knowing the overall dimensions of the roof, that is, the span over the wall plates, pitch of the rafters, length between the gables or hips, any internal supporting walls and the specification of the roof covering, the following data will help to design the size and strength specification of the individual roof members themselves.

Roof structure design must satisfy the requirements of the building regulations for the individual countries of the UK. Currently (at the time of writing this edition), the building regulations can be satisfied by designing either with the British Standard BS 5268-2 2002 ‘Code of Practice for Structural Timber Design. Permissible stress design materials and workmanship’ or BSEN 1995-1-1 ‘Eurocode 5 Design of timber structures’. Common rules and rules for building, the UK National Annex to EC5 and Published Document PD6693-1 ‘Recommendations for the design of timber structures to Eurocode 5’, as above. Clearly, at some time in the future the building regulations will be amended to allow only the EC5 design standards. A limbo situation exists in the timber design industry at present, with some trussed rafters being designed on BS5268-2 and some on EC5. For individual timber roofing members, Trada have two sets of span tables available, one on each of the design methods above. These cover rafters, purlins, ceiling joists and ceiling binders, plus floor joists and trimmers as well as flat roof joists. Designs based on either of these design documents should satisfy local building control. The Trada Technology Ltd documents are:-

- SPAN TABLES for solid timber members in floors, ceilings and roofs of dwellings, 2nd edition.
- Eurocode 5 SPAN TABLES for solid timber members in floors, ceilings and roofs for dwellings.

The first document is based on BS5268-2 and the second on EC5 (see Bibliography for full contact details to obtain the publications). The term ‘solid timber’ describes natural sawn timber from logs, and not engineered timber components such as Ply Box beams, or ‘I’ beams.

A brief word on timber size design considerations. The loads to be supported by the roof structure are made up of a number of elements:

a. The roof covering: tiles, slates, etc.
b. The self weight of the structure: timber, felt, battens, insulation, and ceiling if an attic structure, plus water tanks as necessary.
c. Snow load.
d. Wind load.

Referring to the above:

a. is a statistic relating to the roof covering type and can be obtained from the product manufacturer.
b. is calculated from the known weight of individual members.
c. is a variable with the roof shape and pitch and height above ground and sea level, and is also a variable depending on the location of the building geographically within the UK.
d. this is also a variable based on geographically variable information and is also affected by exposure, that is, the altitude of the building and its proximity to coastal or other areas of high wind exposure.

For the above reasons, any calculation for designing the roof member size, must take all of the above into consideration. Thus, most standard timber sizing data has geographical limitations to its use. The tables reproduced in this book have been designed to illustrate the process to be used when sizing timber members in the following worked example. The Trada tables referred to above are more comprehensive in terms of different loadings, different spacings, and give data for both C16 and C24 stress class timber.

STRENGTH AND SECTION SIZE CALCULATIONS

The load-bearing capacity of a timber member is a function not only of its cross-section, but also of its strength class. Readily available timbers are classified from strength class C16 and C24; these include a range of European-, UK-, Canadian- and USA-produced timbers. Whilst section size savings can be achieved using the higher-grade timbers, there is a cost premium to pay, and on small-scale projects the economy of timber section is not great (more detail will be given on this later). The C16 timber, being of less strength than the C24, results in a larger section, and in some cases the greater width of the timber can be of benefit to the non-professional, giving a greater width of timber in some instances to which to fix both battens and plasterboard ceilings and so on, whilst the tables shown below are based on C24 strength class timber and design method BS5268 (a comparison has been given in C16). For further comparison, sizes based on EC5 in both C16 and C24 have also been shown in Figure 3.6.

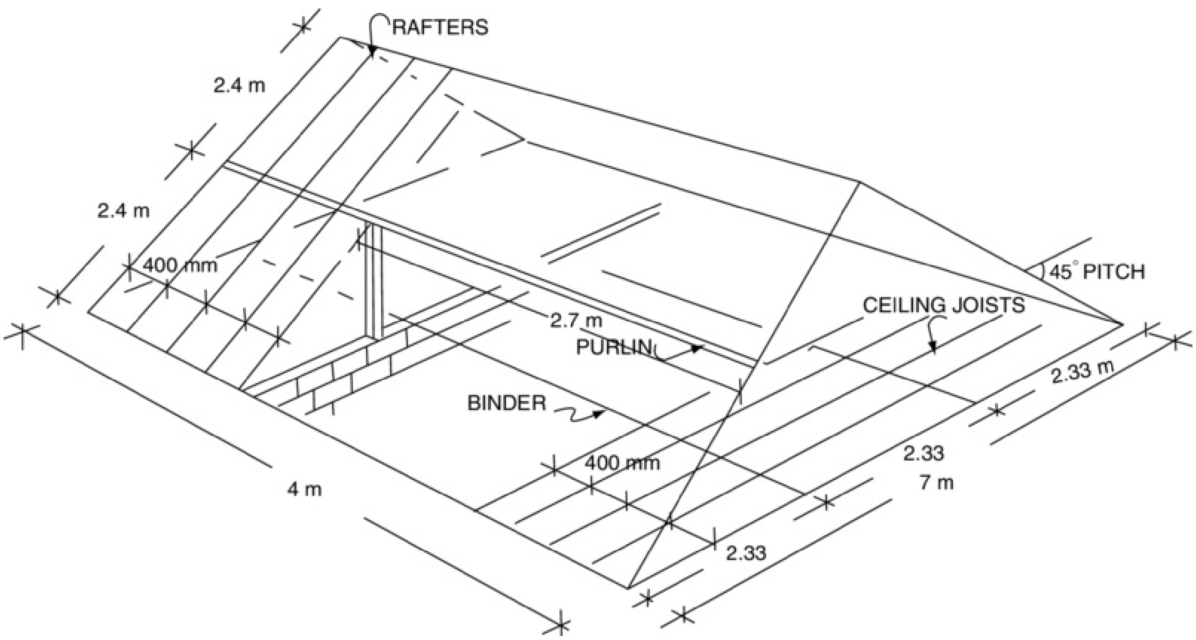

Figure 3.1 Dimensions of a roof in a worked example.

HOW DO WE CALCULATE THE LOADING ON THE ROOF?

The dead load – that is, that of the roof covering itself – can be obtained from the roof covering manufacturer as the 'as laid weight'; an indication of the weights of various tiles and slates can be seen in Figure 9.10. Whilst the tile loading will be expressed in kg/m^2 the dead load forces for design purposes are expressed in kN/m^2. The conversion is approximately 1/100; that is a tile weighing 75 kg/m^2 exerts a force of 0.75 kN/m^2.

The imposed load is that for snow lying on the roof; this varies, as has been stated, with geography, altitude and indeed with the roof pitch, but the latter factor is taken into account within the calculations for preparation of the tables. Snow loading is mainly related to altitude, that is, the location of the building above sea level, but also to exposure. Thus, south western counties which generally are at a lower altitude would have a snow loading of 0.75 kN/m^2, whereas more eastern and higher-altitude (not exceeding 200 m) locations vary between 0.75 kN/m^2 and 1.0 kN/m^2. The extreme north-east of England can be up to 1.07 kN/m^2 and the part of Scotland below 200 m, up to 1.25 kN/m^2. For more exact data, see snow loading maps are provided in the Trada publications described above.

TIMBER MEMBER SIZING DESIGN: AN EXAMPLE

The roof to be designed is located in the highlands of Scotland, but below 100 m altitude. The snow loading is 1.02 kN/m^2.

The ceiling joists are to carry normal loft storage only, not flooring loads. The ceiling would be considered as 12 mm plasterboard, with a load of 0.25 kN/m^2.

Ceiling Joists (Ref. Fig. 3.1)

The spacing of the ceiling joists is 400 mm, the span is 2.33 m.

Ceiling Tie Binders (Ref. Fig. 3.1)

The longest span is 2.7 m between supports, and the spacing is 2.33 m.

Purlins (Ref. Fig. 3.1)

The maximum span of the purlin between supports is 2.7 m, and the spacing of the purlins is also 2.4 m.

Rafters (Ref. Fig. 3.1)

The rafter spacing is 400 mm and maximum span is 2.4 m.

We now have all the information to find the size of timber cross-section to carry the loads imposed upon it. Refer now to the tables in Figures 3.2–3.5 below.