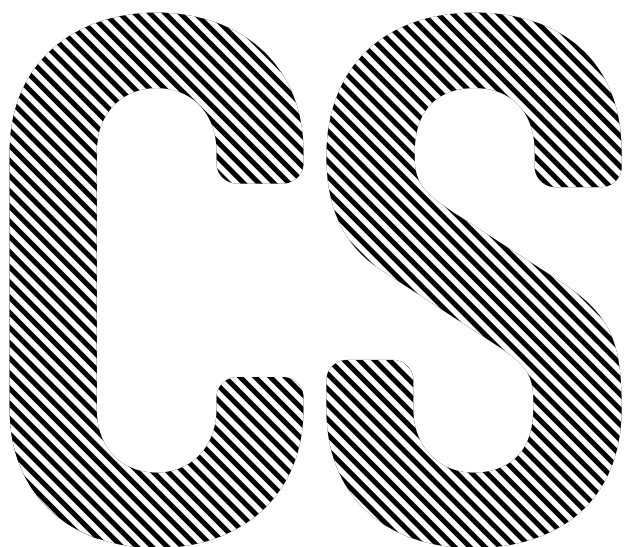


Ann-Christin Siegemund

---

# **Roof Construction**

**BASI**



Ann-Christin Siegemund

---

# **Roof Construction**

Third edition

**BIRKHÄUSER  
BASEL**



---

# Contents

## **FOREWORD \_7**

## **INTRODUCTION \_8**

## **BASICS AND DESIGN FACTORS \_9**

Forces and types of load \_9

Building physics \_11

Fire safety \_14

Lightning protection \_15

Materials used \_16

Planning and building codes \_18

## **SLOPING ROOFS \_19**

Roof styles \_20

Dormer and roof windows \_22

## **ROOF CONSTRUCTION \_26**

Woodworking joints \_26

Closed couple roof \_28

Collar beam roof \_30

Purlin roof \_31

Solid roof \_34

## **ROOF CONSTRUCTION LAYERS \_36**

Types of roof covering \_36

Roof battens \_39

Roofing membranes \_40

Insulation \_41

Drainage details \_44

## **FLAT ROOFS \_46**

Construction \_46

Types of roof construction \_47

Connection details \_48

Edge details \_49

Roof layers \_52

Green roofs \_55

Drainage details \_56

## **ADDITIONAL COMPONENTS \_59**

Fall prevention on roofs \_59

Photovoltaics and solar collector systems \_63

## **IN CONCLUSION \_65**

## **APPENDIX \_67**

Literature \_67

Standards \_68

Picture Credits \_72

The Author \_72

---

# Foreword

To have a roof over your head is one of the basic needs of human existence – it protects us from rain and wind, and helps us to keep warm. To do that, the roof also needs to fulfill some other functions: it needs to be structurally sound and stable. Based on traditional craftsmanship, various types and styles of roofs have evolved, which fulfill these functions in different ways and which are still in use today.

In addition, the roof – which is often referred to as the fifth facade – is also considered under aesthetic aspects. Versions of flat and sloping roofs have a significant impact on the appearance of historical towns and villages, and in modern buildings, too, they are an important part of the conceptual design. Thus, the fifth facade of a building with its many facets – comprehensively covered in this volume – is a key element in the architectural and structural design of a building.

This volume, *Basics Roof Construction*, is intended for the student who, for the first time, is considering the aspects involved in the design of a roof. The book introduces the various types of roof, their advantages and disadvantages, and the construction details the designer needs to be familiar with. In a clear and straightforward way, all the structural and non-structural aspects are explained, including the key design criteria. The student is given comprehensive information – from the basic structure of the roof to the insulation, waterproofing, finishes, surfaces, and drainage systems. The aim of the book is to provide students with an understanding of the principles, the technical terms, and the types and styles of roofs, and their characteristics, to enable them to produce roof designs that meet all the relevant criteria.

This is the second edition of the book, which has been comprehensively revised in structure and content. The author starts with a description of the general requirements a roof has to fulfill and then explains the key characteristics of sloping roofs and flat roofs. This is followed by the thoroughly updated chapters on the various roof construction aspects, ending with detailed explanations of photovoltaics systems and solar collectors, as well as on the design of green roofs, both of which have become standard elements of roof design for reasons of climate protection.

Bert Bielefeld, Editor

---

# Introduction

The roof is part of the envelope of a building and has a number of different functions, which are performed by different parts of the roof. Whether it is open or fully enclosed, the space beneath the roof is protected against wind, rain, and direct sunlight by the roof covering in combination with the underslating/waterproofing membrane. A layer of insulation ensures that both heat losses and heat gains are reduced. The roof envelope is supported by the structural members of the roof construction, the function of which is to transfer the loads impacting on the roof from the outside as well as those resulting from its own construction into the ground via external walls, pillars, and foundations. Furthermore, there are secondary elements that are needed to ensure that the main functions of the roof can be fulfilled.

In addition to the protective functions, aesthetic aspects such as the overall form, construction, finishes, and detailing also need to be taken into consideration. Taking into account current concerns about climate change, roofs may also be designed with “greening” in order to compensate for the ground area that is covered by the building.

However, the selection of individual components should always take into account the respective construction task in hand. For example, elaborate prefabricated steel structures are rarely found in private housing projects; similarly, in industrial building, one generally tries to avoid details that require extensive craftsmanship on the building site.

The shape of roofs is primarily determined by design considerations relating to the respective building and planning aspects but may also reflect regional differences. In Alpine regions, shallow sloping roofs with a large roof overhang are most common, whereas in the northern coastal regions of Europe, gable roofs with steep slopes are more usual. > Chapter  
Roof styles Different building functions have also led to typical roof styles: for example, tennis halls often have curved barrel roofs that allow space for the trajectory of the tennis ball; by contrast, normal congregation spaces often feature flat roofs to enable a flexible range of uses. It is also possible to combine different styles of roof.

A basic distinction is made between sloping roofs and flat roofs, with sloping roofs generally considered to have a minimum slope of 5°. In view of the fact that these two roof styles differ significantly in construction and function, they are dealt with in separate sections of this book, following the description of some basics.