Chapter 2
Introduction

The thermal performance of the building envelope is central to the debate on the construction of "Nearly Zero Energy Buildings" (NZEB). The relationship between type of envelope and final energy consumptions is usually translated into a simplistic deduction: to ensure that the energy consumption of a building is close to zero, it is primarily necessary to dissipate very low heat during the cold season. A global building thermal resistance and airtightness is one of the most important prerequisites to achieve "nearly zero energy".

Consequently, several countries have increased their airtightness and thermal resistance requirements in buildings, and the construction market is always more oriented towards "overinsulated" lightweight envelopes and a global reduction of air permeability of windows. Also renovation techniques aim to obtain the same prerequisites, for instance by replacing single glazed windows by new very tight double or triple glazed windows, or by adding interior or exterior insulation.

However, poorly permeable buildings are more subject to high internal moisture load in combination with an unsuitable ventilation strategy. Modern exterior insulation finish systems do not have thermal inertia and are therefore more subject to considerable amounts of exterior condensation.

Moisture loads and surface condensations are favourable conditions for the proliferation of microorganisms, such as algae and fungi. Consequently, despite the fact that over the past decades building energy efficiency has improved and better quality in living spaces is required, the number of reports on the presence of microorganisms on building facades and indoors is still increasing.

The proliferation of microorganisms in buildings is not welcome not only because of the implications for human health but also because of their contribution to the defacement of materials. The danger for the building occupants lies in the spread of pathogens (disease causing agents). In comparison to health aspects, other building damages caused by microorganisms—i.e., the aesthetic defacement and biodeterioration, is of minor importance. However, even these latter issues should not be excluded from a more thorough investigation. In fact, always more often, the biodeterioration of building materials leads to social and economic disruption for residents and builders.

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The NZEB of the future must be able to give a concrete answer to these problems, but the research on the relationship between biological proliferation and NZEB is still in its infancy. It certainly needs further investigations in the light of the real actual data collected.

The problem is vast and complex and requires a multidisciplinary approach. In fact, it involves aspects of building physics, material engineering, microbiology and medicine. A deep insight is necessary in the short term, because the housing market progresses quickly, adapting to a constantly changing regulatory framework.

In the first part of this book (Chaps. 3 and 4), some information is provided on the principal proliferating microorganisms in contemporary buildings (algae and mould), their causes and conditions of growth, and the resulting consequences for the building materials and people's health.

In Chap. 5, some of the major biological risk prediction models have been reported. Many building hygrothermal analysis methods are able to simulate the coupled transport processes of heat and moisture for one or multidimensional cases which aim to predict biological risks. Additional measurements in laboratory and in situ conditions are often used for the validation of the models. At the end of the chapter, some methods of accelerated experimental testing for the evaluation of biological defacement of buildings materials have then been described.

Since the recent construction practices that aim to reach the NZEB standard are likely to create more favourable conditions for biological growth—as mentioned in Chap. 6, by a description of real cases in literature—controlling and preventing solutions become more and more pressing and important.

Chapter 7 provides an overview of both traditional and new strategies. Traditional strategies include mechanical, physical and above all chemical methods, useful to eliminate the presence of microorganisms and, when possible, to delay their recurrence. Other researches are looking towards safer and more sustainable strategies linked to a proper design, choice of materials and construction of buildings, aiming to obtain a good envelope performance without any added costs.

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