

# Chapter 1

## An Evaluation on Educational Buildings Designed With the Passive House Approach

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### ABSTRACT

*Since the built environments are responsible for the increasing energy consumption, environmental pollution, and global warming, developing energy-efficient design approaches in architecture is inevitable. The 'passive house' concept is one of these approaches that are effectively and successfully applied in residences. Recently, these standards have been applied to different building types like office buildings, hospitals, and schools. Schools designed with this approach have found a place in the literature not only on energy efficiency but also with many positive effects on students/teachers. In this chapter, first, the concept of a passive house is emphasized, and the design approach providing the standards is included. Then, the design principles and standards of passive schools are discussed. In the case study part, these criteria are examined over three school projects built in Europe and USA, energy-efficient design approaches are compared, and the results are evaluated. Results show that this approach allows for energy savings of around 75% compared to average new school buildings.*

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## **INTRODUCTION**

With the industrial revolution, increasing industrialization, population, and urban activities have caused environmental pollution and deterioration of the ecological balance. It has become necessary to take action to improve this situation that threatens the ecosystem. For this reason, sustainable development and environmental issues have been discussed on different platforms since the middle of the 19th century, and solutions have been developed with interdisciplinary approaches.

When we look at the subject from an architectural perspective, it is seen that built environments cause a significant part of energy consumption and damage the environment. According to the International Energy Agency (2017), the transition to low-carbon housing will require introducing highly energy-efficient building solutions globally. For this reason, with the primary goal of “environmental sustainability”, energy conservation design ideas such as ecological architecture, green buildings, energy-efficient buildings, passive houses, zero-energy buildings, and energy-plus buildings have started to be discussed frequently on different platforms.

As a solution toward zero-emission buildings, the passive house approach emerges. This approach is a concept that prioritizes heat recovery and minimizing heat losses. It aims to be energy efficient, comfortable, economical, and at the same time ecological. Effective policy measures are needed to support the transition to energy-efficient buildings.

Policies aiming to use energy effectively and efficiently in buildings have been established internationally and nationally. The Energy Performance of Buildings Directive (EPBD) published by the European Union, numbered 2002/91/EC, is to promote the improvement of the energy performance, indoor climate requirements, and cost-effectiveness of buildings, taking into account the climate and local conditions of the member states. This directive sets out the obligation to implement minimum energy performance requirements in new buildings and existing buildings undergoing retrofitting (EU, 2002).

The EPBD-recast (2010/31/EU), published in 2010, emphasized the need for more concrete actions to reach unrealized energy savings in buildings and reduce the significant differences between the European Union member states’ practices. National plans to increase the number of nearly-zero energy buildings (NZEB) focus on calculating energy performance in buildings, energy performance certificates, and independent control systems for inspection (EU, 2010).

In the directive 2012/27/EU published in 2012, a framework of standard measures was established to achieve a 20% reduction in energy consumption by 2020 (EU, 2012)

In 2018, directives 2010/31/EU and 2012/27/EU were revised, and directive 2018/844 was published. According to the Directive, each member state must establish a cost-effective long-term strategy to support the conversion of the national stock

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