# Chapter 10
# Existing Buildings: How to Meet an nZeb Standard – The Architect's Perspective

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## ABSTRACT

*This chapter is dedicated to the modernisation process of existing buildings aiming to achieve the nearly zero-energy standard. The process is described from the designer's perspective. Related issues, requirements, constraints, design options, and local determinants are analysed, and optimal architectural solutions for selected case studies are also presented. The analysis is based on the KodnZeb project, which included the modernisation of two existing buildings, located in Warsaw (the Faculty of Building Services, Hydro- and Environmental Engineering and Student Housing Muszelka), which differ in architectural features function, location, and needs. Thus, two diverse approaches to the modernisation process are examined. The chapter concludes with general guidelines and recommendations for similar architectural projects.*

## INTRODUCTION

In the 20th Century it became obvious that most of the existing building stock in Poland is in need of major redevelopment (Rynska, 2008). The re-cast of EPBD (EPBD, 2010) requires from 2019 that all new buildings occupied and owned by public authorities are nearly zero-energy buildings (nZEB), and by the end of 2020 all new buildings should also have the same status. Therefore, a new questions arise: is it possible to modernise existing buildings to meet a nearly zero-energy standard? How it can be done and what should be considered during the design process? Answers to these questions can be found in the analysis of the project "Design retro-fit nZEB concept for two buildings – KODnZEB", which was conducted in co-operation between Warsaw University of Technology and Norwegian University of Sci-

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ence and Technology in Trondheim in years 2016 – 2017. The basic aim of the project was to develop an interdisciplinary step-by-step management in case of providing nZEB modernisation procedures of existing buildings (Sowa, 2017). Norwegian know-how and the technology were successfully transferred. However, this transfer had to include a "made to fit" aspect based on the joint knowledge of researchers from various disciplines and countries.

The KODnZEB project aims to modernise two existing buildings, owned by Warsaw University of Technology, to achieve an nZEB standard. Contemporary urban and architectonic features of Warsaw University of Technology complex are the outcome of after-war rebuilding process and construction of various new buildings. Interventions within historic buildings were triggered by inadequate space to house growing didactic requirements. Main emphasis was placed on efficiency and intensification requirements. However, often inadequate technical skills and low quality materials were used. The last years of the former decade, especially after receiving EU member status and possibility to draw on international funds, were filled with revalorisation works on the WUT campus. WUT management requested an urban and architectural analysis, which pointed out buildings to be extended and plots to be invested in. Prior to the start of KODnZEB project the research team and WUT management representatives analysed possible choices. WUT authorities proposed three university buildings, which required modernisation. The ones chosen as case studies differ in type, function, time of construction and used technologies. The first chosen site is dormitory "Muszelka" (Shell), one of the student housing buildings located in Narutowicza complex in Warsaw. The plan of this student social housing dates back to 1922. However, it was built in 1950 (arch. Z.Dytkowski). The second site is the seat of the Faculty of Building Services, Hydro and Environmental Engineering (FBSHEE) located in the main WUT campus area and constructed in the 70-ties based on design by S. Jaczewski and J. Reda. These two different case studies required diverse approach to the design and modernisation process. Various functions, structures, architectures, needs and requirements for selected case studies enabled the designers to investigate how existing buildings can be retrofitted not only to achieve nZEB standard but also to create modern, functional, aesthetic and environment-friendly architecture. The analysis of design processes for both selected KODnZEB case studies, presented in this chapter, aims to present main problems and challenges as well as possibilities and solutions to achieve mentioned goals. The detailed description of both case studies, design processes, selected architectural solutions can be treated as an inspiration for similar projects developed in the future. Thus, the chapter concludes with some general recommendations and advises concerning design solutions for other modernisation projects.

## BACKGROUND

The first task of the design process was to provide a common definition of nZEB for KODnZEB project based on primary energy factor (PEF) value. According to EPBD Recast (EPBD, 2010): "nearly zero-energy building means a building that has a very high energy performance" and "energy required should be covered to a very significant extent by energy from renewable sources". The nZEB standard is achieved when PEF value is higher than in a zero-energy building and lower than in a building, which meets minimum requirements. In this project an nZEB building was defined as the one, which meets 90% of requirements for a zero-energy building (Mijakowski et al., 2015). This definition was chosen, as both of the buildings were undergoing retrofit development and it was decided to lower the benchmark. Thus, PEF values for nZEB are: