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Ventilation system design in three European geo cluster

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Abstract

The primary objective of this study is to evaluate possible ventilation solutions for nZEB multi apartment buildings in three European geoclusters. Geo-cluster concept illustrates trans-national areas where strong similarities are found in terms of climate, culture, construction typologies and other factors. Paper presents comparison of ventilation needs for the same case study building located in Denmark, Estonia, Latvia and Portugal. The economic and technical comparison of different ventilation systems are presented as well. Special focus is attended to develop introduction of modular solutions and integration of ventilation ducts into external insulation as this can serve as a complex solution including both external constructions and engineering networks. Presented modular solution includes prefabricated insulation panels with integrated ventilation ducts. This paper is prepared in scope of work done within EU HORIZON2020 MORE-CONNECT project. Research methodology is based on data analysis provided by project partners as well as practical calculation. Compilation of ventilation air volume requirements according to the local regulations for Latvia, Estonia, Portugal and Denmark has shown significant difference in design air change rate in project countries. The financial analysis reveals the price difference between various ventilation strategies and provides discussion topic regarding ventilation strategies in nZEB buildings.

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Keywords: ventilation, energy efiiciency, duct design, retroffiting. economics

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1. Introduction

Mechanical ventilation with heat recovery system is a must in modern energy efficient building. For example in Latvia building can get nZEB status only in case of exhaust heat recovery with minimal efficiency 75% [1]. However, in cold climates heat recovery is necessary only during the heating season. In other periods, operation of mechanical exhaust is sufficient to ensure necessary air exchange without extra energy for mechanical fan operation while in cases when building is mechanically cooled the air heat exchanger must be operated yearly. Also it must be noted that the installation of fully mechanical supply/exhaust ventilation system increases electricity consumption by 11 kWh/m² for typical multi apartment building. This leads to necessity to carefully choose the appropriate ventilation system type to maximize energy savings while providing good indoor air quality. Investigation have shown that in apartment buildings with natural passive stack ventilation, the indoor air quality changes greatly. For example measurements of indoor air quality done in bedrooms of different apartments in Latvia without mechanical ventilation have shown that CO_2 level varies from 1200 ppm to 4200 ppm, the latter being quite critical. Similar data on IAQ problems in multi apartment buildings, shows research [3] done in Estonia.

The exact choice of ventilation systems is dependent on the location of the building therefore geo-cluster concept is introduced as it illustrates trans-national areas where strong similarities are found in terms of climate, culture, construction typologies and other factors. Usually five to seven Geo-clusters are defined - Northern, Continental Northern East, Continental Centre, Mediterranean and Western Central. During this paper the focus will be on GC 1 represented by Denmark, GC2 represented by Estonia and Latvia and GC4 represented by Portugal. The on-going EU H2020 project MORE-CONNECT project is dealing with development of technologies and components for prefabricated modular renovation elements, including the prefabricated integration of multifunctional components [4]. This project geo-clusters are shown in Figure 1.

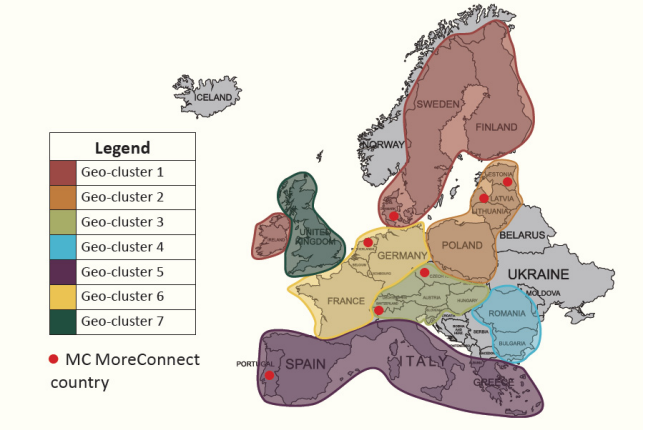

Fig. 1. EU H2020 MORE-CONNECT project geo-cluster

2. Methodology

The methodology to compare the economic aspects of various ventilation types is based on following steps:

- Determining the necessary ventilation air volumes in case of each country;
- Designing most common ventilation system types for an apartment;
- Estimating construction costs of ventilation system installing;
- Calculating and comparing the life cycle costs of each ventilation system including maintenance, necessary electrical energy and necessary energy for heating;
- Estimating practical solutions for integration of ventilation systems elements into limited technical space available in exiting postwar multi apartment buildings;