Implementing nZEB in Romania

Master Thesis written during Erasmus + Program

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ABSTRACT

The following Master of Science Thesis was written during the Erasmus + Program for exchange students at Universite de Liege, Belgium, which is in bilateral agreement with Technical University of Cluj-Napoca, Romania, available between 2014-2020. The research for this work was elaborated in the Sustainable Buildings Design Lab, from the Faculty of Applied Sciences. The work describes the current situation of the buildings energy performance in Romania and technical solutions for implementing nZEB requirements in Romanian residential buildings. The case study presented is a Multi Storey Residential Building from 1980s, located in Blaj, Alba County.

KEYWORDS

Romania, nZEB, ZEB, implementing, passive buildings, passive house, thermal comfort, thermal insulation, building stock, Romanian house

PROBLEM

1. The bioclimatic elements of the traditional Romanian houses are not integrated into the new buildings.
2. The practical aplication of the innovative thermal insulation materials on new or existing buildings is uncertain due to their availability and costs.
3. There is no climatic variation in implementing passive house or nZEB requirements in Romania.
4. There is no balance between heating and cooling estimation regarding the passive house requirements and its impact on the seasonal interior comfort.

OBJECTIVE/HYPOTHESIS

1. Design a new house that integrates the bioclimatic elements of the traditional Romanian house combined with passive house, nZEB or ZEB requirements.
2. Test the energy efficiency of the innovative thermal insulation materials for each Romanian climate area.
3. The impact of the passive house, nZEB and, respectively ZEB requirements on heating/cooling load, thermal comfort, energy consumption and costs should be investigated for all the climate areas from Romania.

AUDIENCE

Architecture Students, Civil Engineering Students, Architects, Civil Engineers, Building Services Engineers.

RESEARCH QUESTION

1. How to find the balance between heating demand and cooling demand in a passive building in order to have energy efficiency?
2. How to avoid overheating of passive buildings?

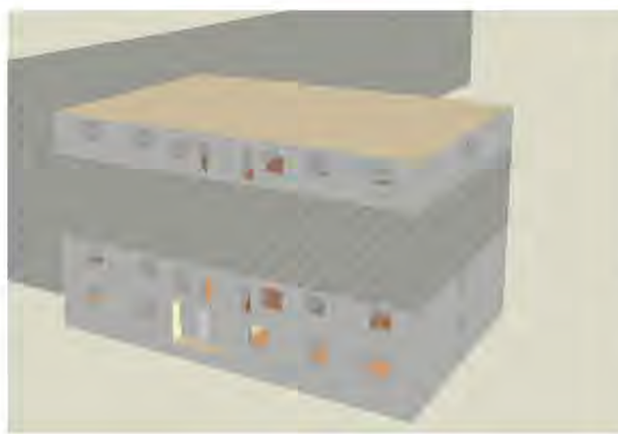
ORIGINALITY

1. Survey of the energy consumption in Romanian Multi Storey Residential Buildings built in the 1980s by gathering the electricity and natural gas bills from 54 apartments.
2. Create the benchmark model after the Multi Storey Residential Building located in Blaj, Alba County, Romania.
3. Simulate the model using the tool DesignBuilder.

METHODOLOGY

1. Literature Review Analysis
2. The Romanian Benchmark Model
3. Building Performance Simulation
4. Development of the Romanian Standard model and nZEB model.

RESULTS



Sector A

	Annual Electricity Consumption [kWh]	Annual Gas Consumption [kWh]
Total Building Level Monitored:	23606	128587.6
Energy consumption per m2 [kWh/m2]:	17.90	97.50
Total Building Level Romanian Benchmark Simulated:	60446.99	222487.5
Energy consumption per m2 [kWh/m2]:	45.83	168.69
Total Building Level Romanian Standard Simulated:	74412.45	554518.7
Energy consumption per m2 [kWh/m2]:	56.42	420.44

Sector B

	Annual Electricity Consumption [kWh]	Annual Gas Consumption [kWh]
Total Building Level Monitored:	20091.00	114290.49
Energy consumption per m2 [kWh/m2]:	15.46	87.95
Total Building Level Romanian Benchmark Simulated:	57743.05	196633.1
Energy consumption per m2 [kWh/m2]:	44.44	151.32
Total Building Level Romanian Standard Simulated:	60206.34	510635.7
Energy consumption per m2 [kWh/m2]:	46.33	392.95

Sector C

	Annual Electricity Consumption [kWh]	Annual Gas Consumption [kWh]
Total Building Level Monitored:	22493	115817.1
Energy consumption per m2 [kWh/m2]:	19.83	102.08
Total Building Level Romanian Benchmark Simulated:	45294.77	171330
Energy consumption per m2 [kWh/m2]:	39.92	151.02
Total Building Level Romanian Standard Simulated:	48266.92	447249.5
Energy consumption per m2 [kWh/m2]:	42.54	394.22

CONCLUSION

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Resources

1. University of Architecture and Urban Planning “Ion Mincu”, Bucharest, Romania
2. The Insitute for Research in Civil Engineering and Economy of Constructions, Bucharest, Romania
3. Technical University of Civil Engineering, Bucharest, Romania
4. The Ministry of Transport, Constructions and Tourism, Romania
5. Buildings Performance Institute Europe
6. Journal articles websites: Scopus, Science Direct, CES Working Paper, WSEAS, Central and East European Online Library
7. ENTRANZE Project
8. SC Electrica Furnizare SA, Romania
9. E.ON Energie Romania
10. The National Meteorology Administration of Romania
11. The National Bank of Romania