An Analysis into the Feasibility of Retrofitting Dwellings in Ireland to Passive House Standards.

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Aim of the Project

This dissertation aims to assess whether retrofitting existing Homes in Ireland to Passive House standards is a feasible and a practical approach to achieving significant energy efficiency gains as the nation strives to meet climate action targets.

Objectives

The following Objectives were set out to determine the feasibility of this concept:

1. Conduct a critical literature review on the Passive House.
2. Investigate case studies on existing Passive House dwellings.
3. Create a retrofit design concept for an existing Irish dwelling, outlining the modifications required to meet Passive House standards.
4. Analyse and quantify the improvements resulting from the retrofit.
5. Provide recommendations based on the findings from research, analysis, and case studies.

Literature Review

The Literature Review analysed existing research to gain knowledge on the work previously done in the topic of the Passive House Concept.
A review of passive house principles was provided, displaying their design benefits in energy efficiency, thermal comfort, and environmental. It outlined the key principles such as quality insulation, airtight construction, and mechanical ventilation with heat recovery.

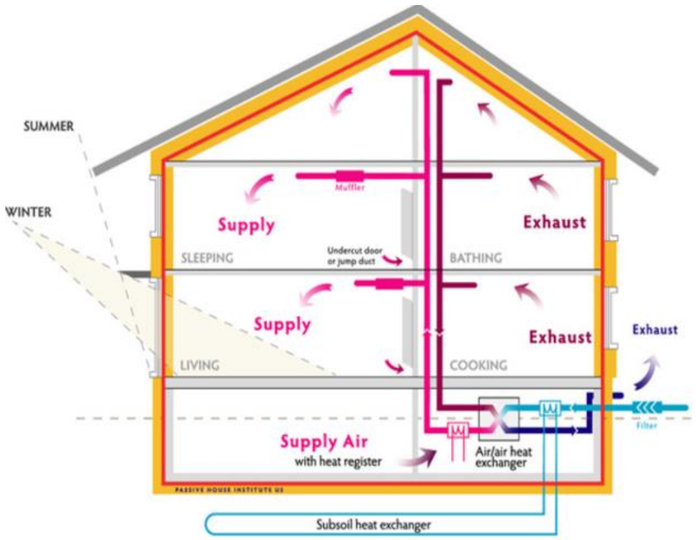

Figure 1: Fundamentals of the Passive House concept (Tanigawa Sara, 2017).

Additionally, the chapter discusses heating systems, ventilation requirements, and the importance of insulation and airtightness in achieving passive house standards, ensuring optimal indoor air quality and comfort while minimizing energy demand.

Methodology

Case Studies - Case studies were conducted to gather insights of technical information, practical challenges, costs and benefits from real-world examples of Passive House buildings.

Figure 2: Case Study 3 – Passive House Retrofit (Flax Brian, 2023) .

Interview - An Interview was done with a member of the Passive House Association of Ireland who retrofitted his own home to a certified Passive House. This provided valuable expert insights into the Topic

Retrofit Design Concept – A concept design was created for retrofitting an existing dwelling built in the 1990's. The aim of this is to explore how the Passive House principles can be applied to existing Irish homes and the benefits they bring.

Results

The case studies demonstrate that passive house retrofits significantly improve thermal performance, reduce energy consumption by up to 90%, and lower environmental impact while maintaining high indoor comfort levels. Figure 2 shows reoccurring similarities of in each case study.

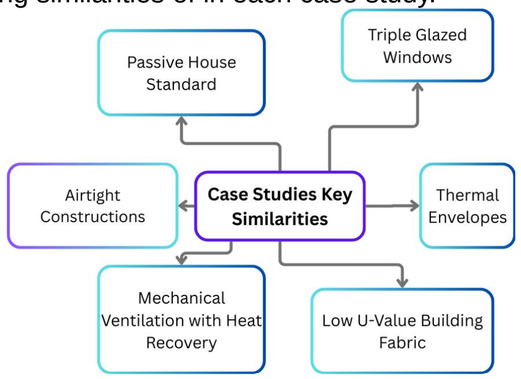

Figure 3: Case Studies Key Similarities.

The Retrofit design concept resulted in significant improvements for the dwelling. Total energy usage dropped from 26,605kWh/y to 7,820kWh/y while Space heating demand went from 16,623kWh/y to 2,489kWh/y leading to a 71% reduction in CO2 emissions.

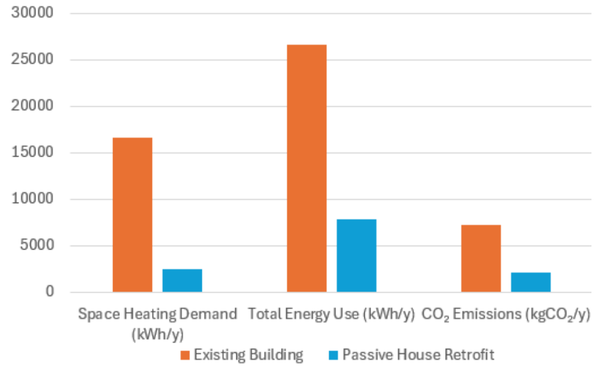

Figure 4: Comparison of Space Heating Demand, Total Energy Usage and CO2 Emissions

The Interview gave a great insight of Retrofitting a passive home "CO2 value cut in half" "Temperature is 21° C all the time at 55% relative Humidity. The experience of living in a Passive House is " better than I ever expected", while cost benefits and Indoor air quality are as good as predicted.

Conclusion

Overall, Passive House retrofits in Ireland are found to be both feasible and beneficial, significantly cutting energy demand, reducing carbon emissions, and improving comfort within homes. Research carried out in this project exposed the following findings:

- Airtightness and thermal bridging are key obstacles in Passive House retrofits, requiring tailored solutions for each building.
- Passive House outperforms NZEB and other green certifications due to more rigorous energy modelling.
- Homes with the Passive House standard require minimal heating requirements, with passive solar gains effectively balancing internal temperatures year-round.

In conclusion, With existing financial supports available, Passive House retrofits offer an economically viable path toward sustainable energy efficient housing in Ireland.

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