



## The effect of polystyrene application on reducing energy consumption in cold climate residential buildings.

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### Abstract

**Research Problem:** High energy consumption in human settlements has increased environmental pollution. More than 40% of the country's energy is consumed in buildings, most of which is spent on heating, cooling, and lighting of indoor spaces. This process can be reduced by taking measures such as optimizing the thermal insulation of the exterior shell of the building. This is especially important in cold climate residential buildings, which have the highest temperature fluctuations.

**Research Question:** What effect does the use of polystyrene in the shell have on reducing energy consumption in the cooling and heating sections of residential buildings in cold climates?

**Research Method:** Eleven residential units in the city of Hamadan were selected as a sample and the thermal insulation information of their outer shell, which was based on the use of polystyrene layers, was recorded. The samples were observed for one year in the operation period in terms of the actual amount of energy consumption. Then, a model of each sample was constructed in Design Builder software and the energy consumption analysis of each was performed. The results obtained from the software outputs were compared with the actual energy consumption of the samples and the deviation of the software reports from the real state was determined. Then, in the software models, changes were made in the physical shell and by removing polystyrene, the usual materials without thermal insulation were replaced and the energy consumption of the samples was simulated again in the latter case. After applying the deviation due to actual consumption error and simulation to the outputs of the new model, the energy consumption of each sample in the state without thermal insulation was normalized and compared with the consumption in the state with thermal insulation.

**The Most Important Results and Conclusion:** The results showed that the use of polystyrene in the outer shell of the building leads to a 43% increase in cooling load and a 27% decrease in heating load based on the conditions of each sample during different months of the year. The combined effect of cooling and heating loads in total indicates a decrease in the thermal load of the building in general during one year. This decrease is 25.9% equal to 34802.9 kWh for the first sample units and 32.6% equal to 30648.3.3 kWh for the second sample units during one year.

**Keywords:** Building, energy, cold climate, thermal insulation, polystyrene, residential

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