

# Modeling and Economic Optimization of under-floor heating system

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## Abstract

Modeling and optimizing the under-floor heating system (UFHS) with Pex pipes are studied in this paper. For modeling the system, two regions were considered. The first one was the over floor region which included room air and walls. This region was considered as one control volume and the system of nonlinear energy equations for room air and walls were solved using Newton-Raphson method. The second or under floor region included heating pipes, concrete and floor finish. This region was modeled using finite volume method. For optimizing the under-floor heating system an objective function (sum of investment and operating costs of UFHS ) was proposed and type and thickness of the floor finish , velocity of hot water passing through the pipe, concrete thickness, and pipe diameter, were considered as the decision variables (design parameters). The sensitivity analysis showed 19.8%, 10.5%, 2.8%, 0.3% increase in the objective function with deviation of four above mentioned design parameters from their optimum values (floor finish from tile to marble, water velocity from 1.5 to 2.5m/s, concrete thickness from 6 to 8 cm, and pipe diameter from 1/2 to 3/4 inch). Finally with decrease in external temperature from -10C to -20C, the objective function increased for 21.7% and the required floor heat flux increased for 33.1%. Increasing the insulation thickness from 2.5 to 7 cm, also decreased the objective function for 20.5% and decreased the required floor heat flux for 38.5%.

**Keywords: under-floor heating system; combined modeling; economic optimization**

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