World Academy of Science, Engineering and Technology
International Journal of Civil and Architectural Engineering
Vol:10, No:04, 2016

Determining Design Parameters for Sizing of Hydronic Heating Systems in Concrete Thermally Activated Building Systems

Authors : Rahmat Ali, Inamullah Khan, Amjad Naseer, Abid A. Shah

Abstract : Hydronic Heating and Cooling systems in concrete slab based buildings are increasingly becoming a popular substitute to conventional heating and cooling systems. In exploring the materials, techniques employed, and their relative performance measures, a fair bit of uncertainty exists. This research has identified the simplest method of determining the thermal field of a single hydronic pipe when acting as a part of a concrete slab, based on which the spacing and positioning of pipes for a best thermal performance and surface temperature control are determined. The pipe material chosen is the commonly used PEX pipe, which has an all-around performance and thermal characteristics with a thermal conductivity of 0.5W/mK. Concrete Test samples were constructed and their thermal fields tested under varying input conditions. Temperature sensing devices were embedded into the wet concrete at fixed distances from the pipe and other touch sensing temperature devices were employed for determining the extent of the thermal field and validation studies. In the first stage, it was found that the temperature along a specific distance was the same and that heat dissipation occurred in well-defined layers. The temperature obtained in concrete was then related to the different control parameters including water supply temperature. From the results, the temperature of water required for a specific temperature rise in concrete is determined. The thermally effective area is also determined which is then used to calculate the pipe spacing and positioning for the desired level of thermal comfort.

Keywords : thermally activated building systems, concrete slab temperature, thermal field, energy efficiency, thermal comfort, pipe spacing
Conference Title : ICCBE 2016 : International Conference on Civil and Building Engineering
Conference Location : Boston, United States
Conference Dates : April 25-26, 2016