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Energy Saving Potential with Improved Concrete in Ice Rink Floor Designs

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Abstract : The ice rink floor is the largest heat exchanger in an ice rink. The important part of the floor consists of concrete, and the thermophysical properties of this concrete have strong influence on the energy usage of the ice rink. The thermal conductivity of concrete can be increased by using iron ore as ballast. In this study the Transient Plane Source (TPS) method showed an increase up to 58.2% of thermal conductivity comparing the improved concrete to standard concrete. Moreover, two alternative ice rink floor designs are suggested to incorporate the improved concrete. A 2D simulation was developed to investigate the temperature distribution in the conventional and the suggested designs. The results show that the suggested designs reduce the temperature difference between the ice surface and the brine by 1-4 ˚C, when comparing with convectional designs at equal heat flux. This primarily leads to an increased coefficient of performance (COP) in the primary refrigeration cycle and secondly to a decrease in the secondary refrigerant pumping power. The suggested designs have great potential to reduce the energy usage of ice rinks. Depending on the load scenario in the ice rink, the saving potential lies in the range of 3-10% of the refrigeration system energy usage. This calculation is based on steady state conditions and the potential with improved dynamic behavior is expected to increase the potential saving.

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