

FULL YEAR PERFORMANCE SIMULATION
OF A DIRECT-COOLED THERMAL STORAGE ROOF (DCTSR)
IN THE MIDWEST

Richard C. Bourne
Davis Energy Group, Inc.
123 C Street
Davis, CA 95616
and
Dr. Bing Chen
Passive Solar Research Group
University of Nebraska at Lincoln
University of Nebraska at Omaha
Omaha, NE 68182

ABSTRACT

Previous papers by the authors describe the direct-cooled thermal storage roof (DCTSR) concept and prior small-scale developmental and monitoring work. DCTSR water containment is provided by a single-ply roof membrane in thermal contact with occupied space below. Hard-topped rigid insulation panels float on the 311 to 411 water storage layer. During summer nights, storage water is distributed above the insulation panels where it is cooled by evaporation and night sky radiation before draining back into the water layer through panel joints. The cooled water provides a thermal flywheel effect to reduce subsequent cooling loads. In winter, storage water may be warmed from below by internal gains or direct solar gains reflected or reradiated from other room surfaces; water remains below the insulation layer during heating load conditions.

A 1024 ft² research building has recently been constructed with a DCTSR covering the entire roof surface, on the University of Nebraska Allwine Prairie Preserve near Omaha. This paper reports use of a modified version of the MICROPAS full year hourly simulation program to estimate performance of the new DCTSR project. Roof zone evaporative cooling algorithms were added to MICROPAS, and the simulation was calibrated to a prior 256 ft² DCTSR test installation. The new test building was modeled with and without the DCTSR in conjunction with an Omaha weather tape.