

Lawrence Berkeley National Laboratory

Recent Work

Title

AN ANALYSIS OF NATURAL CONVECTION IN ROOM GEOMETRIES

Permalink

<https://escholarship.org/uc/item/7hd7h86x>

Author

Gadgil, A.

Publication Date

1979-06-29

U U 1 2 3 4 5 6 7

UC-95d

LBL-9297

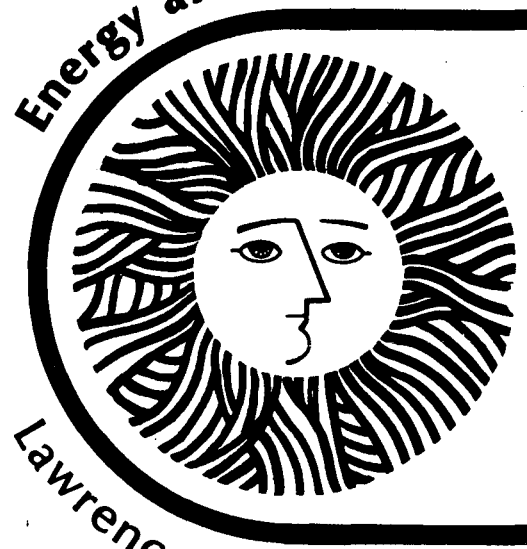
Abstract

To be presented at the 4th National
Passive Solar Conference, Kansas
City, Kansas, October 3-5, 1979.

For Reference

Not to be taken from this room

Energy and Environment Division



An Analysis of Natural Convection
in Room Geometries

*A. Gadgil, F. Bauman
and R. Kammerud*

June 1979

Lawrence Berkeley Laboratory University of California/Berkeley

Prepared for the U.S. Department of Energy under Contract No. W-7405-ENG-48

LBL-9297

LEGAL NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

AN ANALYSIS OF NATURAL CONVECTION IN ROOM GEOMETRIES[†]

A. Gadgil, F. Bauman, and R. Kammerud
Passive Solar Group
Lawrence Berkeley Laboratory
Berkeley, California 94720

A program has been initiated to study convective air flow within thermal zones; both analytic and experimental work are included. Using the results of these projects, temperature stratification, stack effects, and convective heat transfer across zones can be studied. Initial results from both projects will be presented.

The analysis technique which has been developed allows the convection to be naturally driven by differential boundary surface temperatures or to be forced by pressure gradients created by air flow boundary conditions. The computer program models the flow using a hybrid differencing scheme that can switch between Central Difference Scheme (CDS) and Upstream Difference Scheme (UDS), depending on the local grid Péclet number. This permits the spatial grid on which continuity and the momentum and energy balance are applied to assume dimensions of the order of feet. The governing difference equations have been numerically solved for two-dimensional geometries. In the future, this analysis will be extended to fully turbulent flow and to three dimensions.

In a separate coordinated project, an experimental apparatus for measuring steady-state natural convective processes has been designed and constructed. The apparatus is scaled to table-top size and allows both measurement and observation of convection properties of both single-zone and two-zone configurations. The instrumentation permits measurement of (1) the temperature distribution(s) within the space(s) and (2) the heat transfer rate across (between) the zone(s).

Both the analytic and experimental techniques will be described and results from both of these projects will be presented. In particular, the validation of the analysis program using the data from the scaled experiment will be described. Initial results will be presented on the experimentally measured temperature profiles in single- and two-zone configurations, and on two-zone coupling strengths. Preliminary calculations of stack effects in multi-story atrium spaces will be presented.

[†]This work has been supported by the Solar Heating and Cooling Research and Development Branch, Office of Conservation and Solar Applications, U.S. Department of Energy, under Contract No. W-7405-ENG-48.

This report was done with support from the Department of Energy. Any conclusions or opinions expressed in this report represent solely those of the author(s) and not necessarily those of The Regents of the University of California, the Lawrence Berkeley Laboratory or the Department of Energy.

Reference to a company or product name does not imply approval or recommendation of the product by the University of California or the U.S. Department of Energy to the exclusion of others that may be suitable.

TECHNICAL INFORMATION DIVISION
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA 94720