ABSTRACT

The theoretical and experimental study has been implemented to elucidate the effect of vertical mechanical vibration at normal gravity on the natural convection in a cubic enclosure (L=120mm) filled with air as working fluid at Rayleigh number $7 \square 10^7$ and $4*10^8$. The enclosure was comprised of two vertical and opposed surfaces. The right wall was heated at a uniform heat flux, where the left wall cooled was maintained at T_c, surrounded by four other adiabatic surfaces. Vibration forces were applied to this heat transfer cell by mounting it vertically on the armature of electrodynamics vibratior.

Natural convection heat transfer in a square enclosure induced simultaneously by gravity and vibration is investigated numerically. A numerical study has been made for two-dimensional, incompressible, unsteady and turbulent flow in the square enclosure. At Ra= $7 \square 10^7$ the frequencies shedded to the enclosure (2,4&8)Hz and at Ra=$4*10^8$ the frequencies shedded to the enclosure (3,6&9)Hz.

The continuity equation, Navier-Stokes equations and the energy equation in addition the two equations of the Low Re $k - \varepsilon$ Turbulence Model applied to enable it to cope with low Reynolds number flows, Launder and Sharma (1974). By transforming these equations (by using the finite volumes method)from differential forms to algebraic forms using SIMPLE algorithm with hybrid scheme. A computer program in Fortran 90 was built to carry on the numerical solution.

The experimental work is carried out on a built rig which is mainly composed of a cubic enclosure cavity provided with a vibrator exciter as well as the necessary measurement instrumentation to fulfill the required investigations.

Three type of tests for both theoretical and experimental are carried out. The first one reached to steady state and then shedded the effect of vibration to the cubic enclosure **(Interrupted Vibrations)**, while the second shedded the vibration **(Continuous Vibrations)** from the start at ascending frequencies and the third shedded the vibration **(Continuous Vibrations)** from the start at descending frequencies.

From the theory and experimental investigations results conclusion clearly the effect of vibration on natural convection heat transfer inside enclosure.

Experimental investigations results two main conclusions may be raised, in the high Rayleigh number case ($Ra=4*10^8$), the gravitational thermal convection dominates, and the vibration motion does not enhance the heat transfer remarkably. In contrast, in low Rayleigh ($Ra=7*10^7$), the vibration thermal convection is dominant, and the vibration enhanced the heat transfer rate significantly. At $Ra=7*10^7$ and the frequencies 2Hz 16.9% , 4Hz 39% and at 8Hz 60%, while at $Ra=4*10^8$ and the frequencies 3Hz 7.62 %,6Hz 20.8%, and 9 Hz 39%.

Theoretical results in the form of isotherm lines and stream lines reveals a faster development and increasing the thickness of thermal boundary layer at $Ra=4*10^8$ and then reduced as the vibrational frequencies increased that shedding to the enclosure at each Rayleigh number.

The experimental and theoretical results show that an increase in the average Nusselt number with time as the vibrational Rayleigh number Ra_{vib} will increase as resulting of increasing the vibration frequencies.

Finally the results show reasonable agreement between the theoretical and the experimental results and the present results and available previous work.