

# Library training: Mechanical and Aeronautical Engineering by Cora Bezuidenhout



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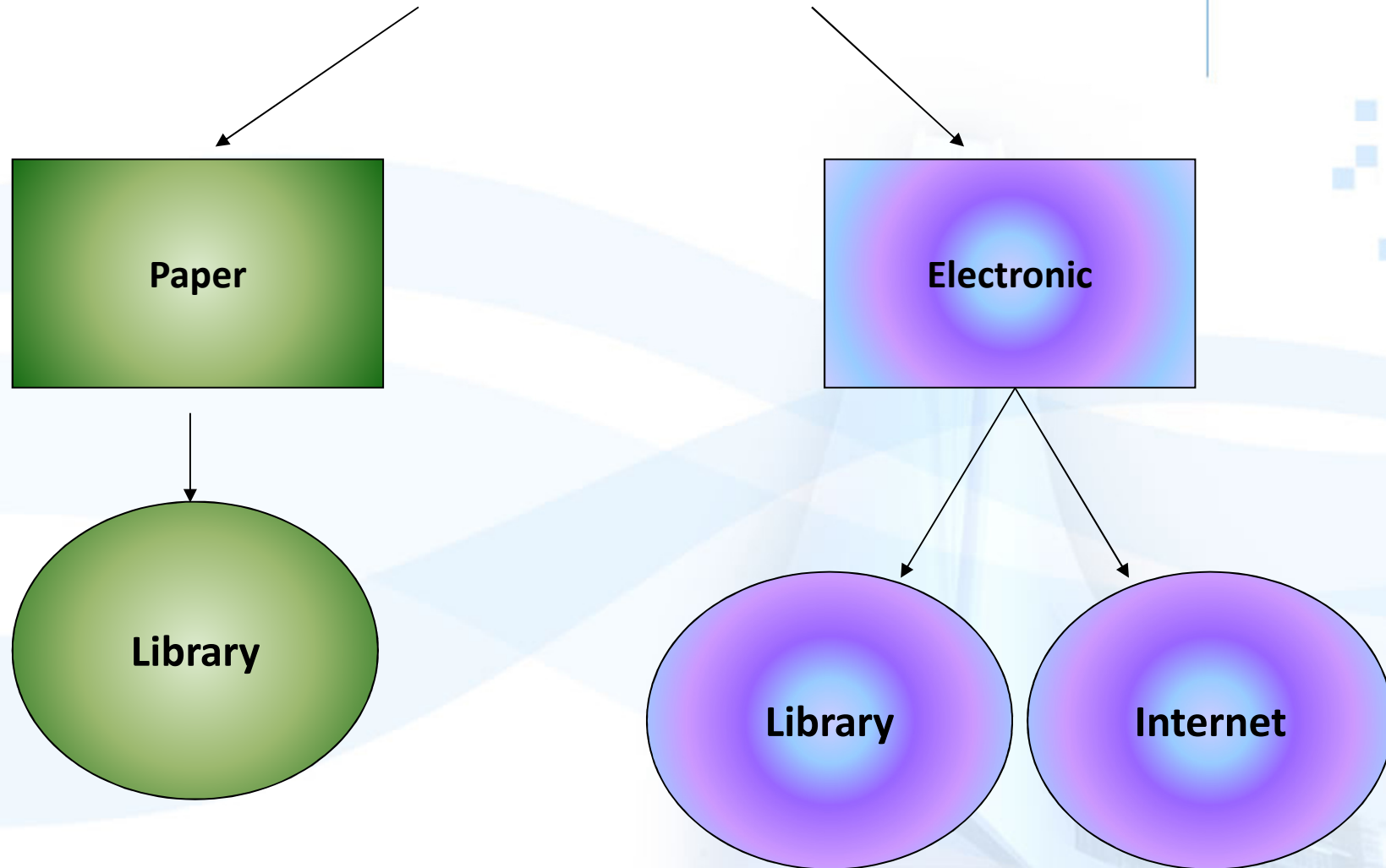


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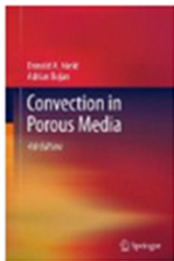
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[Convective heat and mass transfer](#)

Ghiaasiaan, Seyed Mostafa, 1953-  
Cambridge ; New York : Cambridge University Press, 2011.

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(Tips for effective Boolean Searches)

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- ESDU
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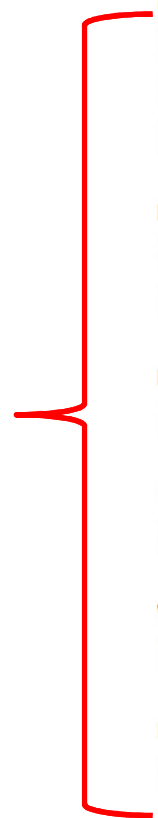
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- GlobalData Mining eTrack
- Scopus
- Proquest
  - >Materials Research Data
- ISI Web of Knowledge



# Recommended platforms and databases

- Knovel Library
- McGraw-Hill Access Engineering
- eBrary
  
- Scopus
- Science Direct
- Proquest

\*see list in brochure



# But how?



- analyse **T**opic
- **U**nderstand concepts
- determine **K**eywords
- do the **S**earch

Project title:

# Effect of vibration on natural convection for parallel heated plates



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# Tips

- Multiple keywords – use ‘AND’ connector
- Synonyms – use ‘OR’ connector
- Exclude with ‘NOT’ connector
- Exact phrase – enclose term with quotation marks

e.g. “natural convection”



# Example:

- vibration\*
- convection
- “natural convection”
- “heated plates”
- parallel
- “parallel heated plates”



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## Natural Convection

... that are used in the correlation of heat transfer data are the Nusselt number  $Nu$  which relates the transfer coefficient to the conduction in the fluid  $Nu = hL/k$  The Prandt... [more »](#)




from Heat Transfer Handbook (2003) [See more results from this title](#) | [Search within this title](#) »

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## 10.9 Natural Convection on Submerged Bodies

...298 **Natural Convection** Table 101 Laminarturbulent transition for **natural convection** on flat inclin **heated** and upward facing or cooled and downwa... [more »](#)



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$$Re \equiv \frac{\rho V L}{\mu}$$

All thermal properties in the foregoing dimensionless groups apply to the fluid at its bulk temperature.

**Natural Convection** In **natural convection**, fluid motion is induced by density differences resulting from temperature gradients in the fluid. The heat transfer coefficient for this regime can be related to the buoyancy and the thermal properties of the fluid through the *Rayleigh number*  $Ra$ , which is the product of the Grashof and Prandtl numbers:

$$Ra \equiv \frac{\rho^2 \beta g c_p}{\mu k} L^3 \Delta T = \frac{g \beta}{\alpha \nu} L^3 \Delta T$$

where the fluid properties  $\rho$ ,  $\beta$ ,  $c_p$ ,  $\mu$ , and  $k$  are evaluated at the fluid bulk temperature. Empirical correlations for the heat transfer coefficient in **natural convection** boundary layer flow have taken the form

HEAT TRANSFER FUNDAMENTALS 9

$$h = C \frac{k}{L} (Ra)^n \quad (\text{W/m}^2 \cdot \text{K}) \quad (1.14)$$

where  $n$  is found to be approximately 0.25 for  $10^3 < Ra < 10^9$ , representing laminar flow; 0.33 for  $10^9 < Ra < 10^{12}$ , the region associated with the transition to turbulent flow; and 0.4 for  $Ra > 10^{12}$ , when strong turbulent flow prevails. The precise value of the correlating coefficient  $C$  depends on fluid, the geometry of the surface, and

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AND

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- Kimber, M. (3)
- Florio, L.A. (3)
- Harnoy, A. (3)
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y natural convection in a vertical flow path through transverse vibrations atic wall	Florio, L.A., Harnoy, A.	2007	Numerical Heat Transfer, Part A: Applications	5
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Volume 55, Issue 9-10, April 2012, Pages 2461-2471

## Journal information: volume, issue, pages

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Eastman, A.<sup>a</sup>, Kimber, M.<sup>a</sup>, Hirata, A.<sup>b</sup>, Kamitani, G.<sup>b</sup>

<sup>a</sup> School of Mechanical Engineering and Materials Science, University of Pittsburgh, 648 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA 15261, United States  
<sup>b</sup> Micromechatronics Business Development Department, Murata Manufacturing Co., Ltd., Nagaokakyo-shi, Kyoto 617-8555, Japan

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### Abstract

With the propagation of ever faster and more powerful electronics, the need for active, low power cooling is becoming apparent. In particular, applications which have traditionally relied only on **natural convection** will soon require an active cooling solution due to continually rising heat loads. A promising solution lies in utilizing piezoelectric materials via fans or pumps. Examples of such devices include synthetic jets and piezoelectric pumps, both of which rely on an oscillating diaphragm to induce flow. The device under investigation in this paper is able to generate flow rates up to 1 L/min and overcome pressures of over 2 kPa. The focus is to experimentally characterize the cooling potential of a piezoelectric-based air pump oriented normal to the **heated** element, an environment similar to jet impingement. Experimental characterizations were made through the use of a thin film heater which provided a constant heat flux while an infrared camera was used to capture the resulting temperature field of the **heated** surface. Full-field data of the **convection** coefficient was analyzed as a function of **vibration** amplitude of the piezoelectric diaphragm and distance from the nozzle to the **heated** target. The maximum heat transfer coefficient was found to always be at the stagnation point for distance to the target. Correlations have been developed which account for both variables considered and can be used to design devices which rely on the same physical characteristics. © 2012 Elsevier Ltd. All rights reserved.

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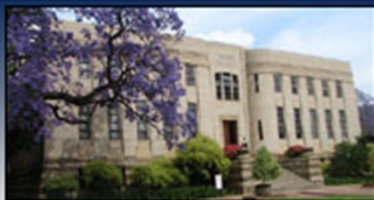
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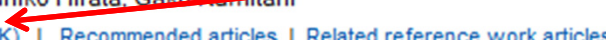
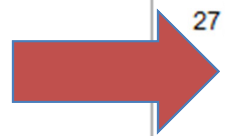
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