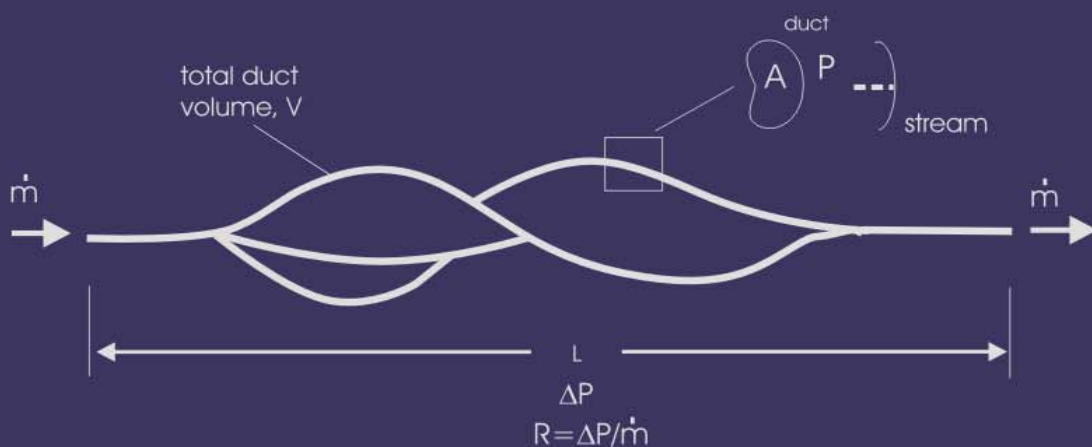


Proceedings of the Symposium

Bejan's Constructal Theory of Shape and Structure



Published by
Évora Geophysics Center
University of Évora

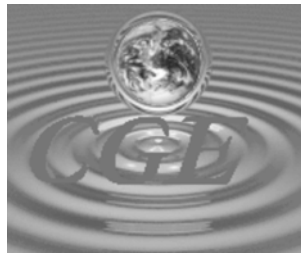
Editors:
Rui N. Rosa
A. Heitor Reis
António F. Miguel

Proceedings of the Symposium

Bejan's Constructal Theory of Shape and Structure

Edited by

Rui N. Rosa, A. Heitor Reis & A. F. Miguel



Centro de Geofísica de Évora
Évora Geophysics Center

Centro de Geofísica de Évora
Rua Romão Ramalho 59
7000-671 Évora, Portugal

ISBN: 972-9039-75-5

Depósito Legal n° 206788/04

© 2004, by CGE - University of Évora (Portugal)

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher.

Contents

Foreword	v
Contributors	vii
Address by the Rector of the University of Évora <i>Manuel F. Patrício</i>	1
Introduction <i>Rui N. Rosa</i>	5
Chapter 1. River Basins: Geomorphology and Dynamics <i>Rui N. Rosa</i>	15
1.1 Introduction	15
1.2 River basins and networks	16
1.3 Topography and topographic statistics	21
1.4 River flow and channel hydrodynamics	23
1.5 Mass erosion transport and deposition	25
1.6 Stochastic drainage basins	35
1.7 Deterministic drainage basins	38
References	45
Chapter 2. Tree-Shaped Flow Structures for Human-Scale and Small-Scales Applications <i>Sylvie Lorente, Wishsanuruk Wechsatoł & Adrian Bejan</i>	49
2.1 Tree-shaped flows	50
2.2 Networks at human scale	50
2.3 Networks at small scales	60
2.4 Concluding remarks	71
References	72

Chapter 3. Dendritic Growth: Classical Models and Constructal Analysis <i>António F. Miguel</i>	75
3.1 Shape and structure of natural systems: the case of dendritic structures	75
3.2 Some classical methodologies for dendrite growth	77
3.3 Constructal theory and dendrite growth	82
3.4 Dendritic bacterial colonies and plant roots	82
3.5 Respiratory system	85
3.6 Formation of trail systems	86
3.7 Movement of individuals in crowds	90
3.8 Concluding remarks	91
References	92
Chapter 4. Thermodynamic Formulation of the Constructal Law <i>Adrian Bejan & Sylvie Lorente</i>	95
4.1 Introduction	96
4.2 Flow between two points	97
4.3 Equilibrium flow structures	100
4.4 Flow between one point and a large number of points	102
4.5 Flow between one point and an infinite number of points	107
4.6 The constructal law	109
4.7 The constructal law and thermodynamics	114
4.8 Concluding remarks	115
References	118
Nomenclature	119
Chapter 5. Performance Evaluation of Some Passive Augmentation Techniques Using Entropy Generation Minimization Method <i>Ventsislav Zimparov</i>	121
5.1 Introduction	122
5.2 Evaluation criteria based on the first law analysis	124
5.3 Evaluation criteria based on the second law analysis	126
5.4 Application of the extended PEC	129
5.5 Results and discussion	135

5.6 Conclusions	140
References	141
Nomenclature	144
Chapter 6. Visualization of Two-Dimensional Heat and Mass Transfer using the Heatlines and Masslines	147
<i>Vitor A. F. Costa</i>	
6.1 Introduction	147
6.2 Heatfunction and heatlines: the first steps	149
6.3 Massfunction and masslines	152
6.4 Use of heatlines in unsteady problems	154
6.5 Similarity solutions for the heatfunction - boundary layer problems	154
6.6 Unification of the streamline, heatline and massline methods	158
6.7 Unification of the streamline, heatline and massline methods to apply to anisotropic media	161
6.8 Extension of the heatline and massline concepts to apply to reacting flows	166
6.9 Conclusions	167
References	168
Chapter 7. Constructal View of Global Circulation and Climate	171
<i>A. Heitor Reis</i>	
7.1 Introduction	171
7.2 Earth as heat collector and radiator	172
7.3 Maximization of heat transfer performance at daily scale	182
7.4 Conclusions	188
References	189
Chapter 8. Entropy Generation for the Next Generation	191
<i>Ibrahim Dincer</i>	
8.1 Introduction	192
8.2 Entropy	193
8.3 Illustrative examples	202
8.4 Entropy in our daily life	210

iv Contents

8.5 Thermodynamics as a fast growing field with its entropy generation	213
8.6 Adrian Bejan's constructal theory of shape in nature, covering construction, thermodynamics, time and life	215
8.7 Conclusions	218
References	218



Susana Rodrigues/ U.E