

# Harmonisation between Architecture and Nature

# ECO-ARCHITECTURE



# Eco-Architecture II

**WIT***PRESS*

WIT Press publishes leading books in Science and Technology.

Visit our website for the current list of titles.

[www.witpress.com](http://www.witpress.com)

**WIT***eLibrary*

Home of the Transactions of the Wessex Institute.

Papers presented at Eco-Architecture II are archived in the WIT eLibrary in volume 113 of WIT Transactions on Ecology and the Environment (ISSN 1743-3541). The WIT eLibrary provides the international scientific community with immediate and permanent access to individual papers presented at WIT conferences.

<http://library.witpress.com>

SECOND INTERNATIONAL CONFERENCE ON  
HARMONISATION BETWEEN ARCHITECTURE AND NATURE

## **ECO-ARCHITECTURE II**

### **CONFERENCE CHAIRMEN**

**G. Broadbent**

*University of Portsmouth, UK*

**C.A. Brebbia**

*Wessex Institute of Technology, UK*

### **INTERNATIONAL SCIENTIFIC ADVISORY COMMITTEE**

K. Connors  
M.L. Garrison  
P. Harwood  
B.A. Kazimee  
P. Kilby  
D. Lewis  
A.A. Mammoli  
L. Marletta

R.M. Pulselli  
J. Quale  
N. Sala  
A. Sichenze  
E. Stach  
W. Timmermans  
A. van Timmeren  
T. Woolley

**Organised by**

*Wessex Institute of Technology, UK*

**Sponsored by**

*WIT Transactions on Ecology and the Environment*

# WIT Transactions

## Transactions Editor

**Carlos Brebbia**

Wessex Institute of Technology  
Ashurst Lodge, Ashurst  
Southampton SO40 7AA, UK  
Email: carlos@wessex.ac.uk

---

## Editorial Board

---

- |  |   |
|--|---|
| <b>B Abersek</b> University of Maribor, Slovenia                 | <b>M P Bekakos</b> Democritus University of Thrace, Greece            |
| <b>Y N Abousleiman</b> University of Oklahoma, USA               | <b>G Belingardi</b> Politecnico di Torino, Italy                      |
| <b>P L Aguilar</b> University of Extremadura, Spain              | <b>R Belmans</b> Katholieke Universiteit Leuven, Belgium              |
| <b>K S Al Jabri</b> Sultan Qaboos University, Oman               | <b>C D Bertram</b> The University of New South Wales, Australia       |
| <b>E Alarcon</b> Universidad Politecnica de Madrid, Spain        | <b>D E Beskos</b> University of Patras, Greece                        |
| <b>A Aldama</b> IMTA, Mexico                                     | <b>S K Bhattacharyya</b> Indian Institute of Technology, India        |
| <b>C Alessandri</b> Universita di Ferrara, Italy                 | <b>E Blums</b> Latvian Academy of Sciences, Latvia                    |
| <b>D Almorza Gomar</b> University of Cadiz, Spain                | <b>J Boarder</b> Cartref Consulting Systems, UK                       |
| <b>B Alzahabi</b> Kettering University, USA                      | <b>B Bobee</b> Institut National de la Recherche Scientifique, Canada |
| <b>J A C Ambrosio</b> IDMEC, Portugal                            | <b>H Boileau</b> ESIGEC, France                                       |
| <b>A M Amer</b> Cairo University, Egypt                          | <b>J J Bommer</b> Imperial College London, UK                         |
| <b>S A Anagnostopoulos</b> University of Patras, Greece          | <b>M Bonnet</b> Ecole Polytechnique, France                           |
| <b>M Andretta</b> Montecatini, Italy                             | <b>C A Borrego</b> University of Aveiro, Portugal                     |
| <b>E Angelino</b> A.R.P.A. Lombardia, Italy                      | <b>A R Bretones</b> University of Granada, Spain                      |
| <b>H Antes</b> Technische Universitat Braunschweig, Germany      | <b>J A Bryant</b> University of Exeter, UK                            |
| <b>M A Atherton</b> South Bank University, UK                    | <b>F-G Buchholz</b> Universitat Gesanthochschule Paderborn, Germany   |
| <b>A G Atkins</b> University of Reading, UK                      | <b>M B Bush</b> The University of Western Australia, Australia        |
| <b>D Aubry</b> Ecole Centrale de Paris, France                   | <b>F Butera</b> Politecnico di Milano, Italy                          |
| <b>H Azegami</b> Toyohashi University of Technology, Japan       | <b>J Byrne</b> University of Portsmouth, UK                           |
| <b>A F M Azevedo</b> University of Porto, Portugal               | <b>W Cantwell</b> Liverpool University, UK                            |
| <b>J Baish</b> Bucknell University, USA                          | <b>D J Cartwright</b> Bucknell University, USA                        |
| <b>J M Baldasano</b> Universitat Politecnica de Catalunya, Spain | <b>P G Carydis</b> National Technical University of Athens, Greece    |
| <b>J G Bartzis</b> Institute of Nuclear Technology, Greece       | <b>J J Casares Long</b> Universidad de Santiago de Compostela, Spain, |
| <b>A Bejan</b> Duke University, USA                              | <b>M A Celia</b> Princeton University, USA                            |
|  | <b>A Chakrabarti</b> Indian Institute of Science, India               |

- S K Chakrabarti** Offshore Structure Analysis, USA
- A H-D Cheng** University of Mississippi, USA
- J Chilton** University of Lincoln, UK
- C-L Chiu** University of Pittsburgh, USA
- H Choi** Kangnung National University, Korea
- A Cieslak** Technical University of Lodz, Poland
- S Clement** Transport System Centre, Australia
- M W Collins** Brunel University, UK
- J J Connor** Massachusetts Institute of Technology, USA
- M C Constantinou** State University of New York at Buffalo, USA
- D E Cormack** University of Toronto, Canada
- M Costantino** Royal Bank of Scotland, UK
- D F Cutler** Royal Botanic Gardens, UK
- W Czychula** Krakow University of Technology, Poland
- M da Conceicao Cunha** University of Coimbra, Portugal
- A Davies** University of Hertfordshire, UK
- M Davis** Temple University, USA
- A B de Almeida** Instituto Superior Tecnico, Portugal
- E R de Arantes e Oliveira** Instituto Superior Tecnico, Portugal
- L De Biase** University of Milan, Italy
- R de Borst** Delft University of Technology, Netherlands
- G De Mey** University of Ghent, Belgium
- A De Montis** Universita di Cagliari, Italy
- A De Naeyer** Universiteit Ghent, Belgium
- W P De Wilde** Vrije Universiteit Brussel, Belgium
- L Debnath** University of Texas-Pan American, USA
- N J Dedios Mimbela** Universidad de Cordoba, Spain
- G Degrande** Katholieke Universiteit Leuven, Belgium
- S del Giudice** University of Udine, Italy
- G Deplano** Universita di Cagliari, Italy
- I Doltsinis** University of Stuttgart, Germany
- M Domaszewski** Universite de Technologie de Belfort-Montbéliard, France
- J Dominguez** University of Seville, Spain
- K Dorow** Pacific Northwest National Laboratory, USA
- W Dover** University College London, UK
- C Dowlen** South Bank University, UK
- J P du Plessis** University of Stellenbosch, South Africa
- R Duffell** University of Hertfordshire, UK
- A Ebel** University of Cologne, Germany
- E E Edoutos** Democritus University of Thrace, Greece
- G K Egan** Monash University, Australia
- K M Elawadly** Alexandria University, Egypt
- K-H Elmer** Universitat Hannover, Germany
- D Elms** University of Canterbury, New Zealand
- M E M El-Sayed** Kettering University, USA
- D M Elsom** Oxford Brookes University, UK
- A El-Zafrany** Cranfield University, UK
- F Erdogan** Lehigh University, USA
- F P Eserig** University of Seville, Spain
- D J Evans** Nottingham Trent University, UK
- J W Everett** Rowan University, USA
- M Faghri** University of Rhode Island, USA
- R A Falconer** Cardiff University, UK
- M N Fardis** University of Patras, Greece
- P Fedelinski** Silesian Technical University, Poland
- H J S Fernando** Arizona State University, USA
- S Finger** Carnegie Mellon University, USA
- J I Frankel** University of Tennessee, USA
- D M Fraser** University of Cape Town, South Africa
- M J Fritzler** University of Calgary, Canada
- U Gabbert** Otto-von-Guericke Universitat Magdeburg, Germany
- G Gambolati** Universita di Padova, Italy
- C J Gantes** National Technical University of Athens, Greece
- L Gaul** Universitat Stuttgart, Germany
- A Genco** University of Palermo, Italy
- N Georgantzis** Universitat Jaume I, Spain
- G S Gipson** Oklahoma State University, USA
- P Giudici** Universita di Pavia, Italy
- F Gomez** Universidad Politecnica de Valencia, Spain



- R Gomez Martin** University of Granada, Spain
- D Goulias** University of Maryland, USA
- K G Goulias** Pennsylvania State University, USA
- F Grandori** Politecnico di Milano, Italy
- W E Grant** Texas A & M University, USA
- S Grilli** University of Rhode Island, USA
- R H J Grimshaw**, Loughborough University, UK
- D Gross** Technische Hochschule Darmstadt, Germany
- R Grundmann** Technische Universitat Dresden, Germany
- A Gualtierotti** IDHEAP, Switzerland
- R C Gupta** National University of Singapore, Singapore
- J M Hale** University of Newcastle, UK
- K Hameyer** Katholieke Universiteit Leuven, Belgium
- C Hanke** Danish Technical University, Denmark
- K Hayami** National Institute of Informatics, Japan
- Y Hayashi** Nagoya University, Japan
- L Haydock** Newage International Limited, UK
- A H Hendrickx** Free University of Brussels, Belgium
- C Herman** John Hopkins University, USA
- S Heslop** University of Bristol, UK
- I Hideaki** Nagoya University, Japan
- D A Hills** University of Oxford, UK
- W F Huebner** Southwest Research Institute, USA
- J A C Humphrey** Bucknell University, USA
- M Y Hussaini** Florida State University, USA
- W Hutchinson** Edith Cowan University, Australia
- T H Hyde** University of Nottingham, UK
- M Iguchi** Science University of Tokyo, Japan
- D B Ingham** University of Leeds, UK
- L Int Panis** VITO Expertisecentrum IMS, Belgium
- N Ishikawa** National Defence Academy, Japan
- J Jaafar** UiTm, Malaysia
- W Jager** Technical University of Dresden, Germany
- Y Jaluria** Rutgers University, USA
- C M Jefferson** University of the West of England, UK
- P R Johnston** Griffith University, Australia
- D R H Jones** University of Cambridge, UK
- N Jones** University of Liverpool, UK
- D Kaliampakos** National Technical University of Athens, Greece
- N Kamiya** Nagoya University, Japan
- D L Karabalis** University of Patras, Greece
- M Karlsson** Linkoping University, Sweden
- T Katayama** Doshisha University, Japan
- K L Katsifarakis** Aristotle University of Thessaloniki, Greece
- J T Katsikadelis** National Technical University of Athens, Greece
- E Kausel** Massachusetts Institute of Technology, USA
- H Kawashima** The University of Tokyo, Japan
- B A Kazimee** Washington State University, USA
- S Kim** University of Wisconsin-Madison, USA
- D Kirkland** Nicholas Grimshaw & Partners Ltd, UK
- E Kita** Nagoya University, Japan
- A S Kobayashi** University of Washington, USA
- T Kobayashi** University of Tokyo, Japan
- D Koga** Saga University, Japan
- A Konrad** University of Toronto, Canada
- S Kotake** University of Tokyo, Japan
- A N Kounadis** National Technical University of Athens, Greece
- W B Kratzig** Ruhr Universitat Bochum, Germany
- T Krauthammer** Penn State University, USA
- C-H Lai** University of Greenwich, UK
- M Langseth** Norwegian University of Science and Technology, Norway
- B S Larsen** Technical University of Denmark, Denmark
- F Lattarulo**, Politecnico di Bari, Italy
- A Lebedev** Moscow State University, Russia
- L J Leon** University of Montreal, Canada
- D Lewis** Mississippi State University, USA
- S Ighobashi** University of California Irvine, USA

- K-C Lin** University of New Brunswick, Canada
- A A Liolios** Democritus University of Thrace, Greece
- S Lomov** Katholieke Universiteit Leuven, Belgium
- J W S Longhurst** University of the West of England, UK
- G Loo** The University of Auckland, New Zealand
- J Lourenco** Universidade do Minho, Portugal
- J E Luco** University of California at San Diego, USA
- H Lui** State Seismological Bureau Harbin, China
- C J Lumsden** University of Toronto, Canada
- L Lundqvist** Division of Transport and Location Analysis, Sweden
- T Lyons** Murdoch University, Australia
- Y-W Mai** University of Sydney, Australia
- M Majowiecki** University of Bologna, Italy
- D Malerba** Università degli Studi di Bari, Italy
- G Manara** University of Pisa, Italy
- B N Mandal** Indian Statistical Institute, India
- Ü Mander** University of Tartu, Estonia
- H A Mang** Technische Universität Wien, Austria,
- G D, Manolis**, Aristotle University of Thessaloniki, Greece
- W J Mansur** COPPE/UFRJ, Brazil
- N Marchettini** University of Siena, Italy
- J D M Marsh** Griffith University, Australia
- J F Martin-Duque** Universidad Complutense, Spain
- T Matsui** Nagoya University, Japan
- G Mattrisch** DaimlerChrysler AG, Germany
- F M Mazzolani** University of Naples “Federico II”, Italy
- K McManis** University of New Orleans, USA
- A C Mendes** Universidade de Beira Interior, Portugal,
- R A Meric** Research Institute for Basic Sciences, Turkey
- J Mikieliewicz** Polish Academy of Sciences, Poland
- N Milic-Frayling** Microsoft Research Ltd, UK
- R A W Mines** University of Liverpool, UK
- C A Mitchell** University of Sydney, Australia
- K Miura** Kajima Corporation, Japan
- A Miyamoto** Yamaguchi University, Japan
- T Miyoshi** Kobe University, Japan
- G Molinari** University of Genoa, Italy
- T B Moodie** University of Alberta, Canada
- D B Murray** Trinity College Dublin, Ireland
- G Nakhaeizadeh** DaimlerChrysler AG, Germany
- M B Neace** Mercer University, USA
- D Neculescu** University of Ottawa, Canada
- F Neumann** University of Vienna, Austria
- S-I Nishida** Saga University, Japan
- H Nisitani** Kyushu Sangyo University, Japan
- B Notaros** University of Massachusetts, USA
- P O'Donoghue** University College Dublin, Ireland
- R O O'Neill** Oak Ridge National Laboratory, USA
- M Ohkusu** Kyushu University, Japan
- G Oliveto** Università di Catania, Italy
- R Olsen** Camp Dresser & McKee Inc., USA
- E Oñate** Universitat Politècnica de Catalunya, Spain
- K Onishi** Ibaraki University, Japan
- P H Oosthuizen** Queens University, Canada
- E L Ortiz** Imperial College London, UK
- E Outa** Waseda University, Japan
- A S Papageorgiou** Rensselaer Polytechnic Institute, USA
- J Park** Seoul National University, Korea
- G Passerini** Università delle Marche, Italy
- B C Patten**, University of Georgia, USA
- G Pelosi** University of Florence, Italy
- G G Penelis**, Aristotle University of Thessaloniki, Greece
- W Perrie** Bedford Institute of Oceanography, Canada
- R Pietrabissa** Politecnico di Milano, Italy
- H Pina** Instituto Superior Técnico, Portugal
- M F Platzer** Naval Postgraduate School, USA
- D Poljak** University of Split, Croatia

- V Popov** Wessex Institute of Technology, UK
- H Power** University of Nottingham, UK
- D Prandle** Proudman Oceanographic Laboratory, UK
- M Predeleanu** University Paris VI, France
- M R I Purvis** University of Portsmouth, UK
- I S Putra** Institute of Technology Bandung, Indonesia
- Y A Pykh** Russian Academy of Sciences, Russia
- F Rachidi** EMC Group, Switzerland
- M Rahman** Dalhousie University, Canada
- K R Rajagopal** Texas A & M University, USA
- T Rang** Tallinn Technical University, Estonia
- J Rao** Case Western Reserve University, USA
- A M Reinhorn** State University of New York at Buffalo, USA
- A D Rey** McGill University, Canada
- D N Riahi** University of Illinois at Urbana-Champaign, USA
- B Ribas** Spanish National Centre for Environmental Health, Spain
- K Richter** Graz University of Technology, Austria
- S Rinaldi** Politecnico di Milano, Italy
- F Robuste** Universitat Politècnica de Catalunya, Spain
- J Roddick** Flinders University, Australia
- A C Rodrigues** Universidade Nova de Lisboa, Portugal
- F Rodrigues** Poly Institute of Porto, Portugal
- C W Roeder** University of Washington, USA
- J M Roeset** Texas A & M University, USA
- W Roetzel** Universitaet der Bundeswehr Hamburg, Germany
- V Roje** University of Split, Croatia
- R Rosset** Laboratoire d'Aerologie, France
- J L Rubio** Centro de Investigaciones sobre Desertificación, Spain
- T J Rudolphi** Iowa State University, USA
- S Russenck** Magnet Group, Switzerland
- H Ryssel** Fraunhofer Institut Integrierte Schaltungen, Germany
- S G Saad** American University in Cairo, Egypt
- M Saiidi** University of Nevada-Reno, USA
- R San Jose** Technical University of Madrid, Spain
- F J Sanchez-Sesma** Instituto Mexicano del Petroleo, Mexico
- B Sarler** Nova Gorica Polytechnic, Slovenia
- S A Savidis** Technische Universitat Berlin, Germany
- A Savini** Universita de Pavia, Italy
- G Schmid** Ruhr-Universitat Bochum, Germany
- R Schmidt** RWTH Aachen, Germany
- B Scholtes** Universitaet of Kassel, Germany
- W Schreiber** University of Alabama, USA
- A P S Selvadurai** McGill University, Canada
- J J Sendra** University of Seville, Spain
- J J Sharp** Memorial University of Newfoundland, Canada
- Q Shen** Massachusetts Institute of Technology, USA
- X Shixiong** Fudan University, China
- G C Sih** Lehigh University, USA
- L C Simoes** University of Coimbra, Portugal
- A C Singhal** Arizona State University, USA
- P Skerget** University of Maribor, Slovenia
- J Sladek** Slovak Academy of Sciences, Slovakia
- V Sladek** Slovak Academy of Sciences, Slovakia
- A C M Sousa** University of New Brunswick, Canada
- H Sozer** Illinois Institute of Technology, USA
- D B Spalding** CHAM, UK
- P D Spanos** Rice University, USA
- T Speck** Albert-Ludwigs-Universitaet Freiburg, Germany
- C C Spyarakos** National Technical University of Athens, Greece
- I V Stangeeva** St Petersburg University, Russia
- J Stasiak** Technical University of Gdansk, Poland
- G E Swaters** University of Alberta, Canada
- S Syngellakis** University of Southampton, UK
- J Szmyd** University of Mining and Metallurgy, Poland
- S T Tadano** Hokkaido University, Japan



**H Takemiya** Okayama University, Japan  
**I Takewaki** Kyoto University, Japan  
**C-L Tan** Carleton University, Canada  
**M Tanaka** Shinshu University, Japan  
**E Taniguchi** Kyoto University, Japan  
**S Tanimura** Aichi University of Technology, Japan  
**J L Tassoulas** University of Texas at Austin, USA  
**M A P Taylor** University of South Australia, Australia  
**A Terranova** Politecnico di Milano, Italy  
**E Tiezzi** University of Siena, Italy  
**A G Tijhuis** Technische Universiteit Eindhoven, Netherlands  
**T Tirabassi** Institute FISBAT-CNR, Italy  
**S Tkachenko** Otto-von-Guericke-University, Germany  
**N Tosaka** Nihon University, Japan  
**T Tran-Cong** University of Southern Queensland, Australia  
**R Tremblay** Ecole Polytechnique, Canada  
**I Tsukrov** University of New Hampshire, USA  
**R Turra** CINECA Interuniversity Computing Centre, Italy  
**S G Tushinski** Moscow State University, Russia  
**J-L Uso** Universitat Jaume I, Spain  
**E Van den Bulck** Katholieke Universiteit Leuven, Belgium  
**D Van den Poel** Ghent University, Belgium  
**R van der Heijden** Radboud University, Netherlands  
**R van Duin** Delft University of Technology, Netherlands  
**P Vas** University of Aberdeen, UK  
**W S Venturini** University of Sao Paulo, Brazil  
**R Verhoeven** Ghent University, Belgium  
**A Viguri** Universitat Jaume I, Spain  
**Y Villacampa Esteve** Universidad de Alicante, Spain  
**F F V Vincent** University of Bath, UK  
**S Walker** Imperial College, UK  
**G Walters** University of Exeter, UK  
**B Weiss** University of Vienna, Austria  
**H Westphal** University of Magdeburg, Germany  
**J R Whiteman** Brunel University, UK  
**Z-Y Yan** Peking University, China  
**S Yanniotis** Agricultural University of Athens, Greece  
**A Yeh** University of Hong Kong, China  
**J Yoon** Old Dominion University, USA  
**K Yoshizato** Hiroshima University, Japan  
**T X Yu** Hong Kong University of Science & Technology, Hong Kong  
**M Zador** Technical University of Budapest, Hungary  
**K Zakrzewski** Politechnika Lodzka, Poland  
**M Zamir** University of Western Ontario, Canada  
**R Zarnic** University of Ljubljana, Slovenia  
**G Zharkova** Institute of Theoretical and Applied Mechanics, Russia  
**N Zhong** Maebashi Institute of Technology, Japan  
**H G Zimmermann** Siemens AG, Germany

# **Eco-Architecture II**

## **Harmonisation between Architecture and Nature**

**Editors**

**G. Broadbent**

*University of Portsmouth, UK*

**C.A. Brebbia**

*Wessex Institute of Technology, UK*

**WIT***PRESS* Southampton, Boston



**G. Broadbent**

*University of Portsmouth, UK*

**C.A. Brebbia**

*Wessex Institute of Technology, UK*

Published by

**WIT Press**

Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK

Tel: 44 (0) 238 029 3223; Fax: 44 (0) 238 029 2853

E-Mail: [witpress@witpress.com](mailto:witpress@witpress.com)

<http://www.witpress.com>

For USA, Canada and Mexico

**Computational Mechanics Inc**

25 Bridge Street, Billerica, MA 01821, USA

Tel: 978 667 5841; Fax: 978 667 7582

E-Mail: [infousa@witpress.com](mailto:infousa@witpress.com)

<http://www.witpress.com>

British Library Cataloguing-in-Publication Data

A Catalogue record for this book is available  
from the British Library

ISBN: 978-1-84564-119-1

ISSN: 1746-448X (print)

ISSN: 1743-3541 (online)

*The texts of the papers in this volume were set  
individually by the authors or under their supervision.  
Only minor corrections to the text may have been carried  
out by the publisher.*

No responsibility is assumed by the Publisher, the Editors and Authors for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions or ideas contained in the material herein. The Publisher does not necessarily endorse the ideas held, or views expressed by the Editors or Authors of the material contained in its publications.

© WIT Press 2008

Printed in Great Britain by Athenaeum Press Ltd.

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.

# Preface

The Wessex Institute of Technology organised its First International Conference on Harmonisation between Architecture and Nature in 2006, which was so successful that a second such Conference very clearly was required, hence the papers collected here from ECO-ARCHITECTURE 2008, held on the Algarve in Portugal.

The original Conference was by no means the first to be held worldwide on the subject of “greening” architecture, design for sustainability and a host of other titles but it was a successful attempt to define what ECO-ARCHITECTURE actually is, i.e. “Harmonisation between Architecture and Nature”.

The subject, of course, has matured in the two years between conferences and the submitted papers virtually categorised themselves into Ecological and cultural sensitivity, Design with nature, Resource conservation and building technology, Design by passive systems, Case studies, Rehabilitation and adaptive re-use whilst the affiliations of the authors – whether in academia, the professions or industry – indicate the very wide international scope and the interdisciplinary nature of the subject.

There are pockets of resistance, led by those who delight in displaying technical prowess rather than designing for real, live, human beings in natural environments in the spirit of Harmonisation which is such a crucial part of our title. But the forces of progress seem to be against them with the current emphasis, worldwide, on “green” values and optimization of our limited resources.

A book like this is the result of collaboration with many colleagues. The editors, as before, are grateful to the authors for the quality of their papers, to the International Scientific Committee and other colleagues who helped review the papers.

The Editors,  
The Algarve  
2008

# Contents

## Section 1: Ecological and cultural sensitivity

Learning from vernacular architecture: sustainability and cultural conformity <i>B. A. Kazimee</i> .....	3
The ecology of the <i>mudhif</i> <i>G. Broadbent</i> .....	15
The vernacular of Tibet, harnessing panoramic sunshine <i>N. Blossom &amp; L. Blossom</i> .....	27
The fortress, a house with a vision <i>B. D'hoore &amp; P. Quataert</i> .....	37
Modern interpretation of FengShui in contemporary sustainable residential design <i>Z. Zhong &amp; B. Ceranic</i> .....	47
Roots and relationships of greening buildings <i>S. Fruehwirth</i> .....	57
Light Imprint New Urbanism – a framework for urban and environmental sustainability <i>T. E. Low, G. Tachiev, P. Kelly, G. Pearlman, N. Black, M. Carney &amp; L. Koutrelakos</i> .....	69
Abianeh Village – “of the same color as nature” <i>M. M. G. Soroush</i> .....	77
Water as a natural and an artistic resource <i>M. G. Bachmann</i> .....	85

Assessing housing: developing a method for neighbourhood ecological footprint analysis <i>R. E. Smith &amp; M. Senbel</i> .....	95
--	----

## Section 2: Design with nature

<b>The <i>dislocation</i> of composition: architecture and eco-sustainability</b> <i>A. Sichenze, I. Macaione &amp; M. I. Insetti</i> .....	107
Swarm-driven idea models – from insect nests to modern architecture <i>S. von Mammen &amp; C. Jacob</i> .....	117
Defining ecological regionalism – a theoretical perspective <i>M. A. Yadav</i> .....	127
In harmony with nature – the Suckling Elephant House of Malaysia <i>A. Bahauddin &amp; A. Abdullah</i> .....	137
Living skins: environmental benefits of green envelopes in the city context <i>D. Roehr &amp; J. Laurenz</i> .....	149
Earthquake resistant characteristics of traditional Khasi houses in Shillong, India <i>B. I. O. Dahunsi &amp; A. K. Mittal</i> .....	159

## Section 3: Resource conservation and building technologies

Hands-on learning: the ecoMOD project <i>J. D. Quale</i> .....	171
Urban energy harvest and optimisation in use of renewable energy sources in the Droevendaal residential area <i>G. V. Tragopoulos, W. Timmermans &amp; R. Rovers</i> .....	181
Cost benefit analysis of energy efficient family houses <i>H. Krstić &amp; K. Čulo</i> .....	191
Timber: a changing material and its effect on the architectural form <i>S. Costa Santos</i> .....	201
Following nature, completing the cycle, properly utilizing our precious water – exploration of future urban water systems <i>Y. Feng, R. Otterpohl, K. Wichmann &amp; U. Braun</i> .....	209



Specifying textiles in a greener world: using sustainable strategies to develop new criteria <i>J. Stark</i> .....	221
---	-----

Sustainable procedures for environmental evaluation of building materials and technologies <i>M. C. Forlani, M. M. Lepore &amp; A. Basti</i> .....	231
---	-----

#### **Section 4: Design by passive systems**

Hygrothermic performance of the exterior and interior surfaces of buildings <i>H. Stopp &amp; P. Strangfeld</i> .....	243
--	-----

Visualizing sustainability in urban conditions <i>T. Shelton</i> .....	253
---	-----

Study of the behaviour of the shutter prototype for non-residential buildings, aimed at containing the summer heating load <i>S. Grignaffini, S. Cappellanti &amp; A. Cefalo</i> .....	263
---	-----

Use of active and passive solar systems in residential buildings <i>S. A. R. Shojaee</i> .....	273
---	-----

#### **Section 5: Case studies**

Generation p(ost-fossil) <i>A. Ellett &amp; M. Despang</i> .....	285
---	-----

The solar house in 1947 <i>A. Denzer</i> .....	295
---	-----

Daylight availability in courtyards of urban dwellings in Athens <i>E. Tsianaka</i> .....	305
--	-----

#### **Section 6: Rehabilitation and adaptive re-use**

The Emperor's new clothes: living skins and the reconsideration of the post-war office tower <i>S. Holmes, J. Maze &amp; M. McGlothlin</i> .....	317
---	-----

Rehabilitation and adaptive reuse of historic buildings in Poland <i>E. D. Ryńska</i> .....	327
--	-----

Rehabilitating existing high-rise residential buildings: the idea of <i>Ecoskin</i> <i>E. Kalisch Rotem</i> .....	337
<b>Author Index</b> .....	349

# **The *dislocation* of composition: Architecture and Eco-sustainability**

A. Sichenze<sup>1</sup>, I. Macaione<sup>1</sup> & M.I. Insetti<sup>1</sup>

<sup>1</sup> *Department of Architecture, Planning and Infrastructures for Transport,  
University of Basilicata, Italy.*

## **Abstract**

This paper deals with the problem and experiences of “ecological hetero-genesis of the ends”, within an architectural context, by defining the 40 year old trajectory of the ecological approach to architecture in a partial and critical balance based on the main results obtained. It results being a context of successes and insufficiencies from which a decisive step in the direction of a phenomenological architectural practice of eco-sustainability can be taken, through tests on both the scale of the *nature-city* as well as “residential *dislocation*”. The paper deals with these new experiences in order to show the visions of projects and initial realisations.

This research deals with the description of a phenomenological approach to design by two new procedures of direct union in relation with the beauty of sense of limit in architecture. Where the sense of limit is extended both to the availability of the resources and the concept of balance of the ecosystem in which architectures are immersed.

*Keywords: nature-city, phenomenology, eco-sustainability, architecture, limit.*

## **1 Introduction**

Following about 40 years of planning and applications, *eco-sustainability* has decisively become an *intentional* part of architectural design and testing of new areas and urban parks aimed at the idea of the sustainable city (e.g. *Vauban* and *Rieselfeld*, Freiburg im Breisgau, Germany; *Solar City*, Linz, Austria;

*Hammarby Sjöstad*, Stockholm, Sweden; *119 Houses on Hagen Island*, Ypenburg, Holland; *Benny Farm Reconversion*, Montreal, Canada).

There are no projects relating to entire *eco-cities*, with only China having planned 400. From the organisation of numerous exhibitions dedicated to bio-constructions as well as the study of publicising the sector, it is clearly evident that Europe has a large pool of techniques, regulations and tests of various types capable of finally overcoming the old idea of sustainability, going beyond the objectives set in Kyoto.

However, even though we are now finally equipped with everything, both technologically and administratively, required to establish a productive culture of bio-constructions, we realise that along with an evident global political and managerial delay [1], there is also a cultural one.

It is both in the participation of the population and society, with the causes having been studied at international conferences [2], as well as the training of architects and town-planners who cannot define the normal procedures of a “sustainable situation”, on the scale of both places as well as a “global ecology, connecting local and global [3].

There are many interconnected reasons for these delays, but they can essentially be traced back to the problem which phenomenological philosophy has already dealt with in depth, while in Italy, it is connected to architectural experience.

If the world of ecological representation, also scientific, and production creates languages, pre-constructed judgements and partial visions of separate aspects of things, of all the things, including natural things, means that even ecological science cannot escape their specific difficulty.

They are therefore based on “structures which connect”, e.g. eco-systems. In reality, they are applied through *objects*.

However, even though they collect, capture and calculate single relations with the natural world, they paradoxically separate them from these and any other objects, disconnecting everything. Therefore every *object* of the bio-construction is added to the others without interconnecting or integrating them into a whole environment.

When faced with this difficulty, architecture adopts a phenomenological-design approach which “suspends the judgement (*l'épochè*) on the sustainability offered as a scientific *fact*.”

It proposes a return to the ecological phenomenon as a lived world.

All that we know about ecology and sustainability starts from our experience of the world in which ecology is only a secondary experience, without this direct relationship with the things and the world, all our “scientific bio-constructions” mean nothing.

Our existence and behaviours towards the resources of nature *sustain* the world as well as *sustainability* itself.

It is therefore a *return to the same things* as well as the same phenomena of nature within the city.

It implies, as asserted by Maurice Merleau-Ponty, that “returning to this world anterior to the knowledge of which knowledge always *talks about*, and in relation to which every scientific determination is abstract, significant and

dependant as the geography in relation to the landscape in which we originally learnt what a forest, a field and a river are" [4].

These things are themselves "pre-objective and anti-predictive".

It therefore means not using the scientific, ecological and bio-constructive knowledge which we now have, but simply not giving them as acquired. On the other, it implies a return to a world distant in time, the *original* experience is considered to be *behind* today's world and in reference to the *appearance of the sense* of those things today.

The world, in a phenomenological sense, is not the being in a pure state but "the sense which transpires from and to the intersection of my experiences as well as those of others, thanks to the grafting of one to the other. It is therefore inseparable from subjectivity and inter-subjectivity, which realises their unity through the revival of my past experiences through my present experiences, through the experiences of others in mine" [4].

Two new procedures of direct union have been proposed upon which techno-science and ecology have based debates, theories and calculations of the constructed environment 1) genetic phenomenology, in other words the "discovery with awe" of existing Nature-Cities [5] and 2) constructive phenomenology, the designing of a new Nature-City today, as the "ecological dislocation" of an architecture which creates in every part the initial relations and the physical conditions of existence of its "world of life".

An **essential idea of the eco-sustainability** of development is therefore becoming part of the design and realisation procedures of architecture which in paying attention to the "slow signs of what escapes every calculation" recognises in itself all that is not an expected and usable object, in the relation with nature. It can still create awe. However, not in the sense of the star architects. Instead.

An architecture stupefies in which being beautiful is both the sense of the limit, extended to the availability of the resources of the ecosystem in which it is immersed.

An architecture stupefies in which, in **the transcending way, in a dislocating way, in the city**, it **re-generates** without stress the relation with nature, renewing the resources.

An architecture stupefies in which the world of life, passing through the objects produced by ecological industry of sustainability, rediscovers the traces of the things included in an original **ecological complexity** which is never already in departure. And this should never reveal itself, allow itself to be seen, apart from by itself, but in the sense of ecological richness in which "everything is connected to everything".

In this sense, there is no "eco-architecture".

There are architectures which, every time in their work, still allow manifestations of itself the ecological complexity of the regeneration of the Nature-City, in relation with a new (always new) *sense of the limit* which can be transcended only in a constant dislocation process.

## 2 The project of architecture between place and *non-place*: *Alethèia*

An experience, transmittable in this sense, is carried out by us designing a park known as *Alethèia* (Masterplan of the park project *Alétheia* coordinated by A. Sichenze within C.A. Fosci, M.I. Insetti, G. Izzi, M.R.A. Piro. Projects supervised by: A. Sichenze, M. Lavecchia, I. Macaione, E. Micelli, A.M. Puleo, A. Telesca, V. Telesca with specialised degree thesis by S. Gramegna, M.I. Insetti, C. Miroballi, F. Romano).

It is worth highlighting the project only for the reason that it assumes the exceptional nature of an essay written aside the architectural works of art.

What it tells of the project however it does not say, and therefore has to be anticipated, is the fact that the tourist route through the park is conceived as a continual *transcendence* of the limits of the experience from one place to another of the Nature-City: from the entrance to the exit, designing a spatialisation in time (where what space tends to substitute time) in the search of “where and how to be” (ecological in the future of the world), in a continual *dislocating* experience. However, what it wants to dislocate here is the experience itself of the order of an eco-sustainable world of the Nature-City, heterogeneous with the aim of bio-climatic strategies and never carried out by itself, continually re-adjusted with respect to new relations of reciprocity between the places that it constitutes along the route.

At the end of this journey of the search of a uncovered sustainability, lived and tested, it can be asked whether it is still possible to live differently, living an eco-sustainable also subjected to a continual dislocation (see also Benoît Goetz, *La dislocation, Architecture et philosophie*, Editions de la Passion: Paris, 2001). Then returning to the unsustainable city, it is possible to imagine that whether an eco-sustainable rehabilitation can be carried out, this can not occur in such a discontinuous and dislocating process.

The human experience of life in a Nature-City made by the host as well as the visitor of the aforementioned park begins at the *Entrance*, passing through the *confining limits* of the park, a winding wall which accompanies the visitor until entering a hypogean structure, the *Door of the falcon (1)*, which opens south and looks over the park from above. It is a project which depends on the welcoming culture of the woman as well as the sense of a rocky architecture which takes full advantage of the bio-climatic advantages of all that is within land. The hypogean space is therefore presented as all involving, soft, fluent, well-looked after, ready to welcome *either one or the other*. The origins of richness are represented in this place, seen in the multiple diversity of the visitors, the guests and the figures which are all united again in the park: the circle, the ellipsis, the cross and the sinusoid.

The second step induces the visitor to abandon their vehicles, upon passing through the *Archipelago I (3)*, a discontinuous system of parking areas which try to hide themselves among the small hills, trees and shrubs. In this way, while on road level, slightly sloping, the vehicular impact is reduced, breaking it up in



part, while at the level of the hills, the trees with their thick leafy branches create a continual eco-vegetation. There are open sites on the insular areas where small groups of people can be with each in order to either display works of art or start an eco-museum which will eventually be developed throughout the park as well as inside the grottos.

Then you enter the bowels of the land, in the *Symposium (2)*: the collective space par excellence in which banquets, shows, conferences, cultural and artistic meetings, dances are held, where the guest has a collective experience associated to the representation. In the architecture of this construction the plurality of the various ways of “being” of the people as well as the points of view, in the representation of the world, is set immediately under the ground, reducing the architectural impact with the landscape, while several other elements emerge in the sunlight.

Re-conquering the light, ascending towards a sacred panorama, the *Annunciation (4)*, from where in a sense a much wider panoramic view can be seen and being, in the other, seen from afar by many other places within the park.

The visitor subsequently reaches the *Hamlet (5)*, a round area, based on the rehabilitation of a row of houses, integrated with new constructions which includes a space nearby where a rural-urban experience can be had, in contact with the traditions of the Nature-City, in other words the re-generation of the body, in close contact with water (present in the areas of rural architecture of water, known as *Gymnasium (7)*, with a *swimming pool, gym -and beauty-farm-, stoà*. The area should deal with the problem of reducing the maximum impact, in a delicate point for the equilibrium of the park, in which all the elements should be considered and contained. The various pools have long looked for the most suitable position, dimension and character, finally aligning with the slope, with the solar orientation and the scenes of the landscape, with the fruits of the land as well as the gastronomy of the Nature-City. The visitor can either relax on the terrace or feast in the *Banquet Hall*, either staying only for a meal or having a particular residential experience in the ecological houses of the *Hamlet* or *Island I (6)*, where there are several different types of accommodation, including that of maximum individuality in contact with the landscape.

The maximum aspiration of civil insularity of a millenarian culture of nature is expressed here, inspired by monasticism, proposed and revisited within a modern context. The project is conceived taking into consideration the volumetric and highly consistent nature of architecture in Basilicata, which relies on noteworthy masonry, re-proposed within a bioclimatic context, in constructive devices, known as *thickness walls*. These are “nature containers” (water, earth, sun, ecological plants) which intertwine the tissue of a type of *micro-urbanistic* ecology.

From the hamlet, the visitor can walk as far as the *Agorà of the market (8)*, a place of *re-departure* and *initiality* of a city which regenerates itself, becoming enriched with things arriving from the outside, coming from the “knowledge-taste” of the productive context of its territory as well as through the opening of the relations of the world with other Nature-Cities, in which we learn of other

ways of knowledge and *how to live* on its own territories of nature. The tourist appreciates the multiple products of the world of the Nature-City.

Above the ridge, there is the “*City of horses*” (9), which cannot be visited but can be seen from a distance. Passing through the “*Green Way*”, a linear eco-vegetative and hydro-morphological system, the visitor then continues the walk until reaching the small road-side hamlet of *THiasos* (10). A complex created as a prestigious residence for cavaliers and *clubhouse*, where a selection of society and products of the Nature-City meet: craftsmanship, music, *club*, places for engaged and married couples.

The *wedding tower*, the last building of the road-side hamlet, looks over *Archipelago 2* (11), the centre of the park.

*Archipelago 2* is dedicated to the representation of peace and sustainability, as well as the freedom of nature. It is made up of three very close “islands”, where in the recent past horse races were held.

The areas, on different levels, belong to a unique system. They have now been recuperated and destined to leisure activities.

The first, *Apeiron*, the typical open space of a park, is dedicated to leisure activities for everyone.

The second island, *Paideia*, *the city for the young*, is a park, a leisure-ecological park, dedicated to *games of peace* to regenerate the Nature-City.

The third island, *Eleutheria*, subject of an eco-vegetative rehabilitation, situated on the highest level, is a mini wood, also dedicated to leisure activities, in preparation of the experience to be carried out in the *Big Wood*.

Having re-conquered freedom, beyond this centre-limit the park offers three more areas of constructed environments which, in addition to the functions of service and residence, proposes three themes for reflection. *Agon* (14), the last “island” of the archipelago, a small stadium for horse-jumping contests, with all the required services, proposes the theme of *competition*.

*Island 2* (13), the small ecological hotel, surrounded by the memory of a typical architecture of the Country-City, on the model of the Charterhouse, ready to dialogue with a ruin re-assigned to a “postal-station” and which proposes the theme of the relationship with nature as well as the ruins of history, in the *horse-journey*.

Whereas in *Meriston* (12), a space of “supplies” for the future which is the basis for a Hostel, young people can have the experience of the *frontier*, where everything is possible, but with the knowledge that the future is strewn with ruins.

Finally, there is the *Remetiri* (15) sculpture: taking its measurements from the same in the journey for the search for the truth which helps to live on the scale of the Nature-City, signifying that after the experience, we have to look at ourselves in order to understand where we are, in relation to the places visited and the discovery of the *truth* which helps live.

It is only on this scale that every individual can overcome his own limits.

In conclusion, it is worth highlighting that the integrative structural connections acting within the inside of the dynamics of the park are characterised by the following three types: the *TISSUE type*, which tends to propose itself as a

*resistant to form complex*, in which the whole sustains a unique form of interconnection and the elements, almost identity, are worth the prototypical quality which sustains it; the *JOINT type*, which is configured as a *composition between parts* with different characteristics in the which the ideas of everyone tends to be absorbed by every single part which carries out a different role from the others; finally the *FASTENED ZIP type*, which can consists of *repeated and different elements set out linearly* and is suitable in the rehabilitation of the existing.

It is also worth noting that the constitutive elements of each type act in function of the constituent relation not only between the component parts but also among the latter and everything.

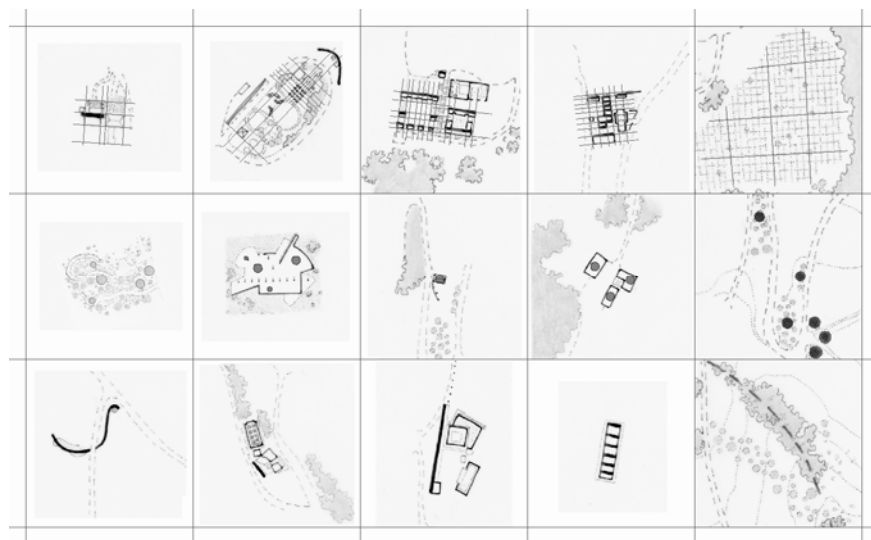


Figure 1. The integrative structural connections acting within the inside of the dynamics of the park. From the top: the TISSUE type, the JOINT type and the FASTENED ZIP type.

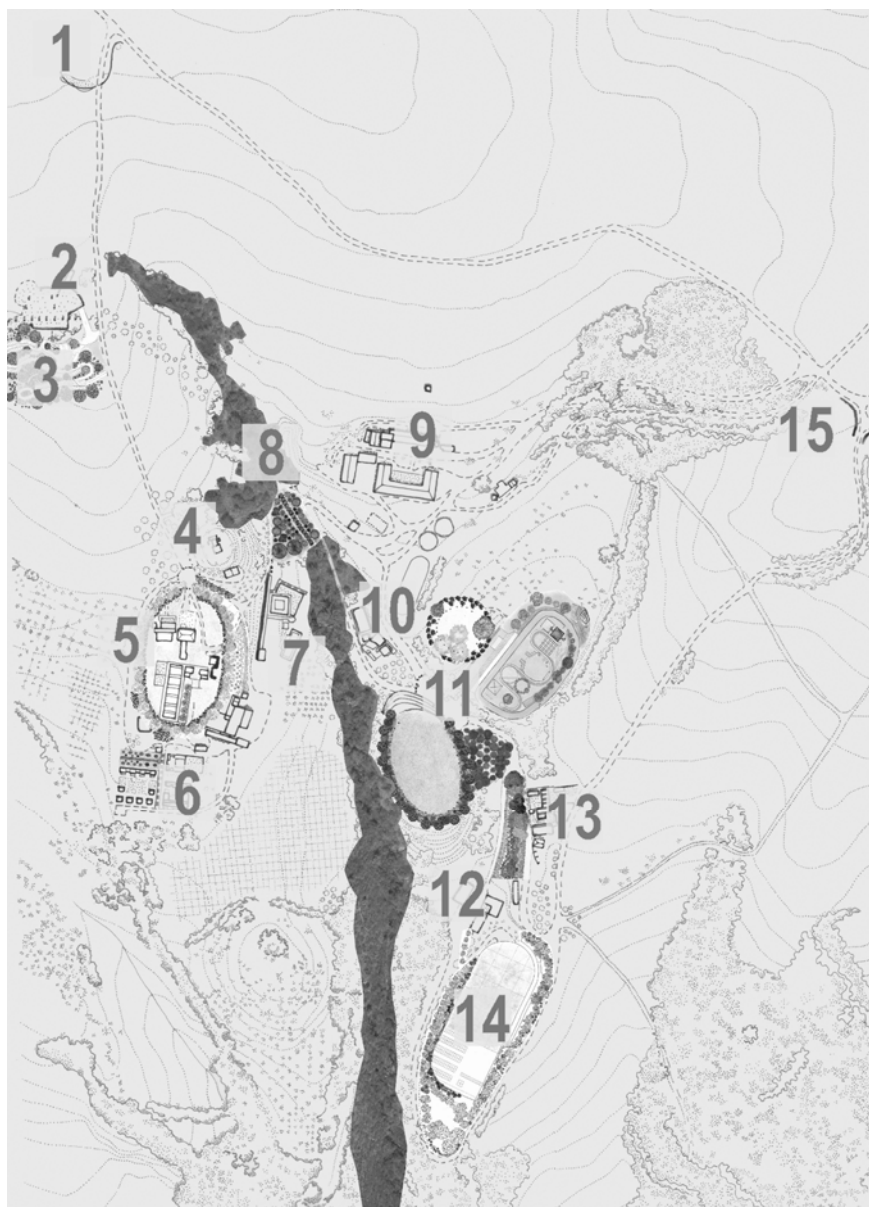
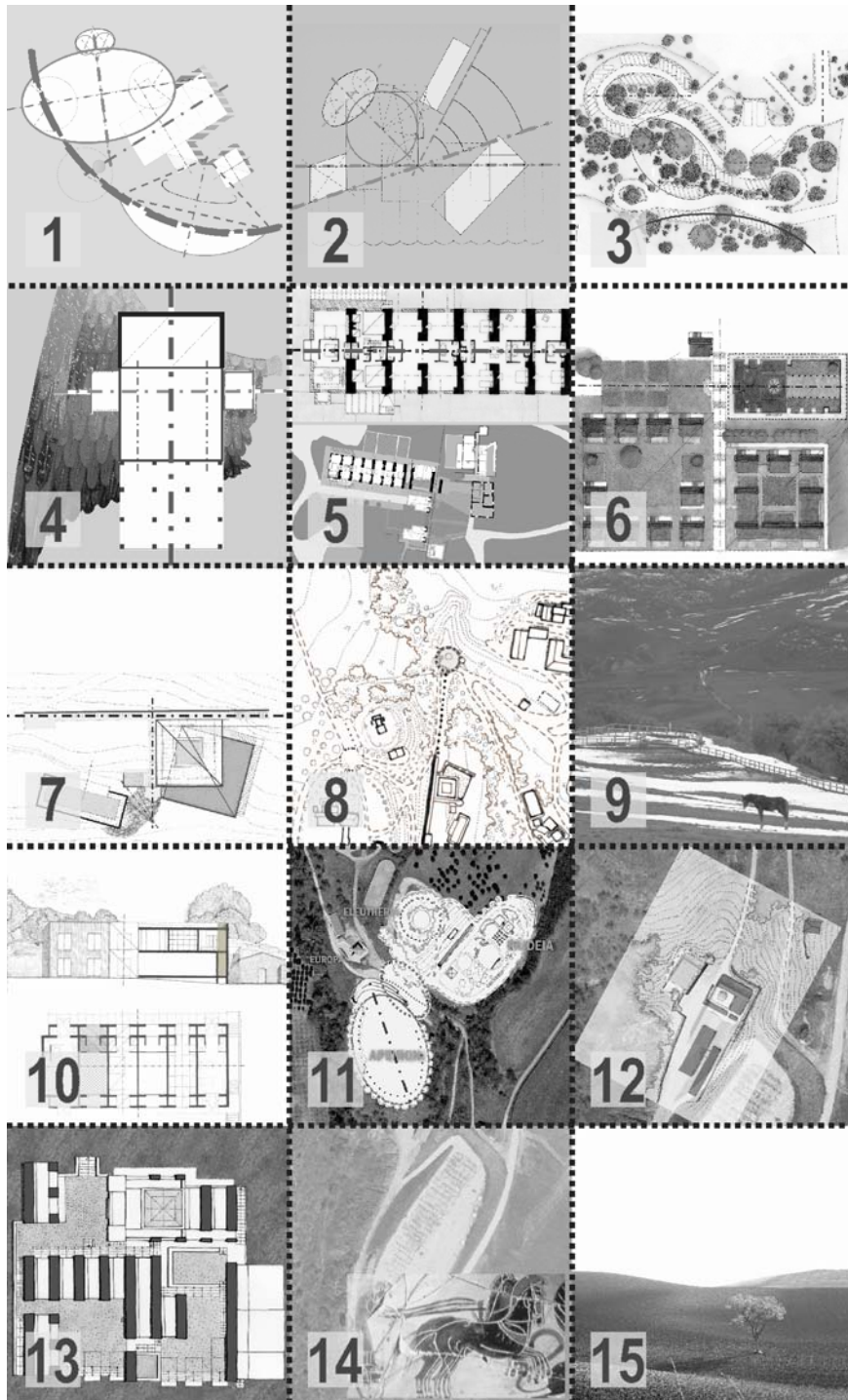


Figure 2. *Alétheia*, plan and, in the next page, the projects.



## References

- [1] Macaione, I., (eds). *Architettura e Management della Città-Natura*, FrancoAngeli: Milan, 2007.
- [2] Sichenze, A., Macaione, I. & Insetti, M.I., The discovery of the *nature-city* and the re-generative strategies. *Sustainable Tourism II*, eds. C.A. Brebbia & F.D. Pineda, WIT Press: Southampton and Boston, pp. 95-104, 2006.  
Sichenze, A., Macaione, I., Lavecchia, M., Piro, M.R.A., Lavecchia, M., Fosci, C.A. & Insetti, M.I., From cultural heritage to sustainability: architecture and the nature-city. *Proceedings of the 7th European Conference "SAUVEUR" SAFEGUARDED CULTURAL HERITAGE Understanding & Viability for the Enlarged Europe, vol. I-Papers*, ITAM-ARCCHIP Centre of Excellence: Praga, pp. 303-313, 2007.
- [3] Insetti, M.I., Book abstract and possibile elaboration of the research. *Architettura e Management della Città-Natura*, eds. I. Macaione, FrancoAngeli: Milan, pp. 244-247, 2007.
- [4] Merleau-Ponty, M., *Fenomenologia della percezione*, Studi Bompiani: Milano, 2003.
- [5] Sichenze, A. & Macaione, I., La città-natura per un turismo sostenibile: fenomeni e strategie, in *Il progetto sostenibile*, **14**, pp. 11-19, 2007.