

computational tools in architecture
cybernetic theory
rationalisation and objectivity

arq

architectural research quarterly



Editor-in-Chief **Adam Sharr**
E. adam.sharr@ncl.ac.uk

Editor-at-Large **Richard Weston**
E. richard@richardwestonstudio.com

Editors **Samuel Austin**
E. samuel.austin@ncl.ac.uk

Martyn Dade-Robertson
E. martyn.dade-robertson@ncl.ac.uk

Graham Farmer
E. graham.farmer@ncl.ac.uk

Zeynep Kezer
E. zeynep.kezer@ncl.ac.uk

Stephen Kite
E. kites@cardiff.ac.uk

Katie Lloyd Thomas
E. katie.lloyd-thomas@ncl.ac.uk

Juliet Odgers
E. juliet.odgers@ncl.ac.uk

Stephen Parnell
E. stephen.parnell@ncl.ac.uk

Editor **Edward Wainwright**
Reviews + Insight E. edward.wainwright@ncl.ac.uk

Assistant Editor **Ruth Lang**
Reviews + Insight E. r.lang2@ncl.ac.uk

Editorial Assistant **Ashley Mason**
E. arq@ncl.ac.uk

Art Editor + Design **Angela Ashton**
E. design@angelaashton.co.uk

Editorial Board **Simon Allford** Allford Hall Monaghan Morris, UK
Andrew Ballantyne Newcastle University, UK
Mark Burry The University of Melbourne, Australia
Carlos Eduardo Comas Universidade Federal do Rio Grande do Sul, Brazil
Richard Coyne The University of Edinburgh, UK
Peggy Deamer Yale University, USA
Susannah Hagan University of Westminster, UK
Francine Houben Mecanoo, Holland
Susanne Hofmann Die Baupiloten, TU Berlin, Germany
Louisa Hutton Sauerbruch Hutton, Germany
Mari Hvattum The Oslo School of Architecture and Design, Norway
Timothy W. Hyde MIT, USA
Momoyo Kajima Atelier Bow-Wow, Japan
Silke Kapp Universidade Federal de Minas Gerais, Brazil
Ulrika Karlsson KTH, Sweden
David Leatherbarrow University of Pennsylvania, USA
Lesley Lokko University of Johannesburg, South Africa
Mary McLeod University of Columbia, USA
Steven A. Moore The University of Texas at Austin, USA
Michael Ostwald The University of Newcastle, Australia
Simo Paavilinen Aalto University, Finland
Jane Rendell Bartlett School of Architecture, UCL, UK
Daniel Rosbottom TU Delft, Holland
Andreas Rumpfhuber Expanded Design, Austria
Simon Sadler University of California, Davis, USA
Flora Samuel University of Reading, UK
Jonathan Sergison Sergison Bates Architects, UK
Despina Stratigakos University at Buffalo, USA
Koen Steemers University of Cambridge, UK
John Tuomey O'Donnell + Tuomey, Ireland
Sarah Wigglesworth Sarah Wigglesworth Architects, UK
Jianfei Zhu The University of Melbourne, Australia

arq: Architectural Research Quarterly (issn 1359-1355) is published four times a year in March, June, September and December. Four parts form a volume. The subscription price which includes print and electronic access (but excluding vat) of volume 21 is £312.00 (US \$524.00 in USA, Canada and Mexico) for institutions; £53.00 (US \$81.00 in USA, Canada and Mexico) for individuals and £38.00 (US \$63.00 in USA, Canada and Mexico) for students, which includes print only, ordering direct from the publishers and certifying that the journal is for their personal use. Single parts are £78.00 net (US \$125.00 in USA, Canada and Mexico) plus postage. EU subscribers (outside the UK) who are not registered for vat should add vat at their country's rate. vat registered members should provide their vat registration number. Japanese prices for institutions (including ASP delivery) are available from Kinokuniya Company Ltd, P.O. Box 55, Chitose, Tokyo 156, Japan. Orders which must be accompanied by payment, may be sent to a bookseller, subscription agent or direct to the publisher: Cambridge University Press, Journals Fulfillment Department, UPH, Shaftesbury Road, Cambridge CB2 8BS, UK; or in the USA, Canada and Mexico: Cambridge University Press, Journals Fulfillment Department, 1 Liberty Plaza, Floor 20, New York, NY 10006, USA. Copies of the journal for subscribers in the USA, Canada and Mexico are sent by air to New York to arrive with minimum delay.

Copying

The journal is registered with the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, USA. Organizations in the USA who are also registered with C.C.C. may therefore copy material (beyond the limits permitted by sections 107 and 108 of U.S. Copyright law) subject to payment to C.C.C. of the per-copy fee of \$16. This consent does not extend to multiple copying for promotional or commercial purposes. Code 1359-1355/2017/\$16.

ISI Tear Sheet Service, 3501 Market Street, Philadelphia, PA 19104, USA, is authorized to supply single copies of separate articles for private use only.

Organizations authorized by the Copyright Licensing Agency may also copy material subject to the usual conditions.

For all other use, permission should be sought from Cambridge or from the American Branch of Cambridge University Press.

Information on **arq: Architectural Research Quarterly** and all other Cambridge journals can be accessed via <http://www.journals.cambridge.org/>

This journal issue has been printed on FSC-certified paper and cover board. FSC is an independent, non-governmental, not-for-profit organization established to promote the responsible management of the world's forests. Please see www.fsc.org for information.

© Cambridge University Press 2017

Printed in the UK by Bell & Bain Ltd, Glasgow

COVER
Bernhard Hafner
Long Time Space
Development of the
Urban Dispersion
Prototype for the
International Ideas
Competition Vienna-
South, 1970.
See pp. 10–20.

leader	3	The agency of digital tools
perspective	5	Processes and practices in computational design Nathalie Bredella and Carolin Höfler.
digital	10	Integrated planning and the design of urban agglomeration: Bernhard Hafner's Comparative Simulation of Alternative Urban Prototypes Daniel Gethmann explores Bernhard Hafner's 'Simulation of Alternative Urban Prototypes' as a cybernetic simulation of the interactions among urban structure, social activity and human behaviour.
history	21	Material models, photography, and the threshold of calculation Daniela Fabricius investigates how Frei Otto used physical models alongside digital calculations to develop methods of representation prefiguring digital tools.
theory	33	Witless slaves or lively artefacts? A debate of the 1960s Jan Müggenburg and Claus Pias address how the methodological appeal of cybernetics has had a lasting effect on architecture.
	45	Design/Entwurf: Observations Susanne Hauser considers similarities and differences between the German term <i>Entwurf</i> and the English word 'design' to open-up a discussion about ideas of rationalisation and objectivity in architecture.
conversation	53	Of algorithms, buildings and fighter jets Robin Forrest reflects on the conceptual rearrangement of design practices around the processing, display and manufacturing capacities of computers, in conversation with Daniel Cardoso Llach.
	65	The evolution of architectural computing: from building modelling to design computation Robert Aish considers the evolution of architectural computing from the Building Modelling Systems of the 1980s to ideas of design computation, in conversation with Nathalie Bredella.
	74	Material networks: architecture, computers and corporations Reinhold Martin considers questions of human subjectivity in relation to computerisation, in conversation with Nathalie Bredella and Carolin Höfler.
review	81	Part-Architecture: The Maison de Verre Through Duchamp's Large Glass Space and Illicit Sexuality in 1930s Paris by Emma Cheatle reviewed by Hélène Frichot
subscribe		A subscription form, which may be copied, can be found on page 2 of this issue