FUTURE**WOOD**

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This book brings together international designers, manufacturers and researchers examining natural and synthetic wood technologies. Composite materials, parametric design and automated fabrication technologies are explored, illustrating new design tools, custom manufacturing and advanced assembly methods.

The essays and projects in this volume demonstrate flexible, adaptable design qualities reflecting a rapidly changing society.

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FUTURE**WOOD**

NEUMANN · BEESLEY

FUTURE**WOOD**

INNOVATION IN BUILDING DESIGN + MANUFACTURING

EDITED BY OLIVER NEUMANN + PHILIP BEESLEY

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Canadian Design Research Network · Riverside Architectural Press

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FUTUREWOOD

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Contents

Preface

Wood and tools. They bring to mind the cabinetmaker's factory, boat builder's jigs, the residential construction site, concrete forms and the amateur's workshop. Each is at the end of conception, where already set ideas become reality. Mostly what is made are the ideas of others-the hand holding the tool is not that of the designer. The history of design would appear to force such a separation between design and its realization. Modern artifacts are complex and demand specialized knowledge and machines for their production. It is easy, or at least expedient, for designers to leave tools and materials to others. Sadly, the common view that designers are ungrounded in practical reality may be simple historical necessity.

This book is a bridge. Its contributors, designers all, show how new tools can span the historical gap between thought and hand, between idea and materiality. Contemporary computer-aided design systems and digital fabrication machines allow us to bend the process of design in on itself, to connect its start and finish. Both computation and physical machines are tools for developing the substance of design. Computational tools enliven the sketch. Once modeled inside a computer, a sketch becomes plastic. We develop, refine and adapt it to context. We create alternative sketches in the hundreds. Digital fabrication makes these sketches physical, as models, prototypes and built form. The loop closes as we use the physical sketch to inform the world of ideas. And the world of ideas changes as we learn the consequences of our design choices.

The contributors to this book are explorers in this new world in which design and craft intertwine. But why wood? In contemporary design, it is but one of a myriad of material choices. The answer lies in the material itself. Wood is easy to work and form; it is accessible to many. It affords possibility. Joining, laminating, carving, bending, cutting and finishing become sources of design ideas. Wood is also 'difficult'; its grain can vary unpredictably. Its differential strength and shrinkage with and across the grain, its limits of folding and bending, and the peculiarities of the joint each pose creative challenges for design. Lastly wood can be beautiful. It rewards inspiration, thought and effort.

Wood, though it is the focus here, remains a placeholder. Each material poses its own questions to computer-aided design and digital fabrication. Contemporary practice worldwide is engaging these questions using all materials and across design domains. But action is inevitably localized. We build for specific sites, actual clients and engage local expertise. Through their focus on the new tools for design, the old material of wood and their particular design situations, the designers behind these articles are our guides into new possibilities.

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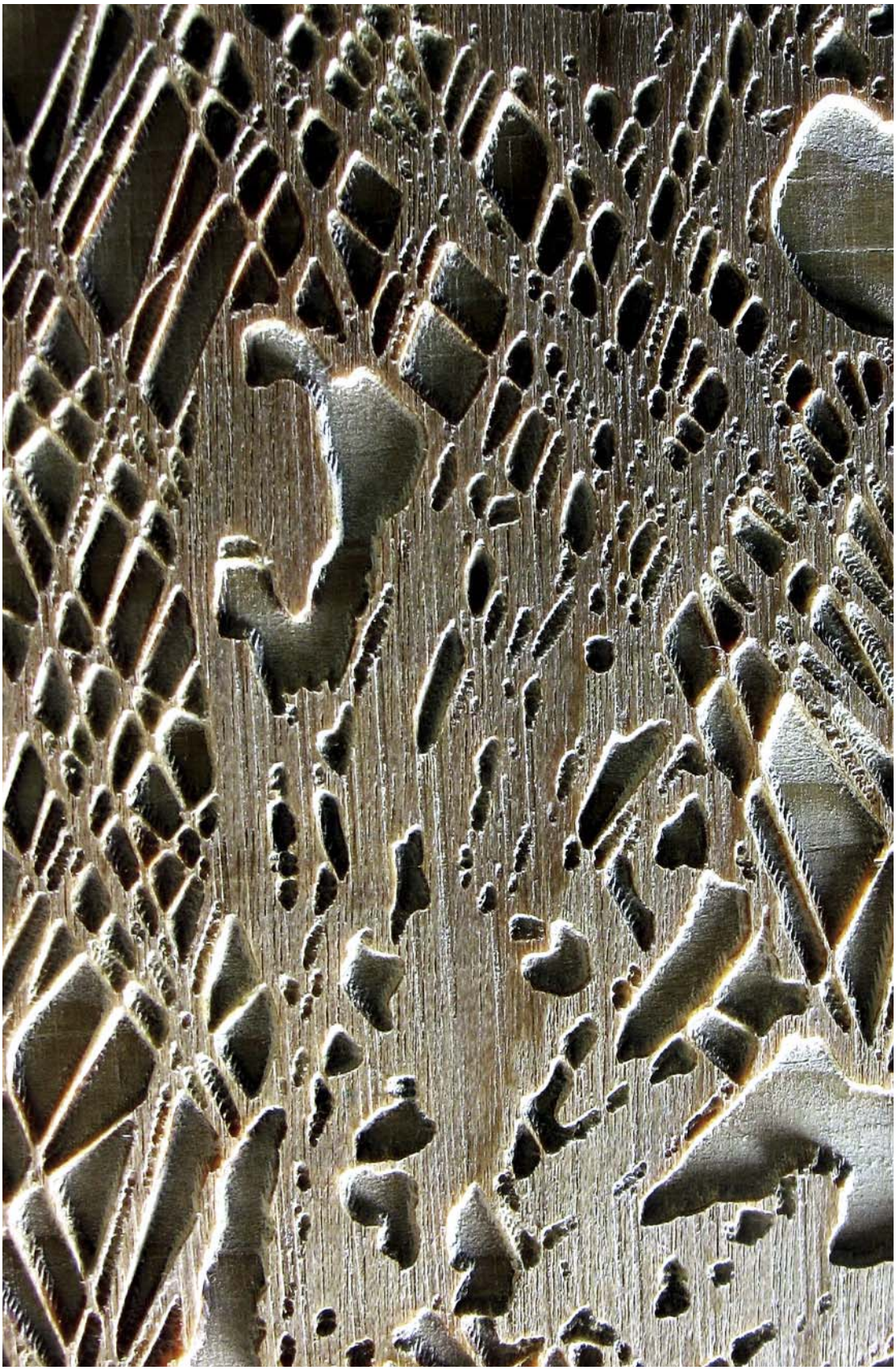

Fabricating / Fabricated Ecologies

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New software and digital fabrication are changing how we use wood. This book brings together international designers, manufacturers and researchers examining natural and synthetic wood technologies. Composite materials, parametric design, and automated fabrication technologies are explored, illustrating new design tools, custom manufacturing and advanced assembly methods. The essays and projects in this volume demonstrate flexible, adaptable design qualities reflecting a rapidly changing society.

Buildings can be seen "not as singular and fixed bodies, but as complex energy and material systems that have a life span, exist as part of the environment of other buildings, and as an iteration of a long series that proceeds by evolutionary development towards an intelligent ecosystem." [1] This approach to architecture applies to design at the scale of objects, buildings, and cities and connects to global discussions about complexity and responsiveness. Parametric modeling and digital fabrication tools enable rich formal explorations and engage complex ecologies in our surroundings. The aim is to explore how digital fabrication can contribute to conceptual explorations and form-finding processes, and how new technology can influence existing design and construction practices.

Parametric modeling establishes relationships between elements of a design that are similar to mathematical equations. Element parameters can be manipulated while constraints and dependencies between elements are maintained. The dynamic models that result are able to respond to changes and offer a degree of flexibility and coordination never previously available. These processes of "anticipation and response make up the dynamic of life" [2] and apply equally to everyday consideration of design, fabrication, and construction and to conceptual explorations of dynamic conditions.

1 **Digitally cut pattern**
Plywood sample

1.
Michael Hensel, Michael Weinstock, Achim Menges, "Emergence in Architecture", in AD Architectural Design, Vol 74, No 3 (May/June 2004) 7.

2.
Michael Weinstock, "Morphogenesis and the Mathematics of Emergence", in AD Architectural Design, Vol 74, No 3 (May/June 2004) 13.

The essays and projects gathered in this publication confirm that "it is inevitable that as a new technological 'system' emerges, so does new art, or even architecture."[3] By exploring conditions and concepts shared by academics, designers and fabricators, the presentations promote integration of digital techniques into design and construction practice. The explorations illustrate how parametric modeling and fabrication can contribute to the conception of new spaces, to everyday realities of commercial construction and to the transformation of the regional wood industry from a resource-based economy to one based in knowledge.

3.
Chris Wise, "Drunk in an Orgy of Technolgy", in AD Architectural Design, Vol 74, No 3 (May/June 2004) 56.

Innovation and Ecology

> *Historically, any idea of Canadian architecture has been 'Janus-faced': looking to past and future, to politics and practice, to material evidence and discourse. Rather than singular and static, any idea of Canadian architecture has been, or must be, multiple and mobile, hybrid and strategic* [4]

Innovation can be understood as a novel re-reading and an exploitation of an existing context. Such an approach tends to emphasize interdependency between new design methods and their particular context in material science, economy and culture. These connected factors contribute to the complex ecology of our surroundings. Using an expanded definition of ecological design, context-specific material expression and built form become significant references for architectural design and production.

Modes of production and communication play a central role in design grounded in ecology. Interdisciplinary collaborations in design, building and research reflect epistemic conditions: concepts of innovation, ecology, technology and place engage a cultural environment in flux.

While modern science often relies on an anthropocentric understanding of the environment, the current shift in terminology from environment to ecology signals a reassessment of the surroundings. An extended definition of ecology can expand the scope of design beyond the environmental performance of materials and types of construction to broad cultural considerations. Innovative design is ecological design. This principle embraces technology as a key to future development and geographic identity. Aspects of place now include interrelated natural and man-made conditions, including social, cultural, economic and technological factors. The result is an all-inclusive definition of context.

4.
Sherry McKay, "Ideas of Canadian Architecture", in *Substance over Spectacle: contemporary Canadian architecture*, ed. Andrew Gruft, (Vancouver, 2005) 192

Technology and Place

Spatial concepts are informed by the logic of fabrication and methods of assembly. A reciprocal relationship between technology, space and locale suggests that the introduction of new technology coincides with new spatial concepts. Concurrently, new technologies necessitate new buildings to house new machines effectively. The case of early industrial buildings in the nineteenth century serves as an example of the correlation of new technologies,

means of production and building wherein "individual types of construction … represented the various technical achievements of their time" and "new machines with their extensive space requirements demanded … progressive change in the specifically industrial architecture". [5]

Situating context-specific design at the intersection of local and global influences has been a common theme since the early 20th century when industrialization and the increase of mass-produced building materials promoted a sense of regionalism as a reconciliation of the "universal and the regional, the mechanical and the human, the cosmopolitan and the indigenous" [6]. However, modern applications of technology have often been treated as independent of space and place.

West Coast Modernism

In British Columbia, influences of fabrication and building technology are evident in the development of a regional cultural identity. As an "example of cultural transfer,"[7] Modern Canadian architecture and industrial design resulted from the integration of international and local influences: plywood furniture, which "represented the first example of industrial design to be produced in BC"[8] merged a modernist sensitivity and modern fabrication methods with local influences. Similarly, the architecture of the time synthesized and reinterpreted cultural influences. Ideas and methods imported predominantly from Europe were inflected with local conditions as designers and manufacturers responded "directly and imaginatively to the omnipresent landscape"[9] with its climate, geography and topography.

As a formation of a regional building identity stemming from "the inventive adaptation of international contributions to suit the region," [10] BC's West Coast Modernism marks a parallel development to the local expansion of war-time plywood fabrication into affordable designer furniture in the United States. Illustrating the relationship of global developments of airplane design and production with local design culture, the designs of Ray and Charles Eames built on specialized knowledge, fabrication and building methods from the aircraft industry. The Eames' houses for the Case Study House program have "a local as well as a national and international context."[11] With the application of "aviation materials, technology, and manufacturing systems to the production of single family house units"[12], their architecture projects were strongly influenced by the development of the Los Angeles area into a national center of aviation during the first half of the 20th century.

Today, as standardization and mass-production have given way to mass-customization processes, digital fabrication technology offers an opportunity for an architectural culture that simultaneously looks to the global developments and to the particularities of the local context. This transformation applies in particular to wood construction. In British Columbia, wood design and building provide a basis for a context-specific building culture, while globally available technologies utilized in wood design and construction produce technological networks with activities in spatially discrete locations. These networks create spatial relationships that tie "social networks of producers"[13]

5.
Susanne Lange, *Bernd and Hilla Becher. Life and Work*, (Cambridge and London, 2007) 25.

6.
Joan Ockman with Edward Eigen, *Architecture Culture 1943-1968*, (New York, 2000) 107.

7.
Rhodri Windsor Liscombe, *Modern Architecture in Vancouver, 1938-63*, (Vancouver, 1997) 26.

8.
Allan Collier, "Plywood and Modern Furniture Design in British Columbia 1945-1960", in *A modern life: art and design in British Columbia, 1945-1960*, ed. Ian Thom and Alan Elder (Vancouver, 2004) 118

9.
Windsor Liscombe, 27.

10.
Windsor Liscombe, 26.

11.
Kevin Starr, "The Case Study House Program and the Impending Future. Some Regional Considerations", in *Blueprints for Modern Living. History and Legacy of the Case Study Houses*, ed. Elizabeth A.T. Smith, (Cambridge, 2002) 132

12.
Starr, 134

13.
Steven A. Moore, "Technology, Place, and the Nonmodern Thesis", in *The Journal of Architectural Education*, 53/4, (2001) 134.

to economic and material resources for construction. The idea that "technology is best understood … through geography"[14] goes beyond the notion that building practices are simply a combination of climate, geographic influences and available talent. Geography takes on a broader definition that encompasses social, economic, cultural and technological factors of a given locality, as well as global influences. For Henri Lefebvre, the dynamic relationship of technology and place produced social spaces wherein technology acts upon nature.[15] Such a discourse can extend the notion of the natural to the more inclusive term ecology. By engaging the social realm, technology can be seen as "essentially a spatial concept,"[16] with the uniqueness of each cultural context leading to the production of spaces with their own particular character. Consequently, "differing qualities of places" and subsequently specific architectural solutions are "more a matter of technological practices than aesthetic choices."[17] As has been pointed out in relation to Canadian architecture, design can be "understood as responsive traces of vital cultural processes."[18]

Frederic Lasserre's[19] definition of modern architecture from the 1940's as "a process of design moulded by practical, economic, technological, and cultural function, but also as a process distinguished by the subjective drama and excitement produced by the introduction of new forms and the association of new materials "[20] is relevant to this argument. Lasserre perceived a conceptual shift in perception of form and space that anticipated a range of contemporary dynamic and flexible systems. Digital fabrication tools such as CNC beam processors, CNC routers, laser cutters and 3-D printers provide a direct link between computer-aided modeling and physical form. These devices allow for the direct translation of conceptual models into built form and promote evolution of practical aspects of traditional wood building methods.

The innovative design at the center of this discussion allows development of culturally responsive designs and buildings that explore the "dynamic polarity between technology and culture, between economy and landscape."[21] The resulting spatial organizations and formal expressions demonstrate an evolving architecture rooted in complex ecologies.

14.
Moore, 134

15.
Henri Lefebvre, *The Production of Space*, (Oxford and Malden, 2001) 31+190.

16.
Steven A. Moore, "Technology, Place, and the Nonmodern Thesis", *The Journal of Architectural Education*, 53/4, (2001):134.

17.
Moore, 134.

18.
Andrew Gruft, "Introduction", in *Substance over Spectacle: contemporary Canadian architecture*, ed. Andrew Gruft, (Vancouver, 2005) 15

19.
Frederic Lasserre was the director of the School of Architecture at the University of British Columbia from 1946 to 1961. As an architect educated in Canada and Switzerland he was instrumental for the introduction of modern architecture in Vancouver.

20.
Windsor Liscombe, 30

21.
Arthur Kroker, *Technology and the Canadian Mind*, (Montreal, 1996) 8.