PERFORMATIVE MATERIALS IN ARCHITECTURE AND DESIGN

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First published in the UK in 2013 by
Intellect, The Mill, Parnall Road, Fishponds, Bristol, BS16 3JG, UK

First published in the USA in 2013 by
Intellect, The University of Chicago Press, 1427 E. 60th Street,
Chicago, IL 60637, USA

A catalogue record for this book is available from the British Library.

Cover image: DNA Fingerprint (Courtesy FlávioTakemoto)
Cover designer: Edwin Fox
Copy-editor: MPS Technologies
Production manager: Bethan Ball
Typesetting: Planman Technologies

Print ISBN: 978-1-84150-649-4
ePDF ISBN: 978-1-78320-141-9
ePub ISBN: 978-1-78320-142-6

Printed and bound by Latimer Trend, UK

This project was funded in part by a Vice Provost for the Arts Grant, a Tyler School of Art Dean's Grant, and a Grant-in-Aid from Temple University, Philadelphia, PA, USA.

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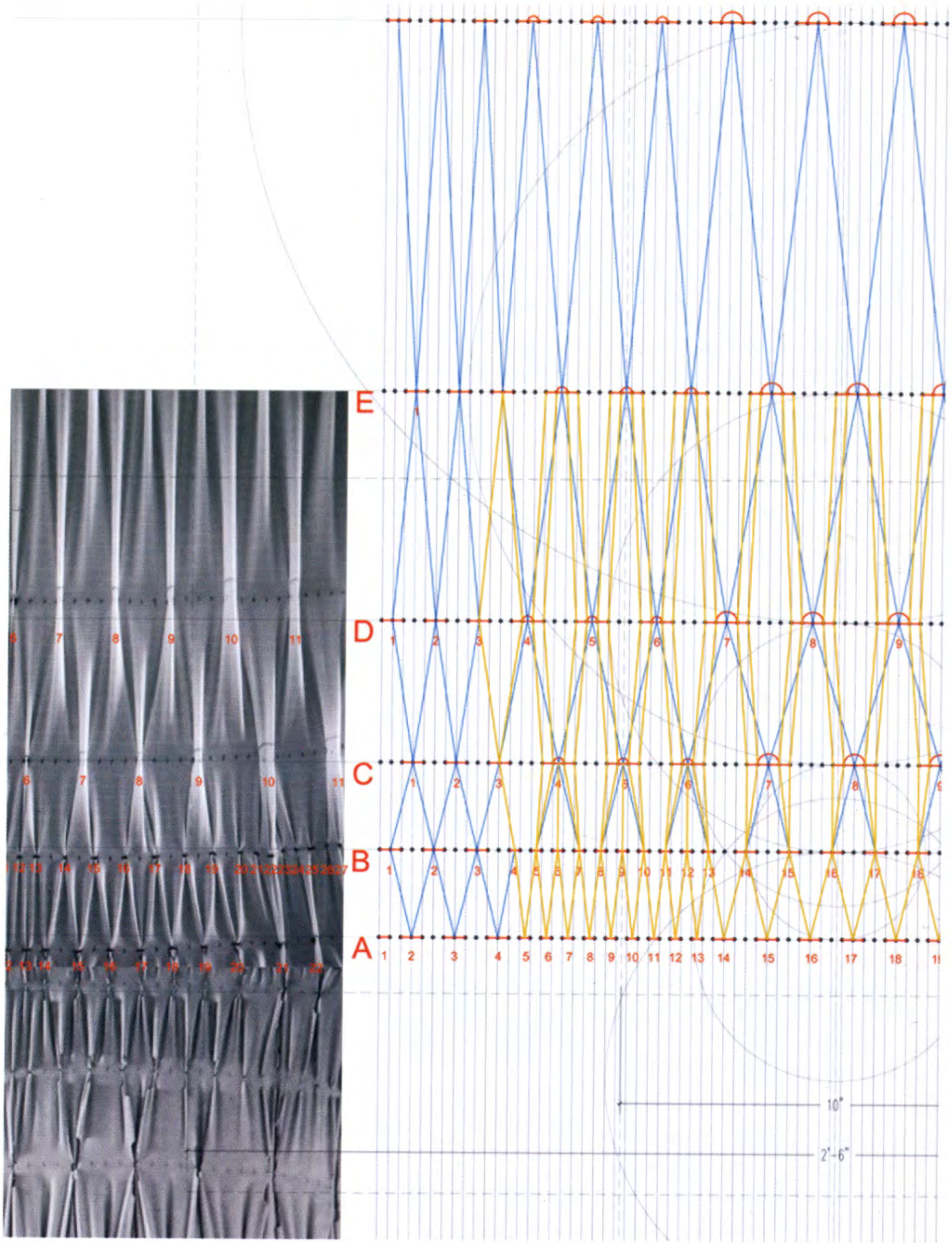

Smocking explores the potential of a pleating technique on a fabric formed concrete surface, a manifestation of an equilibrium reached between the surface tension and omni-directional hydrostatic pressure. Formwork analysis and corresponding notational drawing describe Smocking v. 5. (Courtesy Kentaro Tsubaki)

Smocking: Pleated Surfaces of Fabric Formwork — June–August 2008

Kentaro Tsubaki
Tulane School of Architecture

The construction of exceedingly complex buildings is a testament to recent technological advances. The precision and the speed of digital simulation tools "predict and minimize" various risks associated with such endeavors. Simulation is by definition about "predicting the predictable."[1] Yet, the poetics of architecture is a phenomenal performance of physical construct beyond the predictable, evoking an emotional and intellectual response. It is rather shortsighted if the technological objective is simply to minimize risks by subverting material tendencies and limitations. Design decisions based on responses from material processes are integral to the art of craft. How do we embrace the imperfections, the material risks and resistances always present in fabrication and making?

The embodied knowledge of making is gained through the physical interaction with materials, searching for an order rooted in history, perception and materiality.[2] *Smocking* explores the potential of a pleating technique on a fabric-formed concrete surface, a manifestation of an equilibrium reached between the surface tension and omnidirectional hydrostatic pressure. This dynamic process cannot simply be depicted pictorially. A hybrid notational/geometrical drawing system was developed to precisely document the fabrication process and to imply the formal characteristics of the outcome.

Smocking exposes ways to negotiate the issues of risk and precision contrary to the reality of current building practices; to execute efficiently with minimum risks with computational muscles at its disposal. It represents an attempt to harness the self-organizing tendencies of the physical materials under gravity within the fabrication process. The formal quality is appreciated. However, its performative potential is yet to be explored systemically. Is it possible to calibrate the surface geometry to take advantage of the characteristics of concrete such as high compressive strength and thermal inertia? The project intends to continue provoking the deeply entrenched architectural practice through questioning the obvious and the rational in a fundamental way.

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Notes

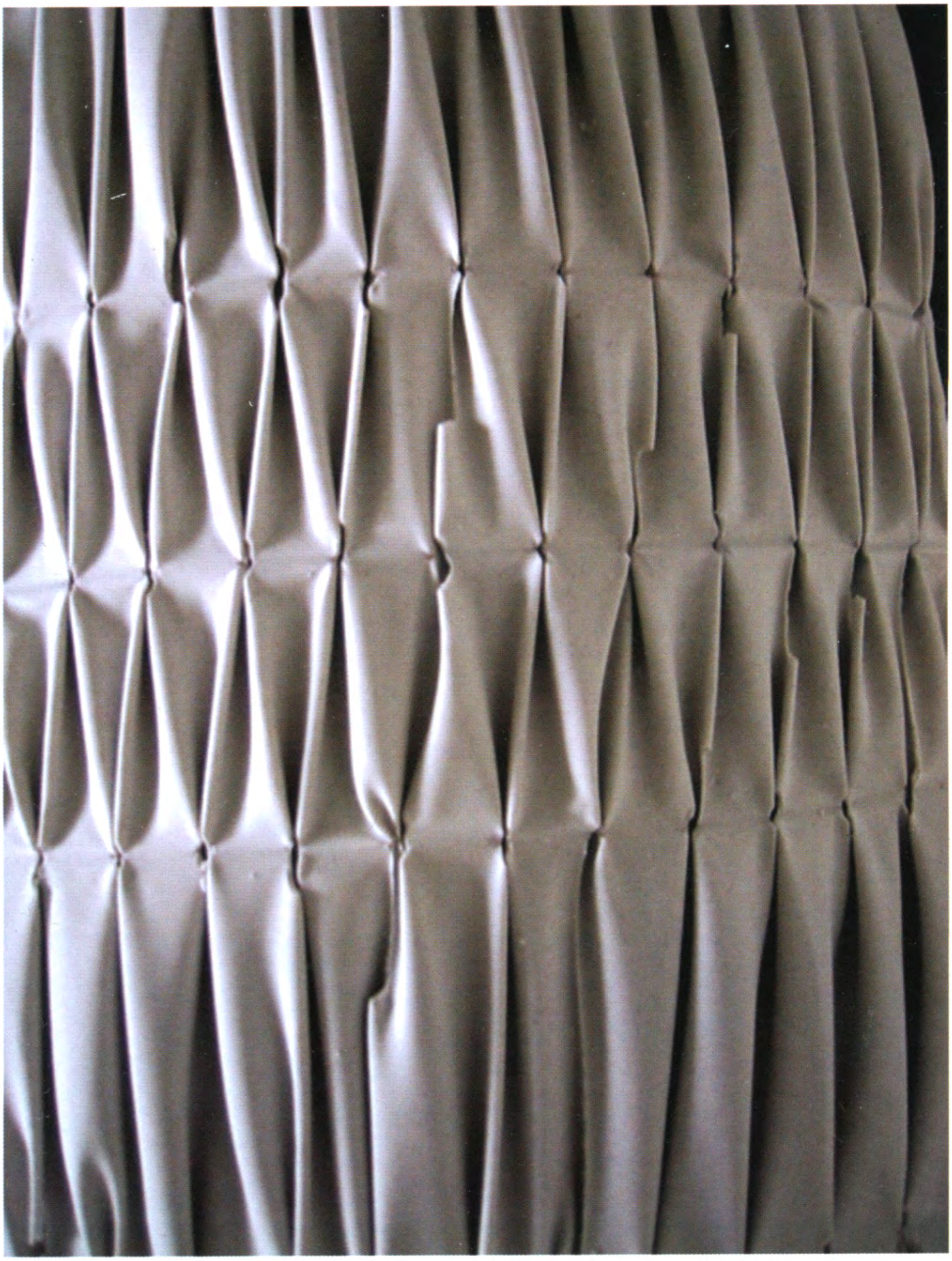
1 As described by David Leatherbarrow in the chapter "Conceptual Performativity," in B. Kolarevic and A. Malkawi (eds.), *Performative Architecture beyond Instrumentality*, New York and London, Spon Press Taylor & Francis Group, 2004.

2 The "embodied knowledge of making" is discussed by Alberto Pérez-Gómez in the article, "Modern Architecture, Abstraction, and the Poetic Imagination."

materials. Michelle Addington (2005: 4) describes this dilemma as follows, "This is an important distinction as our normative means of representation in architectural design privileges the static material: the plan, section, and elevation drawings of orthographic projection fix in location and in view the physical components of a building." Accordingly, the interaction of performative materials cannot be fully described through a depiction of surface or physical border, it compels a probing of relations, exchanges, and interactions that require altered means of visual communication. In the years since Addington published the critical text on the nature of smart materials, considerable scrutiny has been placed on the potential of smart materials and systems, while techniques of representing the dynamic behaviors of these materials and their environments are only slowly emerging.

Similarly, computational processes also challenge the applicability of two-dimensional means of communication as suitable for architecture practice moving forward. As observed by Yasha Grobman (2012: 11) computer-based design and production are leading toward "the architect producing the file from which the real object is produced without any need for mediators." However, the implications of the evolution from a traditional process whereby the architects produce a set of scalar drawings to a new paradigm in which the architect produces a complete and accurate virtual model of the building are not inconsequential. At the root of the issue are questions of precision, tolerance, and professional liability. Antoine Picon (2010: 162) writes of the potential shift toward digital documentation observing, "The need to make design procedures more explicit will be further increased by the evolution towards a systematic constitution of a common pool of data, often referred to as a Building Information Model, to be shared by the various actors involved in a project." The move toward the production of precise data obligates even greater coordination amongst professionals within a design team, thereby elevating the importance of management of the overall *design process*. In contrast to the idealized fluidity often associated with prophecies of digital potentials, the realities of virtual documentation that are emerging begin to challenge that assumption. As Picon (2010: 163) puts it, "In such a context, the designer's ultimate competence becomes more and more about when to make certain states of things irrevocable."

The connections between digital methods of visualizing and analog methods of making occupy a critical intersection within architecture and design. The analog world exists within the realm of human perception as physical scale is distinguished relative to the human body and the observations discerned by the visual acuity of the eye. Conversely, within the virtual realm the perception of scale exists only within the distorted reality presented by the computerized interface. In theory, virtual accuracy is infinite, limited only by the precision of inputs and the functioning of the device. At the same time, virtual materials lack the corporeal resistance presented by physical states. The apparent exactitude of digital surfaces and materials confront their limitations upon entering into physical existence. As explained by Phil Ayres and his colleagues at the Center for Information Technology in Architecture in the chapter 4 essay, "Making a Digital-Material Practice," the translation between digital and physical contexts requires hybridized methods of investigation that



Plaster cast detail, Smocking v3; Smocking explores the potential of a pleating technique on a fabric formed concrete surface, a manifestation of an equilibrium reached between the surface tension and omni-directional hydrostatic pressure. (Courtesy Kentaro Tsubaki)

Fabric formwork, Smocking v5 (Courtesy Kentaro Tsubaki) allow for the negotiation of physical conditions to provide feedback into the virtual realm. Hence, developing modes of representation in architecture are working to close the gap that persists between digital and analog means of material making. *Smocking: Pleated Surfaces*, a project by Kentaro Tsubaki featured within chapter 3, explores the tension between precise notational drawings that signify the design process and a haptic sense of materiality evoked by unpredictable forces within the physical construct.

In addition to interpretation between analog and digital domains, the need to discern the corollaries between multi-scalar effects further complicates visualization techniques associated with performative materials. Future development of these potentials obligates investigation within both scientific and computational fields of study. Ali Rahim (2006: 193) speculates, "Directly inputting the behaviors and properties of smart materials into digital design models, for example, might enable architects to iteratively test the behavior and affects of such substances in a generative design, under various conditions of context and use." Although our ability to simulate sensory aspects of architecture is developing, these platforms typically exist within discrete scalar ranges, rarely allowing for the seamless translation of metrics between multiple scales of research. Furthermore, knowledge of these relationships generally resides in isolated disciplines of biology, chemistry, engineering, materials science, architecture, ecology—each with its own practices and methods of representation and evaluation of critical relationships. As we approach a more holistic understanding of the interactions of matter at multiple scales, it underscores the need for scalable metrics and communication tools, which allow for iterative translation from the nano-scale to the building scale, to the scale of collective environments. It also calls for methods of representation that transcend disciplinary boundaries and transform traditional, isolated modes of practice.

The Experimental Workspace for Design Research

The introduction of experimental research into the discipline of architecture also shifts the nature of the physical workspace. Design processes of drawing, modeling, and documenting are being supplemented with activities such as prototyping, simulating, and testing, thereby altering the setting in which these activities can occur. As the notion of invention is becoming more familiar to design, the place for the production of architecture at times assumes the qualities of a laboratory, such as that utilized by Zbigniew Oksiuta in his work with biospheres, as presented in the "Material Ontologies" chapter of this book. As the ability to fabricate more bespoke materials and systems increases, the traditional space of a design office can assume the qualities of fabrication workshops and production spaces. Finally, as the technical demands of architecture increase, the place of design also necessitates conditions suitable for environmental testing and simulations. The creative physical "space" used for the production of architecture affects the level of inventiveness embodied in the work. As such, places of design innovation provoke haptic interfaces with materials and

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Performative Materials in Architecture and Design addresses the convergence of several significant and fundamental advancements in the ways that materials and environments are designed, evaluated and experienced within architecture and related disciplines. The emergence of experimental and ultraperforming materials, digital design and fabrication techniques, and interactive processing systems has established an interconnected network of technological inputs that has stimulated the development of materials, assemblies, and systems with performative properties. Providing an overview of representative design projects and relevant theories, this volume illuminates both the interaction of these technologies and the role of materiality in research, design, and practice. Emphasizing the value of research as a mode of design inquiry, the work is experimental and provocative of future innovations not yet applied. The breadth of the work suggests a future in which the reductive dichotomies that commonly define the discipline—such as inside and outside, natural and constructed, technical and poetic, even digital and analog—can be matured, redefined, and less distanced.

Rashida Ng and Sneha Patel are assistant professors of architecture at the Tyler School of Art at Temple University in Philadelphia. Together they cofounded SEAM*Lab*, a nonprofit think tank dedicated to research and dissemination of design-based knowledge related to materiality and the built environment.

ISBN 978-1-84150-649-4

9 781841 506494

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