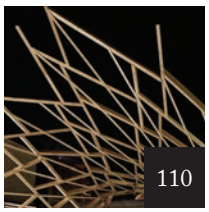
CITA *works*

Mette Ramsgaard Thomsen
Martin Tamke
Phil Ayres
Paul Nicholas

INDEX / *projects*



LAMELLA FLOCK

2010

INTERFACE ECOLOGIES

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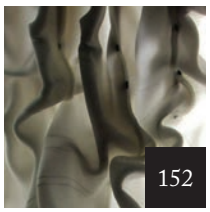

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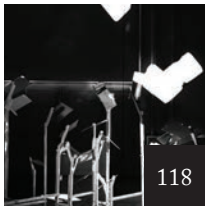

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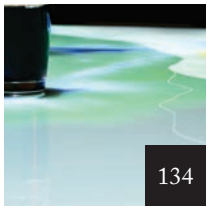

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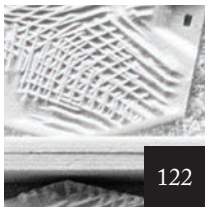

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CITA
Introduction

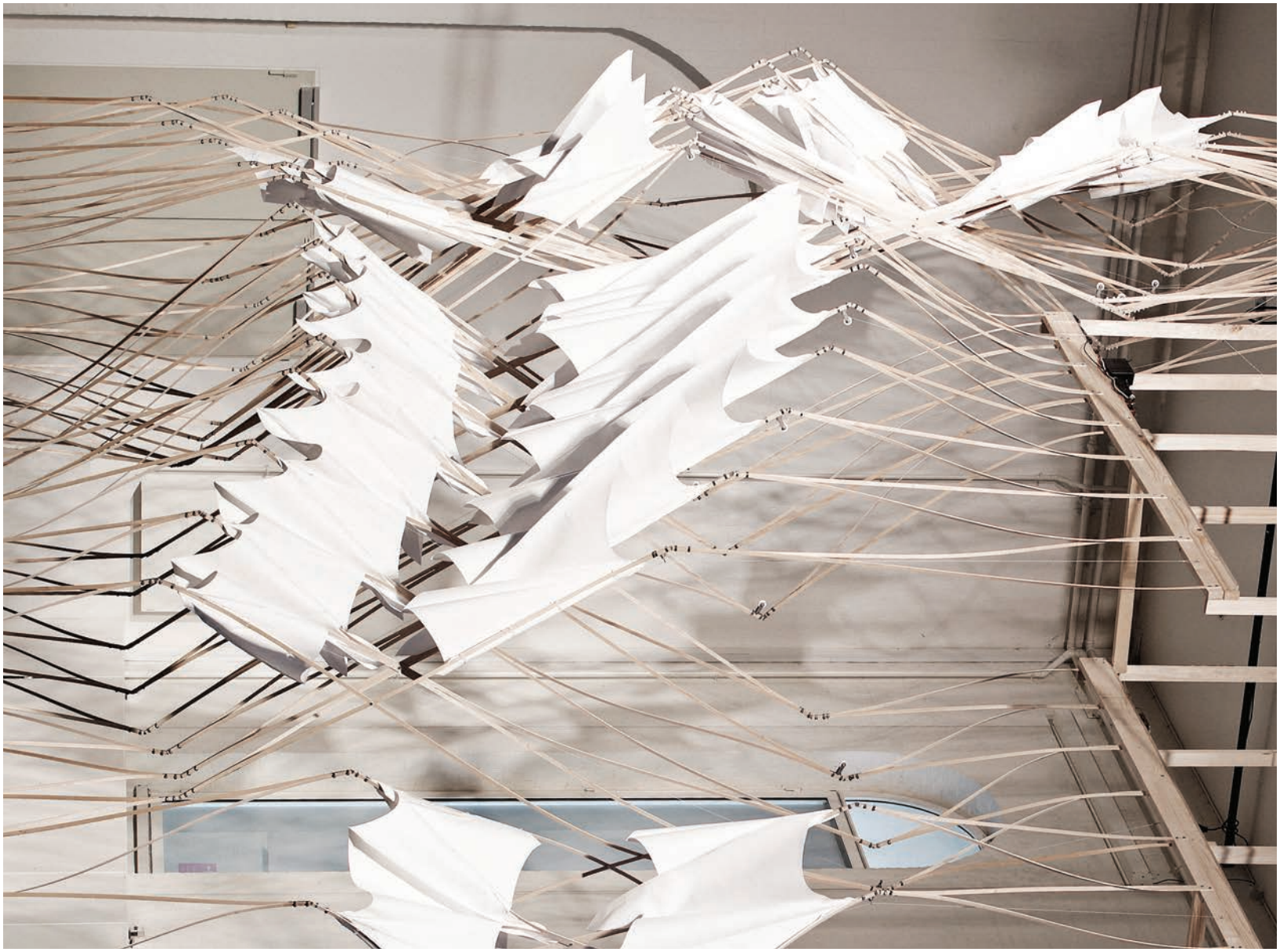
CITA—Centre for Information Technology and Architecture—is a research centre investigating the emergence of a new digital practice in architecture. Our remit is to query how computation challenges the way we think, design and build architecture. Digital design has largely been understood as an optimisation tool, improving existing design practices. At CITA, our aim has been to question not only how computation extends and enhances architectural design, but also how it introduces real differences into what architecture can be.

At CITA, computation is understood as basic research advancing fundamental knowledge across the breadth of architectural practice. Explorative and open-ended, our research asks how computation challenges not only the representational traditions of architecture, but also the structural and material logics that underpin building culture. Computation bestows design with a new mathematical depth. By replacing the representation of simple geometric extension with a new language of variable geometries controlled through the Boolean logics of conditional statements and looping iterations, computation radically changes the foundations of design.

The emergent practices of 'information modelling' draw new boundaries between the generative and the analytic as well as between the drawn and the made. Programmable design tools engage actively with information, directly calibrating and calculating the impact of a given design decision. As such, the traditions of the design environment converge with new analytical practices in which the impact of design intent can be evaluated and tested. By learning from parallel fields of structural engineering, environmental engineering and material science, architectural design tools now hold the ability to model force and flow, to compute complex inter-scalar dependencies and to interface these with intuitive design environments.

Simultaneously, at the other end of design practice, the interfacing of digital design tools with Computer Numerical Controlled (CNC) fabrication has led to a profound rethinking of material practice in architecture. By challenging the industrialist paradigm of mass production, the extended integration of advanced digital fabrication allows architects to take part in the design of materials as well as their detailing, specification and assembly. Materials and material fabrication are now addressed at the scale of their composition and the idea of creating site- and use-specific materials that grade and change in respect to their direct application now permeates digital thinking.

It is this territory of investigation that CITA occupies. Through research projects that examine the spatial,



structural and material consequences of digital technology, our aim is to create new design methods that employ advanced simulation and link to digital manufacture, resulting in new spatial and structural ideas.

From Craft to Performance, from Actuation to Behaviour.

At CITA, our work has cultivated an interest in material practice. Our research investigates many different material systems, including timber, textiles, steel, and fibre composites. Working across a varied material field, we explore how computational design strategies can advance and invent new processes for known materials and employ known processes for new materials. This has led to a fundamentally performative conception of materials. By understanding materials not as static or inanimate, but as engaged by complex behaviours and performances, our aim is to expand structural and material thinking by creating new lightweight, flexible and resilient structures.

The interest in material performance is informed by two central enquiries. On the one hand, working with digital fabrication and material design necessitates an understanding of the craft traditions that lay the ground for a particular material practice. How are materials created and what are the tools of their fabrication and the traditions for further detail and assembly? On the other hand, digital design allows us to formalise these performances in computational simulations. At CITA, we ask how simulations can be informed by fundamental crafts-based knowledge and how they can be interfaced with intuitive design environments that allow us to design for, and with, these performances.

This interest has led to a series of projects exploring material performance. Working with the elastic bending of wood and fibre composites, the plastic deformation of steel and the compressive and tensile properties of textiles, we explore how these performances can be employed as active parameters in new material and structural systems. The investigations are developed across different scales of design engagement, from the large scale of building structure to the intricate scales of material design. Material performance intrinsically engages this inter-scalar thinking. These projects ask how performances at material scale interact and interfere with performances at structural scale. How do we understand the relative performances of a multi-scalar design space? Can we find meaningful ways of steering the active feedback loops of these manifold design engagements?

In parallel, CITA has been interested in how these structural investigations can engage a behavioural understanding of architecture. Behaviour is here understood as emerging from multiple low-level interactions. By using robotics as a framing paradigm, CITA asks how materially performing systems can interact and exchange with computational systems. In a series of actuated projects, we explore steering as a conceptual design paradigm, as well as a direct means of engaging mechanical actuation and energy-active materials. Combining an interest in the structural design of materials with the development of strategies for integrating sensing and actuation, we investigate a new class of materials that can be intricately varied and graded.

These research trajectories challenge existing methods of representation. All the presented projects build distinct information models that interface real-world data and find ways of representing, simulating and analysing their material organisation. They invent means of formalising material performance and support feedback between discrete design concerns. They establish modes of organising information that lie beyond the paradigm of three-dimensional extension and ask how new interfaces between the built and the drawn can engage the lifespan of artefacts rather than conclude with the presentation of a design schema.

Finally, the projects share an interest in questioning the spatial consequences of these ideas. If computation enables new structural and material practices, how will these practices impact on architecture and the way we think our lived environments? The emphasis on realising full-scale demonstrators that can be entered and explored directly as spatial artefacts allows us to project more speculative and poetic ideas of how architecture can be transformed through

the invention of a new design practice. This book presents CITA's research practice spanning from its beginning 10 years ago. It tracks the development of the key concepts and guiding research questions. The book presents CITA's three key research areas:

Digital Formations: investigating the consequences of digital fabrication on the design of new structural and material systems.

Interface Ecologies: exploring the design of hybrid systems that join digital and physical dimensions.

Behaving Architecture: examining the design of programmable structures and materials that respond to their environment through material specification or actuation.

The book emphasises the design-led research project as a primary instrument of investigation. With a strong focus on the realisation of fully scaled material prototypes and demonstrators, our aim is to strategically site research enquiries with the network of concerns that make up architectural design practice. At times highly speculative, at other times directly applicable, we understand research as an *integrated practice* that liaises with multiple fields of expertise.

The presentation of individual projects is accompanied by the description of a series of research probes. Research probes are here understood as open-ended explorative enquiries through which questions are created rather than resolved. Where all projects involve the making of explorative probes, the book includes central probes that have been instrumental in the creation of overarching research enquiries.

Finally, the book presents a series of key research exchanges. Dissemination and the sharing of research enquiry are central parts of CITA's practice. We see these as formative moments creating important exposure and critical feedback while also partaking in the consolidation of the digital design research field. Exchanges include the hosting of research conferences central to the field, such as *Smartgeometry 2011*, the establishing of networks, such as *Digital Crafting*, and the hosting of visiting professorships. These events have contributed to the shaping of our research practice and expanded our enquiry.

The aim for this book is to share our research practice and the shaping of our research questions.

CITA is part of the Royal Danish Academy of Fine Arts Schools of Architecture, Design and Conservation (KADK). CITA was founded in 2005 by Professor Mette Ramsgaard Thomsen. The core CITA team includes Associate Professor Martin Tamke, Associate Professor Phil Ayres and Assistant Professor Paul Nicholas. Over the last 10 years CITA has included a varying team of PhD students, post doctoral scholars, research assistants and interns, all contributing to our research environment. A full list can be seen on the people pages.

Mette Ramsgaard Thomsen

METHOD

CITA employs a research-by-design methodology focusing on design-led physical experimentation and full-scale testing. The emphasis on design as a method of enquiry and the implementation of material design experiments create opportunities for engaging directly with the investigated techniques and technologies along the digital chain from design and analysis to specification and fabrication. This *integrated approach* positions the research enquiries within a similar network of interconnected expertise and practice that defines the process of architectural design.

At CITA, we understand the design project as a critical research instrument. The projects engage both the concrete solving of their particular research questions as well as larger conceptual, spatial and technological questions of how computation challenges what architecture can be. Here, design is understood, to use the words of Stan Allen, as an "intelligent creative practice" that is "…flexible enough to engage the complexity of the real, yet sufficiently secure in its own technical and conceptual basis to go beyond the simple reflection of the real as given". [1]

The focus on realisation through material design experiments has led to the differentiation between three kinds of design activity resulting in the creation of demonstrators, prototypes and models. The demonstrators exist as the culmination and conclusion of a research project. The demonstrators are the places in which ideas are embodied, tested, analysed and evaluated by the research team. They act as proof of concept, testing the hypothesised performances and generated design criteria. The demonstrators are abstractions in the sense that they isolate the enquiry from the full complexity of architectural design – of environment, site, programme and sociality. Instead, they ask how a particular part of a building, structure or space could be construed. But demonstrators are also spatial investigations. They situate the technological enquiry within an architectural language and scale allowing them to be directly experienced and assessed in respect to the spatial qualities and differences they present.

The demonstrator relies on the development of a host of other probes that invent and prototype the conceptual and technical basis of the project. At CITA, we differentiate between different *speculative models* and *material prototypes* as key moments in research development. Speculative models allow ideation and blue-sky thinking, retaining the ability of the architectural model to pose questions rather than develop answers. Scaled and often realised through the hacking of existing tools, the speculative model engenders a mode of sketching, of inventing and conceiving what computational methods can do.

Material prototypes aim to develop the answers that speculative models ask. Much more divergent and fragmented than the demonstrator, they are part of an intermediate practice of scoping ideas and testing concepts, techniques and technologies. As elements, details or test assemblies, they aim to discover partial performances of the design processes, structures, fabrication systems, assembly logics and materials that make the research project.

1 — Allen, S. (2000). *Practice, Architecture, Technique and Representation.* Introduction pp. XVI-XVII. G+B Arts International imprint, pp. XVI – XVII.