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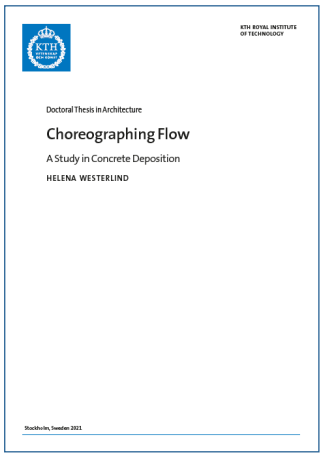
Modell of the Viva-housing project in Gothenburg presented by the cooperative Housing provider Riksbyggen.
Photo: Sten Gromark.

PHD REVIEW: CHOREOGRAPHING FLOW: A STUDY IN CONCRETE DEPOSITION BY HELENA WESTERLIND (ROYAL INSTITUTE OF TECHNOLOGY, STOCKHOLM)

REVIEWER: DR. MARCELYN GOW[1]



The dissertation, *Choreographing Flow: A Study in Concrete Deposition* by Helena Westerlind, Royal Institute of Technology, Stockholm, makes several important contributions on both theoretical and practical levels to the discourses on material agency in architecture, authorship in relation to digital fabrication and material histories in relation to sustainable practices. A central argument of the thesis is that a hylomorphic conception of making – one in which form as an organizing force is imposed upon inert, homogenous matter – has historically been ingrained in the discourse and practice of architecture, and that this orientation to hylomorphism must be rethought in order to engage with material in a more responsive and sustainable manner.

The focus of Westerlind's research is on the shift from casting concrete (through a practice of pouring into prepared formwork) to the deposition of concrete (through a practice of digitally choreographing material-flow along a toolpath). This shift is highly relevant as it presents a re-evaluation of the identity or status of concrete in architecture. Rather than understanding concrete as a homogeneous material, we are asked to consider it as an active process that unfolds and transforms over time. The element of time or duration is significant as this has all too often been left out of material discourses in architecture.

1 Coordinator – Design Theory & Pedagogy program, Southern California Institute of Architecture, Los Angeles.

The research attends to the meso scale of the filament in concrete deposition – situated between the micro scale of concrete's composition and the macro scale of the resultant form. A central query is how a continuous strand of concrete can be organized to form a three-dimensional structural component. By introducing the logic of the stitch from the context of textiles, the work critically reconsiders the prevalence of fabrication processes that strive for a seamless appearance (again, the seamless is premised on a hylomorphic approach in which fidelity to a 3D model or "virtual mould" is given primacy).

In this body of work, the role of geometry in the architectural design process is radically resituated. The thesis points out the limitations of boundary representation in 3D modelling platforms, where geometry is used to represent the extents or outlines of a solid form through a series of surfaces. This approach, as the author convincingly demonstrates, fails to consider the "interior matter" – what lies between the surfaces. Building on Katie Lloyd Thomas' consideration of the lines in an orthographic drawing in relation to the way in which material is equated with the empty space between these lines, this critical reflection on the biases of 3D modelling platforms has important implications for rethinking hierarchies of form in relation to material in the design workflow.[1] This raises an important question for future researchers — namely, how could the design of 3D modelling platforms be rethought to address this omission and attend more carefully to material agencies?

1 Katie Lloyd Thomas, Material Matters: Architecture and Material Practice (London: Routledge, 2007).

Choreographing Flow asks us to consider the extents of the *design process* in architecture rather than the design as a fixed entity. It situates design authorship in respect to entanglements with the tools, technologies and materials thereby engaged. Westerlind points out that the 3D model has historically been equated with the design. Rather, in this research, geometry is understood as a path along which flow can be choreographed through time. The generation of complex curvilinear form in contemporary architecture has been articulated through spline-based geometry and the representation of the seamless surface – as demonstrated in the work of Bernard Cache and Greg Lynn.[2] This dissertation moves away from that approach and argues for an engagement with geometry as an active agent in an unfolding process. The author here builds on Gilbert Simondon's discussion of the "technological operation" (the casting procedure), where a series of preliminary operations converge in a *dynamic* operation.[3] This conceptualization of various agents meeting in a durational process provides a convincing alternative to the hylomorphic approach to form-making.

2 See Bernard Cache, Earth Moves: The Furnishing of Territories (Cambridge, MA: MIT Press, 1995) and Greg Lynn, Animate Form (New York: Princeton Architectural Press, 1999).

3 Gilbert Simondon, Individuation in Light of Notions of Form and Information, trans. Taylor Adkins (Minneapolis: University of Minnesota Press, 2020).

The thesis' introduction of the stitch and orienting concrete deposition toward the logic of textile fabrication provides a highly relevant contribution to the discourses on additive processes of fabrication in architecture. The author points out that, in the shift from casting to additive

manufacturing, the role of the toolpath has continued to be understood in the same way as formwork has historically been conceived – according to a default hylomorphic orientation. The thesis critically rethinks the "making discrete" of form through its translation into the contours that drive the build in an additive process, minimizing deviation from a 3D model.

The role of resolution is also discussed in a way that introduces a critical distinction between detail and resolution. Westerlind suggests that decoupling the concept of resolution from fidelity to a pre-existing model may allow for resolution to be engaged with as a generative process, partially driven by the presence of material properties. This facet of the research allows for a more profound understanding of material resolution and its role in architecture.

The thesis is situated between the theory and practice of architecture, and builds on Hélène Frichot's work on "concept-tools", whereby thinking and doing are not conceived of as autonomous activities but rather inform one another in tandem as ways to knowledge.[4] This dissertation interweaves historical, theoretical and practical knowledge throughout the structure of the chapters, and presents reflections that invite the reader to create affiliations across the discourses and projects under consideration.

4 Hélène Frichot, How to Make Yourself a Feminist Design Power Tool (Braunach: Deutscher Spurbuchverlag, 2016) and Hélène Frichot, Creative Ecologies: Theorizing the Practice of Architecture (New York: Bloomsbury Visual Arts, 2018).

The empirical aspect of the dissertation consists of three projects. The first of these, presented in chapter four, "Mixing", focuses on the rheological properties of concrete, and considers the managing of flows related to the means of extraction and environmental concerns. Geological timescales and scales of material deposition are considered.

Chapter five, "Testing", deals with the design of a test path whereby the flow choreography is enacted and evaluated. The relationship between craftsmanship and manufacturing is also considered. This instrument is developed through a series of trials as an alternative to the convention of the slump test for cast concrete. The test path is intended to allow the designer to engage with emergent behaviour and think through the material at a more fine-grained level.

The third project, the design of numerous toolpaths incorporating stitching, is the subject of chapter six, "Stitching". The toolpaths are visualized, and a selection are prototyped as full-scale "swatches" (the swatch being adopted from the practice of knitting a test sample). This comprehensive catalogue of material depositions (choreographed flows) provides the reader with an important view into the milieu in which the research was conducted and theorized.

Significant aspects of this practice-based research include rethinking architectural design, manufacturing methods and workflows (how the designer engages with material practices), as well as presenting the ability to fabricate intricate forms that would not be possible using formwork. Up-ending a top-down thinking, where geometry and form predetermine the material outcome, this thesis embraces an approach to material whereby the organization of lines, or what I would call *trajectories of possibility,* come to the fore.