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## Surface Fatigue

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In materials science, fatigue is a type of failure mode that occurs when particular external forces are repeatedly exerted over a surface, resulting in material degradation. Over time, a smooth surface is progressively transformed and weakened by the accumulation of localized microscopic cracks, until a particular crack reaches a critical size and causes structural failure. (i) The material surface, in other words, grows tired as it is exposed to repeated external demands, its area subdivided by striations and reorganized into a tessellating micro-pattern. In contemporary architecture, surface has enjoyed a privileged status as a popular subject of morphogenetic research as well as a generator of spatial organization and affect. Digital design technologies, in particular surface-based modeling software, have over the past two decades unleashed the plastic capacity of architectural surfaces to nimbly respond to external factors, while facilitating a range of potent techniques for constructing connectivity and continuity within and across spatial, material and informational differences. Generated digitally, the contemporary surface is ubiquitous and seemingly omnifunctional, with a performance repertoire that demands extensive multitasking: skin, structure, aperture, interior atmosphere, furnishings, fenestration, landscape. Reflecting the evolving integration of digital tools in the architectural design process, from scripting to fabrication, as well as in response to issues of scale, constructability and material, the surface that may have once been continuous, monolithic, and smooth, has progressively become patterned, component-based, and striated. (ii)

Scanning the broad range of digitally generated projects of the past decade, from gallery installations to sports stadiums, it appears that the contemporary surface gains vitality through panelization, tessellating, and subdivision. These patterns, frequently ornamental in appearance, provide the means and methods for the architectural manifestation of the surface at full-scale, including geometric rationalization, part-to-whole organization, and material distribution. By freely associating the surface patterns that emerge through material behavior with those that are generated digitally at the scale of architectural components, one arrives to an evolving body of work by contemporary designers whose inquiries target the intersection between material self-organization and digital automation. Varied in motivation – from emulating dynamic material conduct at the micro-scale as a means of diagrammatically scripting architectural formation over time to engaging with particular material properties for their form-finding potential – such work expands the agency that materials have in the design process, accepting them neither as passive receivers of preconceived form nor as static entities with fixed behavior. While the digital surface in contemporary architecture has been showing signs of fatigue for quite some time now – overexposed, overworked, spread too thin, and all over exhausted – a recent crop of digitally-minded designers and design educators, Sophia Vyzoviti among them, have been reinvigorating the tired surface by embracing its expanded repertoire of material performance. Vyzoviti's porous and deployable architectural screens, much like the work of her contemporaries that include Atelier Manferdini, Matsys, Hirsuta, and ISSStudio, exploit materials' response to and interaction with factors such as gravity, time, and human participation, and consider materiality as a dynamic condition made static only through temporal framing. The resulting surfaces are organized by various patterns of aggregation and their three-dimensional manifestation, contingent upon deployment at full-scale, resists a priori representation. By inextricably linking rule-based pattern geometries, mate-

rial behaviors as well as human and environmental prompts to one another, the projects effectively compress the conventional distance between studio-based design processes and their site-deployed outcomes.

In his essay "Material Complexity," (iii) Manuel DeLanda argued that materials' morphogenetic potential is best expressed by their complex and variable behavior. In defining the aspirations relative to the relationship between form and material, DeLanda's following statement captures the kinds of ambitions that resonate throughout much of the work under consideration:

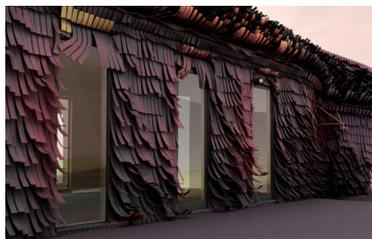
We may now be in a position to think about the origin of form and structure, not as something imposed from the outside on an inert matter, not as a hierarchical command from above as in an assembly line, but as something that may come from within the materials, a form that we tease out of those materials as we allow them to have their say in the structures we create. (iv)

Such a position, in the context of digital design, suggests a reciprocal power dynamic between computational and material means, resisting in this way the technocratic top-down approach to form-making. Rather than resorting to relentless patterning as a digital method of disciplining materiality, projects such as Matsys' P\_Wall (2009) (vi) recognize materials' active agency in the plastic formation of the architectural surface. The project, a room-sized wall-mounted museum installation, consists of a series of tessellated hexagonal panels whose geometries are informed by the interaction of the liquid plaster from which they were cast with the formwork used for the

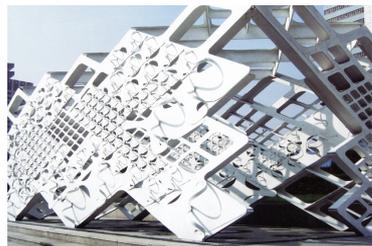


*Matsys, P\_Wall*

casting. The overall surface is organized by two overlaid digitally generated patterns: the rhythmically differentiated hexagonal field and a point-field. Together, the two provide the geometries that define the formwork for casting, which in turn determines the constraints within and against which the plaster behaves. When cured, the hardened panels capture the dynamic behavior of the liquid material as it encounters the digitally calibrated geometries, the materiality of the formwork and the influences of gravity and time. The temporal aspect of material performance is



*Hirsuta, Raspberry Fields*



*Atelier Manferdini, West Coast Pavilion*

further amplified in Hirsuta's Raspberry Fields (2008-present), (vii) a house renovation that includes new exterior cladding designed to progressively reflect the environmental forces exerted onto its surface. The house is clad in wood, and each wood tile – shingle – is designed contrary to the convention whereby the wood grain is parallel to the long side of each tile in order to minimize material deformation. Instead, the grain is oriented to maximize, rather than suppress, the geometric transformation of the flat material as an effect of weathering. With the passage of time, the shingles are expected to progressively curl, twist and tangle, more or less depending on their position in relation to the prevailing wind and storm direction. The evolving form

of the building envelope - thickened, furry, and geometrically relaxed - is a result of the material's range of responses to localized external forces within the constraints of the tiling pattern. The surface also gets relaxed and as such performs more effectively in Atelier Manferdini's West Coast Pavilion (2006). (v) The temporary structure's envelope, organized by a matrix of nesting polygons, is digitally cut from sheet metal and consists of a series of interlaced components, part taut part draped. The draping is a result of the subtractive process that produces apertures across the flat surface as the material that would ordinarily be removed is allowed to cling on and is reattached to the structure in order to further articulate the envelope through texture, detail and modulation of light. Calystegia (2010) by ISSStudio, a wall/curtain hybrid, exploits the draping of wool felt as a method of calibrating surface aperture. Based on a parametric array of components, the behavior of soft felt transforms the form of 'hard' digital geometry, introducing to the computationally based gradient of openings an overlay of apertures that are an outcome of the system's interaction with gravity. What is perceived in the digital model as a single closed seam between adjacent components in fact splits open once the prototype is physically installed perpendicularly to the ground plane. The resulting openings are inversely proportional to those with the adjacent components – the smaller the opening within, the larger the split in-between. Digital computation and material calibration produce a range of mutually dependent surface conditions that modulate view, filter light and intensify the textural quality of the double-sided interior screen.

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*ISSStudio, Calystegia*

Within this context, Sophia Vyzoviti's collaborative work with students further articulates the design-research trajectories pursued by her international peers as it engages with the complex relationships between design techniques, forms and materials. To a degree that is greater than her colleagues, however, Vyzoviti explicitly reintroduces the body as central to the process. Surveying the extensive documentation of her most recent series of investigations – the porous and deployable screens – one encounters architectural form contingent upon the active presence of fingers, hands, arms, torsos, full figures, even multiple bodies. In a self-described low-tech/high-concept manner, *(viii)* the collaborative bodies enable the emergence of adaptable soft shells by providing the interface between rule-based geometric patterns and flexible material properties. In this way, the bodies act as agents of systematic design techniques, and are also frequently used as the projects' site and program. The documentation of the work, as framed by the book, is organized in four sections: cut, pleat, tile, and weave. The title of each section is both a noun and a verb, referring to the repeated pattern unit that is embedded within each porous screen on the one hand, but also the action through which each flat material surface is transformed into a thickened architectural condition on the other. Each cutting, pleating, tiling and weaving pattern is spatialized and three-dimensionalized by iterative handwork, with the bodies at once reaffirming and dismantling the rigid repetition of the pattern geometries. Not unlike the rock band described in Dave Hickey's essay "The Delicacy of Rock-and-Roll", the collective bodies produce, despite their focused precision, a "a hurricane of noise, this infinitely complicated, fractal filigree of delicate distinction." *(ix)* What is revealed in the surface noise of apertures, folds, and ribbons is a range within which surface components – both in relation to their individual geometries as well as relative to their position within the overall system – can produce variation. The pattern is both a set of repeated geometries and a series of actions and the body mediates between predetermined form and material behavior.

Frequently supplementing these primary patterns/actions are secondary instructions (e.g. cut-stretch, cut-fold), which invite the participants to intervene within the emergent geometries through pure action – no preconceived pattern. By stretching, twisting and revolving the perforated, folded and woven material, the bodies act as forces of tension and compression and, by providing the variables of space and time to each construction, effectively serve as the projects' sites. While the body-as-site intent is explicit given several of the wearable constructions in the collection, it is the participants' exertion of force over the materials in order to observe and record their formal behavior that particularly blurs the clear distinction between the space of the designer and the site of deployment, and thus between the design process and its outcome. In installations like Meanderplex the scaling up of model-making materials such as paper to the architectural full-scale too blurs the distinction between process and product. Along with the rational rules of engagement and the negotiation of the group dynamic, the paper's incremental movement, sagging, and warping – the material's demonstration of fatigue as a result of overworking – reveals an expanded range of the system's morphogenetic potential. The constructed paper screen, an aggregation of multiple components by multiple bodies installed as an interior gallery facade, is both a form-finding instrument and an architectural product that is responsive to its spatial program.

Vyzoviti's practice – indeed the experimental, iterative and improvisational quality of the work delightfully reminds one more of band or dance practice than of conventional architectural labor – while thoroughly informed by the theoretical and technological content of digital practice, eschews the architectural limits of computation by investing in and constantly renewing the relationships between human participation and material agency. At a moment when various computational platforms are promising thorough informational integration from design to construction,

material behavior is reduced to digital scripts, and architects are (for good reason) increasingly invested in code-writing, her extensive body of work is a reminder of the generative potential of design processes that occur in the spaces that are interstitial, tangential, marginal, but nevertheless deeply related to digital practice. By pairing the performative repertoire of participating designers with the range of behaviors of materials, Vyzoviti's differentiated surfaces reflect - not as a matter of value judgment, but rather as a source of expanded potential - a spectrum of "energy levels" from extreme fitness to slouchy fatigue. The practice as such focuses on the organization of labor in relation to material organization and, rather than repressing, amplifies as a matter of research and insight the expanded range of behaviors outside of static states of equilibrium. In Vyzoviti's work as well as in that of her like-minded contemporaries, the emphasis is not, to echo DeLanda again, "on the spontaneous generation of form" (x) nor is it a matter of maintaining a position outside of digital practice; instead, such experimental efforts seek to forge new affirmative relationships between computation, materiality and the designer and as such rescue the contemporary surface from cliché.

## References:

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- (i) *I am indebted to my colleague Damon Northrop for his feedback and insight during our productive exchanges about material behavior in relation to surface fatigue.*
- (ii) Branko Kolarevic and Kevin Klinger, "Manufacturing / Material / Effects," in *Manufacturing Material Effects: Rethinking Design and Making in Architecture*, ed. Branko Kolarevic et al. (New York: Routledge, 2008), 13.
- (iii) Manuel DeLanda, "Material Complexity," in *Digital Tectonics*, ed. Neil Leach et al. (West Sussex: Wiley-Academy, 2004), 20.
- (iv) *Ibid*, 21.
- (v) "P\_Wall (2009)," Matsys, accessed November 9, 2010, [http://matsysdesign.com/category/projects/p\\_wall2009/](http://matsysdesign.com/category/projects/p_wall2009/).
- (vi) "Raspberry Fields," Hirsuta, accessed November 9, 2010, <http://www.hirsuta.com/RASP.html>; also, "Raspberry Fields," SuckerPUNCH, posted on January 18, 2010, <http://www.suckerpunchdaily.com/2010/01/18/raspberry-fields/>.
- (vii) Lisa Iwamoto, *Digital Fabrications: Architectural and Material Techniques* (New York: Princeton Architectural Press, 2009), 42-46. Additional project information is available on the designer's website <http://ateliermanferdini.com>.
- (viii) Sophia Vyzoviti, "From paperfolds to object-space prototypes," in *Supersurfaces: Folding as a method of generating forms for architecture, products and fashion* (Amsterdam: BIS Publishers, 2006), 10.
- (ix) Dave Hickey, "The Delicacy of Rock-and-Roll," in *Air Guitar: Essays on Art & Democracy* (Los Angeles: Art issues. Press, 1997), 101.
- (x) DeLanda, 19.