Chapter 19
Energy/Form/Rule:
Experiments in Energy Form–Finding

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ABSTRACT
After nearly three decades since their first appearance in architectural practice, digital design tools are increasingly pervasive in nearly every aspect of the profession and throughout the building life cycle, from project development to construction administration to demolition and recycling. While an integrated approach to building information management is becoming the key to winning projects, the creative attitude of an earlier generation of computational designers is being quickly replaced by new tools and protocols geared toward achieving efficiency targets and boosting profitability. The author reflects on the evolving nature of the digital practice and the potential for a new generation of architects to resolve diverging aspirations towards creative freedom and efficient use of resources. The chapter draws on a few experimental projects by the author that combine traditional design tools with computational techniques to explore a direct correlation between building form and energy performance while forging a new vocabulary for sustainable design.

INTRODUCTION
The traditional boundaries of architecture have been greatly expanded by technological advancement in detecting, measuring and visualising the energy forces acting on the built environment—forces that were largely invisible to the architect’s eye until two decades ago. Over the same period of time, the so-called ‘digital revolution’ brought to architects the tools to design and construct formal systems that are potentially capable of responding to these underlying forces with unprecedented precision and resolution. These new powerful tools came to fruition in the midst of an environmental crisis of extraordinary proportions, giving design professionals the opportunity to play a central role in solving the energy challenge. The effect of the new digital regime, however, has been a gradual drifting towards extravagant and often wasteful design propositions. By and large, the flourishing of a new formal vocabulary, enabled by digital tools, rarely translates into buildings that perform better.

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With energy efficiency and rational use of resources becoming the overriding concerns in both new construction and retrofits, architects have been gradually marginalised in the design and construction process, as they have failed to provide responsible answers to the environmental crisis engulfing the planet. The resulting leadership vacuum has been rapidly filled by myriad of new professional figures—energy specialists, feasibility consultants, construction managers—who have all made their way into the construction cycle, often relegating the architect to the role of concept designer producing fancy renderings for the client.

The Energy Challenge

Europe has undertaken an ambitious roadmap towards the reduction of greenhouse gas (GHG) emissions by 2050 and, more recently, the commitment to COP21 targets is producing the first obligations at the EU level to achieve significant cutting of GHG emissions by 2030. Most of these targets entail efforts in the built environment, especially in cities, which are recognised as the drivers for change. The reduction of energy use and GHG emissions poses an intrinsically multi-scale and cross-disciplinary challenge—one that appears well suited to the skill set of the architect—yet it is mostly tackled by deploying a plethora of isolated and highly technical solutions.

After more than two decades of environmental policies in place, achievements in energy savings related to the built environment have been disappointingly modest. In fact, most results have been achieved due to factors outside the architectural and the urban design fields. For instance, reduction of GHG emissions occurred as a result of technological innovations in the mobility and energy sectors, such as more efficient energy plants, an increase in clean sources within the energy mix of networks, green innovation at the scale of building components and more efficient appliances (“Progress on Energy,” 2016).

The projects presented here are part of a decade-long effort by the author to recast the on-going debate on sustainability in the built environment from a pre-eminently architectural position. Very different in scale, program and location, they all explore the correlation between form and energy in its various manifestations. Collectively, they start to identify a specific, measurable relationship between geometry—the traditional domain of the architect—and performance, particularly in the area of energy efficiency and sustainable use of materials in buildings. These projects are the result of concrete commissions, either by a private client, a research institution or a competition authority; as such, they were developed within a specific timeframe and budget, using the limited resources typically available to an emerging architecture practice today.

Generational Divide

Advanced CAD and parametric tools, which were the exclusive domain of the aeronautical industry and a few large engineering firms only a decade ago, are now available to young practitioners to develop and control complex shapes. Similarly, digital simulation tools that predict the environmental performance associated to a particular building form—such as airflow, daylighting and sun radiation levels—are becoming increasingly more accessible and easier to use, providing an intuitive and inexpensive sketch tool to designers. These tools can have a profound impact on the way we design buildings and cities, since they provide invaluable support at a very early stage of the design process, when most decisions are made, as opposed to entering the process at a much later stage, when the designer is less willing to accept changes to a consolidated design. Also, they come at a much lower cost, since they replace the kind of quantitative advice traditionally offered by specialised engineering firms.