The architectural detail has provided the essential material building block for conveying an idea. Carlo Ratti and Matthew Claudel of the SENSEable City Lab at the Massachusetts Institute of Technology (MIT) ask how this, though, is all set to change in a digital context. As technologies shrink and vanish from sight, what might become the new minimum meaningful unit for architecture? How might a new relational scale establish itself, at the level of the ‘invisible detail’ or the microchip? How might this, in turn, change the very nature of buildings as they become highly responsive, human-occupied transmitters?
There is a grain of sand in a concrete wall in the Church of the Light in Ibaraki, Japan (1989). It is the smallest material element of the building – a mere speck – yet this sand was deliberately chosen by Tadao Ando to serve as a crucial tool in the profound transformation of human spatial experience, ultimately to resolve a meticulously crafted piece of architecture. This grain of sand is not just a utilitarian constructive material dumped into concrete slush and poured as walls of a building – it is evidence of intentionality.

The granule might seem to fall under the Oxford English Dictionary’s traditional definition of detail: ‘A minute or subordinate part of a building, sculpture, or painting, as distinct from the larger portions or the general conception.’

By this characterisation, an individual detail is simply a constituent part that carries neither value independent of the whole, nor a direct relationship to it. Yet it could be more. An alternate definition – one we presuppose in this article – lends detail the weight of significance far beyond its function as a subordinate unit. What is at stake is the difference between sand as mute aggregate filling a volume of concrete, and sand as a crucial element in the delicate communication of architectural meaning. In the latter, detail can be thought of as the smallest radical element of architecture that can be imbued with significance, what in other fields, such as statistics or medicine, might be termed the ‘minimum meaningful’.

A detail is the most basic unit for conveying an idea in and of itself while simultaneously serving as a building block in elaborating a larger concept. An analogy is borrowed from linguistics: the morpheme, defined as ‘any of the minimal grammatical units of a language, each constituting a word or meaningful part of a word, that cannot be divided into smaller independent grammatical parts’.

A morpheme is the irreducible linguistic element, whether it is a single letter, a group of letters or a full word. It may or may not stand alone, such that every word is composed of one or more morphemes. Yet the critical qualifier is that it conveys meaning. Similarly, in an architectural sense, the smallest morphological detail is irreducible and carries meaning in and of itself, in addition to composing the overarching theoretical construct of a building.

Peter Zumthor, an architect renowned for his mastery of material, contends that ‘details express what the basic idea of the design requires at the relevant point in the object … They lead to an understanding of the whole of which they are an inherent part.’ As in Ando’s grain of sand, detail can be thought of as a hyper-specific, localised transmitter of meaning that simultaneously echoes and composes the intricate ensemble.

Detail is the crucial operative component of architecture: from the small to the large and from material to concept, the detail holds sway. The individual unit, the minimum meaningful, echoes and constitutes the whole. How, then, can the notion of detail be redefined in a digital context? How can architects surrounded and suffused by networks explore possibilities beyond what is material or formal? Will the architect continue to be fettered by those same means of conveying significance? Can we imagine a new, digital ‘minimum meaningful unit’ of signification?

Zumthor’s solemn material piety and Ando’s attention to the minutiae of construction amount to a contemporary obsession with detail – a preoccupation that can be traced back to the Modernism of the early 20th century. Its momentum began with a concerted effort to strip architecture of ornament,
effectively destroying the intermediary means of architectural communication. And if ‘ornament is crime’, as Adolf Loos polemically contended, the architect’s only recourse was to obsessively focus on abstract detail – a white wall demands perfection. The constructive detail, the minimum meaningful, was paramount, and each nakedly visible element had to speak clearly, from the choice of window dimensions to the type of metal in a doorknob. In the final capitulation of ornament, only the micro and the macro of architecture remained – material and concept – amplifying a stark dichotomy of scales and demanding that the architect consider every visual and material choice intentionally. The era continued to echo with manifesto-driving phrases – ‘Less is More’, ‘God is in the details’, ‘Architecture is order’ – that elevated detail proportionately to the social theory it supported. According to Marco Frascari: ‘The common denominator in these different forms and uses (of the phrase “God is in the details”) indicates that the detail expresses the process of signification; that is, the attaching of meanings to man-produced objects.’ Modernism exacerbated a dipole of distilled material simplicity and abstract coherence.

Today, as silicon merges with concrete, wood and brick – that is, as architecture receives a heady digital transfusion – a new relational scale may emerge. Technologies are shrinking and even vanishing from sight, gently suffusing our buildings and cities, and handing architects a new toolkit for conveying meaning at the human scale. Microchips have become fluid, adaptable and dispersed, to the point that detail is not strictly visual, but virtual: ‘The suggestion that the detail is the minimal unit of production,’ wrote Frascari, ‘is more fruitful because of the double-faced role of technology, which unifies the tangible and intangible of architecture.’

At the event horizon of the tangible/digital collapse, technology can constitute a minimum meaningful unit for architecture in several ways. First, a microchip (or its effect on a building) can be made visually explicit as physical components of the building. Borrowing from the work of Hiroshi Ishii at the Massachusetts Institute of Technology (MIT) Media Lab, this digitally activated space could be thought of as ‘radical atoms’: ‘Our vision of “radical atoms” is based on hypothetical, extremely malleable and reconfigurable

“Radical atoms are blossoming into a thriving field at the crux of computation and fabrication, poised to transform architecture through a profound denouement of the traditional physical/digital boundary.”
materials that can be described by real-time digital models so that dynamic changes in digital information can be reflected by a dynamic change in physical state and vice-versa. Bidirectional synchronization is key.11

Radical atoms are blossoming into a thriving field at the crux of computation and fabrication, poised to transform architecture through a profound denouement of the traditional physical/digital boundary. Explorations like Cedric Price’s pioneering cybernetic theory of performative architecture (1976–80) – buildings that could be constantly reconfigured by an algorithmic ‘Boredom Program’) – through Jean Nouvel’s Institut du Monde Arabe (1987), with its light-responsive facade of dilating apertures, show possibilities for mechanical systems to be controlled remotely or immediately and explicitly transform a building’s appearance and operation in real time. As technologies and materials become increasingly sophisticated, built space will appear as never before, visually transformed as a result of explorations in dynamic structure animated by sensors and actuators working in tandem.

From the propagation of ubiquitous computing, another tool has emerged to shape and communicate the minimum meaningful: ‘invisible detail’. Without being visually perceived, a microchip can nonetheless instigate a powerful interaction between people or between people and architecture, becoming, in many ways, a system of ‘living bits and bricks’.12 Through these ambient electronics, intangible interactions with the building and its inhabitants are now the subject of design. If the essence of architecture is to shape the human experience of space, then the faculty of the architect expands dramatically when he has the ability to deploy technologies that remain unseen yet reveal their presence – convey meaning – performatively, through their effect on people.

At the same time, intangible elements can also be a crucial interface with broader networks, exploding architecture to a potentially infinite scale (and radicalising the Bauhaus dream of working ‘from spoon to city’).13 Being enmeshed with a digital fabric constitutes a dramatic shift in the purview of architecture, what Mark Wigley describes as ‘network fever’: ‘The growth of invisible networks demanded new scanning instruments. The computer was the ideal mechanism to negotiate between the visible and the invisible … Electronic space is being settled.’14 What Wigley describes is an integral coupling of digital bits and material atoms, one that redefines the role of networks in humanity’s physical space. In the same way as architecture mediated between man and environment (primitive hut), citizen and state (government building), or believer and god (church), digitally infused space can become the new interface between the human and the global network, a hyperlink between personal experience and, well, everything.

Networks overlaid on physical space now form a digital blanket that connects people, objects and events, enabling a vibrant and unprecedented understanding of patterns and flows – the signature of humanity. In only the past decade, the meteoric propagation of smart phones has placed a high-powered computer in almost every pocket, activating each denizen of the city as a node in the collective human network. Even beyond telecommunications, sophisticated technologies for sensing and actuating allow for real-time observation, analysis and transformation of urban space, an idea developed, among others, by Mark Shepard in Sentient City: Ubiquitous Computing,
There is no longer a dichotomy between the visible and the invisible, tangible and intangible details: radical atoms and invisible details are intrinsically bound by a technology-infused performative dimension.

Architecture, and the Future of Urban Space, seeks to reconcile the intricate details of urban scale with the invisible aspects of the human experience within it. The TrashTrack project, led by researchers at the MIT Senseable City Lab, is an example of this approach. In 2008, they initiated the TrashTrack project to track and analyze an invisible dimension of urban space: the waste disposal system. By attaching geolocating tags to thousands of ordinary pieces of trash, a surprising network was revealed. This digital suffusion of urban space allowed an unprecedented visualization of waste management dynamics, providing a fine-grained management approach at the scale of individual behavior to that of systematic management.

In the mid-1980s, as technology moved towards prosthesis, a nascent 'cyborg theory' emerged, thanks to the ideas of thinkers like Donna Haraway, William Mitchell, David Rovit, and others. This same line of thinking carried forward to posthumanism, with a new generation of congenital rather than prosthetic technology, and today gives way to digitally networked humans. Without a dichotomy between the visible and the invisible, tangible and intangible, technology-infused performative dimension is key.

Digital and physical merge to reveal an invisible metabolic function of the city: its waste removal system. In 2009 an initial deployment of thousands of geolocating tags were attached to ordinary pieces of garbage, and over the following weeks and months traced a dizzyingly complex disposal chain across the entire US, an elaborate system brought to light through the invisible detail.

MIT Senseable City Lab, TrashTrack trash tracking project, Seattle, 2009
enned in an Internet of Things. With a complete suffusion, invisible detail will be the crux of performative interaction between people and with architecture.

The Modernism of the 20th century sparked an epoch of detail as a monologue rather than a dialogue. The minimum meaningful unit was a material, tangible morpheme that amounted to a poured-in-place manifesto. But that is changing. As built space comes to life at the convergence of bits and atoms, we have the opportunity—the responsibility—to rethink architectural detail as a responsive, performative, human-integrated transmitter of meaning. Architect and theorist Peter Eisenman polemically asked: ‘Now that technology has gone rampant, maybe we need to rethink the cosmology—can we go back to a cosmology of anthropocentrism?’ And that, precisely, is the power of the architectural detail in a digital era: to refocus the minimum meaningful unit of significance onto human interaction. ☐