HIGH DEFINITION
ZERO TOLERANCE IN DESIGN AND PRODUCTION
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HIGH DEFINITION: ZERO TOLERANCE IN DESIGN AND PRODUCTION

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3D scanning provides entirely new avenues of understanding and engagement with the complexities of context, form, behaviour and volume that heretofore have been unattainable, crudely approximated or poorly grasped … ‘zero tolerance’ is presented as a strategic choice to negotiate, rather than a narrow goal to aim for.

— Bob Sheil

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Front cover: ScanLAB Projects, Terrestrial laser scan of rock formations in Joshua Tree National Park, California, part of the LA Skin Deep series, 2012. © ScanLAB Projects Ltd

EDITORIAL
Helen Castle

Δ's impulse is always towards the pioneering – its natural proclivity is to look forwards, anticipating just how fecund new developments in technology might prove to architecture. As Professor of Architecture and Design through Production and Director of Technology at the Bartlett School of Architecture, University College London (UCL), Bob Sheil has established a considerable reputation for a deep and sustained interest in fabrication attested by his previous publications for Δ and the seminal 'Fabricate' conference that he co-founded with Ruairi Glynn. This issue’s focus on verification technologies, specifically 3D scanning and its associated interface with modelling and manufacture, represents a significant shift. It also, as Sheil states in his introduction, gives us the sense of an 'air of a new frontier opening up' (pp 8–19).

The issue delivers much that is exciting at the cutting edge of technology with Tobias Nolte and Andrew Witt's description of the self-optimisation system that Gehry Technologies developed for the realisation of the Fondation Louis Vuitton art museum in Paris (pp 82–9). Skylar Tibbits also provides an insightful account of the 4D printing processes that the Self-Assembly Lab at the Massachusetts Institute of Technology (MIT) is collaborating on with multi-material printing company Stratasys Ltd (pp 116–121). New developments in technology often highlight or accentuate existing possibilities and preoccupations in design. This is an important aspect that Sheil gives space to in the issue by dedicating several articles to defining a high-definition approach and the perceptions surrounding it, whether informed by innovative or conventional techniques – see Ilona Gaynor and Benedict Singleton (pp 48–53), Birgir Örn Jónsson (pp 54–9) and Michael Webb's (pp 60–73) articles.

With new technologies, existing fissures within and between disciplines are often in danger of becoming drawn further apart. This issue focuses on the meaning of tolerance across conditions of fine-grain information, predominantly from a design perspective, but there is also the sense that we need to remain attentive of the opportunities that might be afforded, or lost, across practice and within the construction industry. Ruairi Glynn (pp 100–05) warns that the clunky and cumbersome nature of practice might prove a hurdle too far for the widespread adoption of hyper-connective, high-definition sensing among the profession, despite being wholeheartedly embraced by students in architecture schools. In a poignant Counterpoint to the issue (pp 128–32), Branko Kolarevic reminds us of the attitude of the building industry and the ‘messy’ realities of the construction site that design parameters are imported into. Δ

Note
1. Bob Sheil is the guest-editor of Δ Design Through Making, July/August (no 4), 2005 and Δ Protoarchitecture: Analogue and Digital Hybrids, July/August (no 4), 2008; and the editor of Manufacturing the Bespoke: Making and Prototyping Architecture, Δ Reader, Wiley (Chichester), 2012. The founding ‘Fabricate’ conference (15–16 April 2011) was co-chaired at the Bartlett School of Architecture, UCL, by Bob Sheil and Ruairi Glynn.
bottom: Point cloud model of the western elevation of the Royal Central School of Speech and Drama. The model captures one of three spaces in or around the building that hosted a series of collaborative experiments in architecture, scenography, performance and 3D scanning in September 2013.

Protoarchitecture Lab, The Perform Project at the Royal Central School of Speech and Drama, University of London, 2013

top: Point cloud model of tests for the Perform project that involved robotic arms, moving reflecting surfaces and 3D scanning.
Bob Sheil is an educator, researcher, practitioner, designer, maker and writer whose work is focused on the transgression between making, craft, digital fabrication, design processes and the impact of evolving design technologies on architecture. He is an international speaker and critic, a collaborator on built works, publications, events and projects, and has recently set up and directs the Protoarchitecture Lab at University College London (UCL). He is Professor in Architecture and Design through Production and Director of Technology at the Bartlett School of Architecture, UCL, where he also runs MArch Unit 23 with Emmanuel Vercruysse and Kate Davies of Liquidfactory. He is also a founding partner of sixteen*(makers), whose design for an experimental building (55/02) in collaboration with Stahlbogen GmbH won a RIBA award for design in 2010. He has guest-edited two previous issues of \( \Delta \): Design Through Making (July/Aug 2005) and Protoarchitecture: Analogue and Digital Hybrids (July/Aug 2008), as well as the \( \Delta \) Reader Manufacturing the Bespoke: Making and Prototyping Architecture (2012).

Sheil has also been published in several international peer-reviewed journals, including Architectural Research Quarterly, The Journal of Architecture, Space and Nexus, and has presented key papers, lectures and talks in the US, China and Europe. In 2011 he co-founded and co-chaired, with Ruairi Glynn, the highly acclaimed international ‘Fabricate’ conference at the Bartlett, UCL, for which he also co-edited a substantial parallel publication. He is an advisor to the second ‘Fabricate’ conference to be held at ETH Zurich in February 2014. In 2012 he edited 55/02: A sixteen*(makers) Project Monograph (Riverside Architectural Press); he is currently working on a collaborative design project with the Royal Central School of Speech and Drama, the artists’ collective Shunt, and ScanLAB Projects.

High Definition: Zero Tolerance in Design and Production defines a shift in the emphasis of his past publications that have covered the subjects of design and making in the digital age, particularly around the role of the designer as a maker. In this instance, he is drawing our attention to verification technologies, particularly 3D scanning and its associated interface with modelling and manufacture. The 21st century has begun with an explosion of new tools, techniques and methods, as well as a mounting catalogue of challenges facing the designer. Rather than be expected to master any one tool or set of tools, future designers must balance the role of evaluator and end-user programmer as they reinforce their role as visionaries in a dense cloud of information and expectations. As the potential to develop ever more precise data increases, this collection of diverse essays seeks to define a critical position in relation to the habit of continuously pushing limits. \( \Delta \)
HIGH DEFINIT NEGOTIATING ZERO TOLERANCE
The limits of photography cannot yet be predicted. Everything to do with it is still so new that even initial exploration may yield strikingly creative results. Technical expertise is obviously the tool of the pioneer in this field. The illiterate of the future will be the people who know nothing of photography rather than those who are ignorant of the art of writing.

—Walter Benjamin (1928)\textsuperscript{1}

Over the course of the last decade, the focal point for advanced technologies in architectural design has shifted from the outer edges of the virtual to a position of hybridity with the actual. The tangible has caught up with the intangible, and possibilities that were entirely speculative in non-physical domains just a few years ago are now being materialised and built. The term ‘digital’ no longer only conjures up notions of complex representation, computational geometries and intelligent systems, but also fabrication, craft and materials. At the same time, designers are faced with (and connected to) more tools to make their work than ever before, each packing extraordinary power, accuracy, capability and provocation. Subsequently, the scope on how these tools influence, validate or facilitate the designer is expanding rapidly and the challenge is to navigate such dynamic circumstances with a clear sense of critique on how they assist in advancing architecture as a visionary practice and subject.
More recently the tool range has taken an abrupt leap forward in the realm of definition and accuracy, and this issue of \( \Delta \) is positioned as a critical reflection on what this means. It gathers an international and diverse collective of inquisitive and critical innovators whose work is exploring uncharted territory with measured curiosity. It speculates on how we might operate in the near future with inspiring and sobering insight, and presents a series of challenging questions that address designers’ values in relation to the production of their work. Underlying the issue is the core relationship between digital technology and the designer’s intent, where the meaning of tolerance is explored across conditions of fine-grain information, the management of complex processes, and engaging with the difference between the simulated and the built.

The Digital Generation

The typical undergraduate entering an architecture course today was six years of age at the turn of the millennium. They were born in the same year as the Apple QuickTake, the first commercially available digital camera. They took their first steps as the World Wide Web entered our homes, and built-in satellite navigation systems were available in production automobiles. By the time our present freshers were 10 years of age, Facebook was launched and Concorde had made its last commercial flight. In their teens, perhaps the time when they first contemplated reading architecture, the digitalisation of the Information Age was in full flow, 3D printing was mainstream, and both the construction and design industries were exchanging protocols on manufacturing processes. By the time they were accessing their first university podcast lecture, they were simultaneously downloading a plug-in upgrade and uploading their own latest applet development. Students today, and the architects of tomorrow, are the first generation entirely raised in a digital culture. They have been shaped by a period of profound and dynamic change, and they are entirely familiar with technologies that are always new. In this context, this issue of \( \Delta \) also attempts to navigate a critical path through present evolutions that are occurring so thick and fast that the cloud we should be most concerned about is the one that obscures vision, on all sides.

Matthew Shaw, Subverted Lidar Landscape, London, Unit 23, Bartlett School of Architecture, University College London (UCL), 2008–09

The zone of ambiguity. Point cloud model of the territory surrounding London’s Houses of Parliament developed from aerial-captured lidar data. The location and its manipulated lidar portrait became the site for a speculative project investigating scanning technology, material behaviour, and laws for public gathering.

A series of prototypical objects explore the form and materiality of stealth and subversion. Each object starts life as an intuitively carved wooden sketch. These become 3D notebooks on which to design precise insertions and additions. The objects are then 3D scanned using a self-built scanner to enable precision inserts to be machined and added to the originals. These objects are then scanned and their digital siblings cast and machined from the scanned data.
Acts of Deception

Reality in the 21st century is increasingly defined by the untrustworthiness of its representation. Seeing is deceiving. Whether for artistic, commercial or political ends, images mediate our understanding of the world, conjuring powerfully convincing secondary narratives that can serve to reveal truth, obscure it or reinvent it entirely. Reality is constructed from what we are given to believe and all, it seems, is not as it seems.

— Kate Davies, Co-tutor, Unit 23, Bartlett School of Architecture, UCL, 2012

55/02 is an experimental building by sixteen*(makers) and Stahlbogen GmbH, and was completed in 2009 at the steel fabricator’s factory in Blankenburg, Germany. The story behind this project and accounts on its design and hybridised digital production are documented elsewhere. However, the images here talk of reflective observations made a year and more beyond its assembly on site at Kielder Water and Forest Park, Northumberland, UK, and are produced through 3D lidar scanning, executed by ScanLAB Projects, between March and June 2010.

One image presents an overlay of the 3D scan upon the digital design model. In other words, the ‘built-record’ model superimposed upon the ‘design-record’ model, where difference is clearly measurable. Given the approach and experimental design and fabrication tactics of the project, differences were actively encouraged and entirely expected, yet their specifics were not known prior to such mapping. Although in this instance such difference is not of any critical status, the exercise revealed the persistence of translation issues between the drawn and the made, even in the digital age. In an age of increasingly vertiginous standards in visual definition, boundaries between the real and the digital are becoming imperceptible and our visual literacy is fundamentally challenged and infused with suspicion and doubt. As Kate Davies says, ‘Seeing is deceiving’, and the tactile experience of engaging with the physical properties of design has therefore become an act of verification upon the visceral and cerebral construct. In this regard, the inclusion of exquisite new work by the visionary architect Michael Webb (pp 60–73), and the seemingly polar opposite world of the Centre for Advanced Spatial Analysis (CASA) at the Bartlett School of Architecture, University College London (UCL) (pp 40–47), is a deliberate move to frame the arguments of this issue in the broadest of terms. For the former, the meticulous layering and accretion of material and meaning upon a long and extended conversation of time, space, motion, geometry and fabrication talks of high definition as a theoretical assemblage of spatialised imaginings. For the latter, the theme is addressed as a revelation on the saturation of urban geographies through subliminal and parasitical technologies for which the city’s inhabitants are both prey and predator.