Black Box

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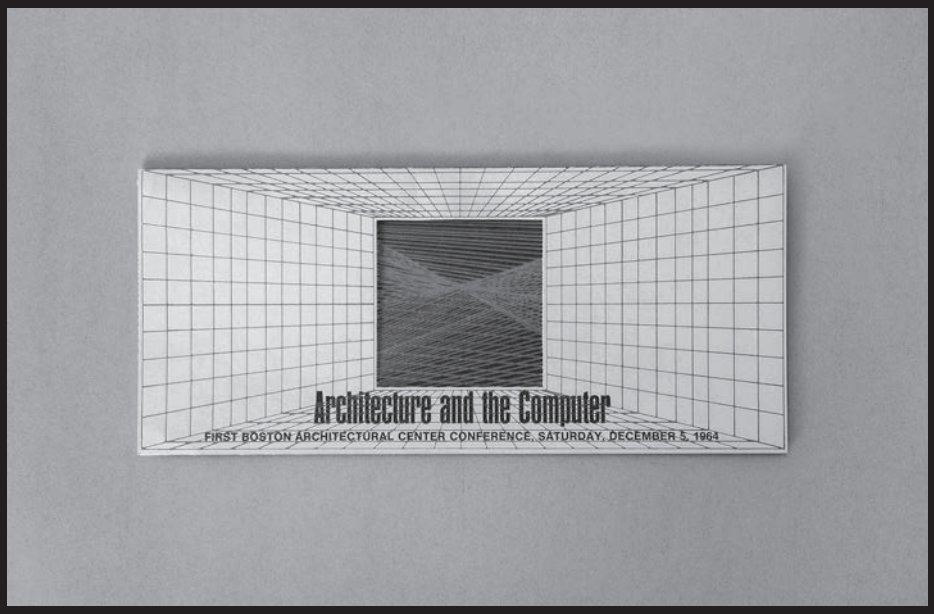
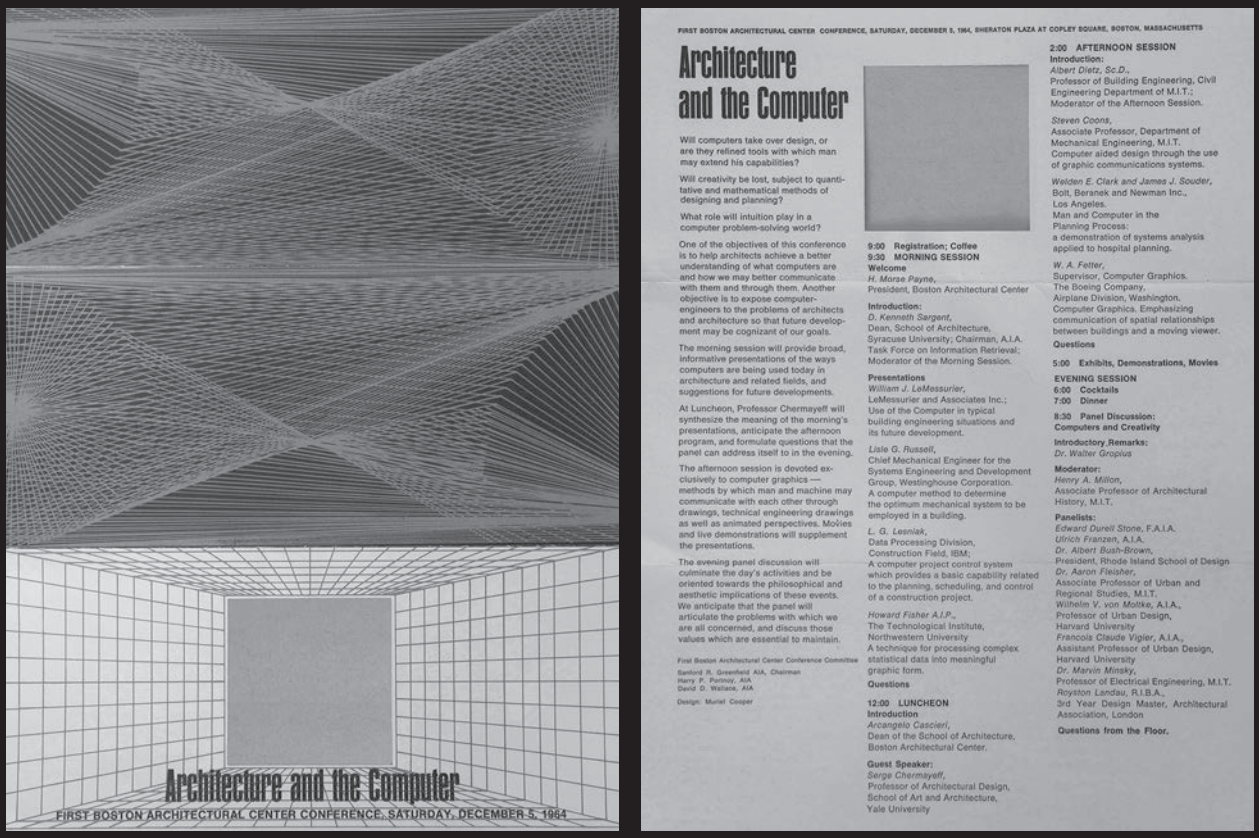


We know that Digital is inevitable and irreversible; and when we think about it, we evoke the present and catch a glimpse of the future. But there is still a story to tell: digital culture is not just about the future. It can be useful to reflect on this according to a historical perspective that is still somewhat obscure and unexplored – some kind of *black box* that unveils the path taken. In this sense, we went back 60 years, to the time when some designers wanted to build architectural and design machines that turned the design process into a dialogue. However, at that time, these ideas proved to be difficult to convey into practice. The existing technology wasn't advanced enough to include ideas and theoretical models. Despite the prominence of the term "Artificial Intelligence" during the 1950s and '60s, it eventually disappeared – until its re-emergence in recent times; its premises were way ahead of its time.
In fact, the development of "digital architecture" does not merely comprehend the use of a new tool; is rather inseparable from a broader cultural framework. Fernando Lisboa (1960–2008), who was a teacher at the Faculty of Architecture of the University of Porto and a key-figure in the integration of computing in the field of architecture in Portugal, stated that "historical experiences show that a new tool does not automatically lead to renewed creativity or to the adequate energies to benefit from it. This fact cannot work as a sedative to stop people from trying to understand and keep on researching"[1] – thus encouraging research on new instruments, in order to increase and reach their full potential.

1 Fernando Lisboa, "www.arquitectura" in Alves, J., Campos P., Brito, PQ (eds.) The *Future of the Internet*, Central Atlantic Editions, Matosinhos, 1999, p. 227.



Trifold Brochure. "Architecture and the Computer", Conference at the Boston Architecture Architectural, 1964. Images collected by Isa Clara Neves at the Boston Architectural College Archives. August, 2018.

During one of the first events that addressed the connection between architecture and computing – *Architecture and the Computer – First Boston Architectural Center Conference* (1964) – Walter Gropius stated: "I wish we architects keep an open mind towards these possibilities offered to us by science. The increasing comprehensiveness of our new tasks in architecture and in urban developments need new elaborate tools for their realization. It will certainly be up to us architects to make use of them intelligently as means of superior mechanical control which might provide us with ever-greater freedom for the creative process of design".[2]

Almost 70 years after the emergence of the computer, we keep discovering new tools and platforms. Digitally assisted design has been driven by technologies with diverse functional, cultural, social and economic goals. These technologies have transformed and continue to transform design by rapidly changing its processes, practices and products. The new design and assessment tools enable designers and architects to imagine, design and create new forms of construction, more ecologically sustainable buildings and new environments that interconnect or integrate themselves into physical spaces.

2 Walter Gropius, "Computers for Architectural Design," in *Architecture and the Computer. Proceed ings of the First Boston Architectural Center Conference* (Boston: Boston Architectural Center at MIT, December 5, 1964), from the department of architecture, MIT, p. 41.

The use of digital technologies in actual construction opens a new field of reflection, quite complex and with many implications. For this reason, *Black Box – Stories of the Future* will also address the new relations between design and computational potential, aiming at a better adaptation of technological improvements to design and focusing on the impact of computer sciences on design and architecture. Nowadays, the design of an object is not the main focus, but rather the possibility of creating guidelines that allow the production of said object – an issue that many educational institutions for design are exploring.

In short, we are interested in reflecting on an era that began in the 1950 and gained a new expression in our time – despite all its ups and downs, breakthroughs and setbacks. Until the beginning of the new millennium, one could say that the "material" was transferred to the "digital", thus creating the *Big Data*. Nowadays, the designers/architects aim to transfer the "digital" to the "material". And we currently have access to computer-operated machines that allow us to accomplish said process. For example, students and researchers can work with these machines at digital manufacturing and robotics laboratories.

With the beginning of the millennium – particularly during the decade that is now ending – "Artificial Intelligence" became part of architectural and design production. Understanding, debating and framing this transformation are the key starting points of 21st century design. Hence, it is important to reflect on what is actually changing: what are the possibilities of digital production? What can we learn from the past about rule-based design and design science? What are the possibilities of digital tools? In addition to the new digital production institutions that are successively inaugurating, is it also crucial to promote a design theory that comprehends a computational perspective? Who will lead this paradigm shift, where Digital materialises like never before?

The *Black Box – Stories of the Future* will contribute to establish a critical view of the influence of computer technology on design and architecture, thus promoting a reflection on emerging technical paradigms that are strongly reshaping the way we live.

Curators of *Black Box - Stories of the Future*

DFAB HOUSE stands on the upper floor of the NEST building. Photography: Roman Keller. Image courtesy of Fabio Gramazio – ETH Zurich.

Fabio Gramazio

HISTORY REPEATS ITSELF – AT DIFFERENT SPEEDS

The following text is the synthesis of a brief conversation, via Skype, between the curators and Fabio Gramazio, one of today's most prominent names in computational design and robotic fabrication. His eloquence of thought flows, liquid and steady, albeit in a discreet tone. In these lines, Fabio Gramazio captures the zeitgeist, lucidly reading our contemporaneity and anticipating the *stories of the future.*

IN THE NEAR FUTURE, DIGITALISATION WILL REVOLUTIONISE THE CREATION AND CONSTRUCTION PROCESSES IN ARCHITECTURE.

To begin with, it is very important to make a distinction: while some people think that Digital will revolutionise everything instantaneously – in industry, society, etc. – and also automatically save the world through data mining and smart cities, we believe this to be a very technocratic notion, a techno-naive or techno-optimistic view on development – which we have already witnessed in recent history, particularly concerning technology. In addition – and this comes from a deeper understanding of the industry and the design processes – we believe that design and architecture could eventually save the world, rather than technology. However, when applied to design, technology can render it much more effective and influential, namely in what concerns meeting the main objective (saving the world) and creating more interesting environments and improved architecture – which, in the long-run, will progress alongside each other. This conviction comes from the notion that the construction industry – I'm not specifically mentioning the people involved in the building process itself, but those in charge of design, financing, etc. – is such a broad, unstructured and complex cosmos of different stakeholders, with different cultures, rhythms and financial possibilities, thus making it virtually impossible to change everything overnight. There's no killer app that can change all of these dimensions. But there is a chance to establish a digital building culture (the keyword here is culture). In this sense, culture is something that grows bottom-up; it is not a big master plan promoted by governments or institutions. Culture is something that emerges from discussion, from actually doing something. And this is what will eventually change the world and the way we build, create and think about architecture. It won't be an instantaneous change, but more like a reform in small, perhaps almost invisible steps – which will last for one or two generations and eventually change everything. And it will include everybody: the clients and how they perceive building, as well as the carpenters and the designers. The main goal is to establish a new basis of knowledge that goes beyond the application of the software, thus promoting a new understanding of the mechanisms and the processes of how things relate to each other. Ultimately, said reform will hopefully have a significant impact.

Nowadays, we are challenged by many complex issues and we need to address them swiftly and effectively, hopefully in the next 10 years. And even though we are aware that there have been many societal and cultural changes, if we address culture without considering existing imposed

Mario Carpo

DESIGN, AUTOMATIZAÇÃO E BRUTALISMO COMPUTACIONAL

A noção de customização digital em massa foi inventada por arquitetos e designers no início da década de 90, seguindo-se os primeiros testes práticos de produção em série não-estandardizada. Porém, naquela época, os designers que recorriam a tecnologias CAD/CAM não tinham uma grande variedade de escolha em termos de materiais com os quais podiam trabalhar ou do tamanho das peças que podiam fabricar. Na coleção *Alessi Teapots* de Greg Lynn – um conjunto não-estandardizado composto por 99 variações do mesmo modelo paramétrico – cada um dos 99 bules assemelhava-se a (e deveria ser visto como) um monólito ou um único bloco de metal; tal não sucedeu, apesar de ser essa a ideia que o conjunto pretendia transmitir – segundo a qual cada bule seria fabricado com placas de titânio fresadas, impressas em 3D ou mesmo extrudidas. No entanto, ao tentar aplicar a mesma lógica a uma série não-estandardizada de edifícios (*Embryologic Houses*, c. 1998–2000), Lynn foi o primeiro a referir que tal processo de fabrico não podia ser facilmente replicado.[1] A estrutura de uma casa paramétrica não-estandardizada poderia, eventualmente, ser composta por um elevado número de painéis (não-estandardizados e digitalmente customizados); no entanto, estes teriam de ser fixados a uma estrutura e também unidos entre si. Dada a sua forma irregular, essa mesma estrutura teria de ser produzida manualmente – e todas as porcas, parafusos e juntas teriam de ser inseridos à mão. Resumidamente, há 20 anos, a casa não-estandardizada de Lynn acabaria por ser feita à mão, ao invés de fabricada digitalmente.

A transferência de tecnologias não-estandardizadas de pequena escala (utilizadas maioritariamente na criação de produtos) para a construção em grande escala continua a ser um dos grandes obstáculos em termos de design. Alguns criadores de ferramentas digitais tentaram ultrapassar esta barreira, aumentando o tamanho das suas impressoras. No entanto, e como as impressoras tendem a ser maiores que os objetos que imprimem, alguns desses projetos resultaram em experiências quixotescas, com *hardware* que não era, de modo algum, prático. Hoje em dia, a versatilidade da robótica – apoiada pela força bruta da computação do *Big Data* – permite uma abordagem diferente: em vez de imprimir monólitos cada vez maiores, é preferível começar com um conjunto de peças individuais (por mais numerosas ou pequenas que sejam) e deixar a tarefa de separá-las e montá-las a cargo da I.A. e dos robôs. Hoje, graças à I.A., é possível notar, calcular e produzir um número quase ilimitado de peças diferentes (ou idênticas); além disso, é também possível escrever e executar um vasto número de movimentos robóticos distintos (ou semelhantes) para garantir a montagem dessas mesmas peças. A lógica da customização digital em massa (a produção de itens individuais diferenciados, com o mesmo custo unitário que as peças iguais produzidas em massa) é perfeitamente espelhada pela lógica da montagem robótica (apoiada pela I.A.): os gestos robóticos semelhantes custam o mesmo que os variáveis; as operações robóticas de grande amplitude ou duração custarão o mesmo, independentemente de os movimentos robóticos serem iguais ou não.

De facto, e tendo em conta que o fabrico e a montagem podem ser estandardizados (cópias ou gestos idênticos, respetivamente) ou não-estandardizados (cópias ou gestos variáveis, respetivamente), torna-se relativamente simples compilar uma matriz matemática dos quatro modos de produção e montagem – dos quais um (a montagem de peças não-estandardizadas) parece ser o mais improvável; os três restantes referem-se à maioria das experiências que estão a ser realizadas por designers de computação, a nível global. Além disso, o fabrico estandardizado e não-estandardizado, bem como a montagem estandardizada e não-estandardizada, podem (teoricamente falando) ser efetuados através de processos manuais, mecânicos ou digitais – com a exceção da produção e da montagem não-estandardizadas, que só podem ser desenvolvidas manualmente ou digitalmente. A principal matriz resultante destas combinações poderia, por sua vez, ser utilizada para descrever a quase totalidade da história da arquitetura.

Dada esta vasta gama de resultados possíveis, podemos questionar o facto de certas preferências (bastante particulares) serem as mais procuradas pela comunidade de designers, espalhada pelos quatro cantos do mundo. Aquilo a que alguns chamam de "resolução excessiva" ou "estilo do *Big Data*" – o estilo voxelizado de discretismo e particlização – era (e continua a ser) o sinal externo e visível de uma lógica interna e invisível que, por sua vez, deixou de ser a lógica de nossa mente.[2] Os traços dessa sensibilidade estética podem ser encontrados em vários aspetos do design contemporâneo, seja por razões culturais e técnicas não relacionadas com a computação (como nos trabalhos mais recentes de Kengo Kuma), ou mesmo devido à ausência de qualquer consideração técnica (tal como acontece em certas obras de Sou Fujimoto). Por outro lado, o estilo denso que (à data da redação deste artigo) caracterizava a escola do brutalismo computacional de Bartlett (também presente em vários trabalhos produzidos na SCI–Arc, USC, MIT,etc.) é igualmente sustentado por considerações técnicas semelhantes às previamente referidas. Esta densidade única e tão característica decorre do facto de vários *designers* optarem pela montagem não-estandardizada ou combinatória de um catálogo finito de peças estandardizadas ou mesmo pré-fabricadas. Dadas as premissas técnicas da automatização robótica, essa opção pode parecer peculiar e arbitrária. Indubitavelmente, se hoje em dia existem novas tecnologias que permitem a customização em massa de qualquer processo de montagem, por que motivo não po-

Stories of the Future

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