

Mark Burry

## Essential Precursors to the Parametricism Manifesto

# Antoni Gaudí

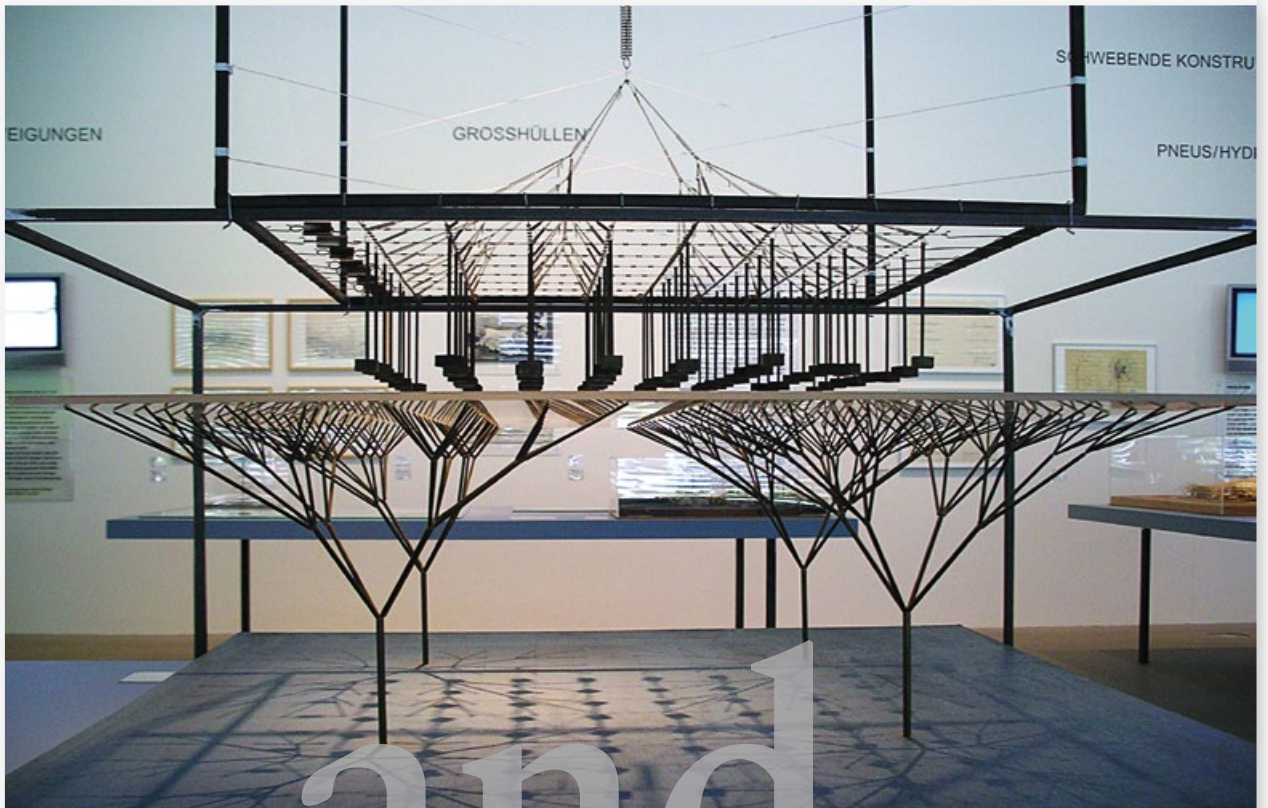


Antoni Gaudí,  
1:10 inverted (hanging) model  
for the Colònia Güell Chapel,  
Santa Coloma de Cervelló,  
Barcelona,  
1898-1906

Scale-inverted (hanging) model for the  
chapel located just outside Barcelona.

Frei Otto,  
Hanging Model,  
Leicht bauen, natürlich  
gestalten,  
Architekturmuseum der  
Technischen Universität  
München,  
Pinakothek der Moderne,  
July 2005

*opposite:* Otto's logical translation of load  
paths through this 'built diagram' based  
on the parametrically variable distribution  
of forces.



# and Frei Otto

As Senior Architect to the Basilica of the Sagrada Família in Barcelona, **Mark Burry** has been ‘thinking parametrically’ for almost his entire career. Here he describes how his longstanding role overseeing the completion of Antoni Gaudí’s masterpiece has afforded unique insights into the work of a great geometer and parametric thinker. Burry places the contribution of Gaudí alongside that of Frei Otto – the other eminent 20th-century Proto-Parametricist.

When Patrik Schumacher first unleashed ‘Parametricism’ on the world in 2008, the principal reason for a largely antagonistic response was the proselytisation of a new style posited as a *modus operandi* at the expense of the very serious historical and theoretical back-up that was core to the original proposition.<sup>1</sup> Writing myself as someone who had been thinking parametrically for almost my entire professional career commencing in 1979, largely but certainly not exclusively thanks to an early analogue encounter with the efforts to progress Antoni Gaudí’s design for the Sagrada Família Basilica in Barcelona, I was not especially bothered by the apparently sudden discovery of ‘Parametricism’ per se. In Gaudí’s 43 years of practice he evolved from historicist to organicist, and ultimately to geometer through his exacting use of geometry – a fusion of intersecting hyperbolic paraboloids with hyperboloids of revolution: parametrically variable flexible architectural design by any definition. With this hands-on introduction to Gaudí’s parametric thinking extending over decades I considered that the style argument was therefore a rather unfortunate distraction, taking the creative mind away from the principal core issue – thinking and acting parametrically.

As the ensuing kerfuffle has matured towards ‘Parametricism 2.0’, Schumacher’s announcement of the new style as a manifesto seven years ago, intentionally or otherwise a debate on a crucial dimension of computationally influenced architecture was initiated that might otherwise have been quickly passed by were Parametricism situated merely as a methodological commentary on a particular approach to design. As a result of that original and unexpected position statement, we now have a generation of emerging architects who have been extraordinarily sensitised to the fundamental nature of design parameters, and the way that self-consciously aware digital design computation through parametrically variable inputs can be welcomed as a driver for a far greater sophistication within the studio.

Personally I favour any deliberate design process that keeps digital agency firmly under the control of the architect, and at some distance ahead of any careless deployment of someone else’s algorithm, or the embrace of the accident and other related happenstances.<sup>2</sup> It is surely essential that architects make good use of the manifesto as a provocation medium, and the announcement of Parametricism was one of the first wide-reaching manifestos of this scale possibly since Archigram

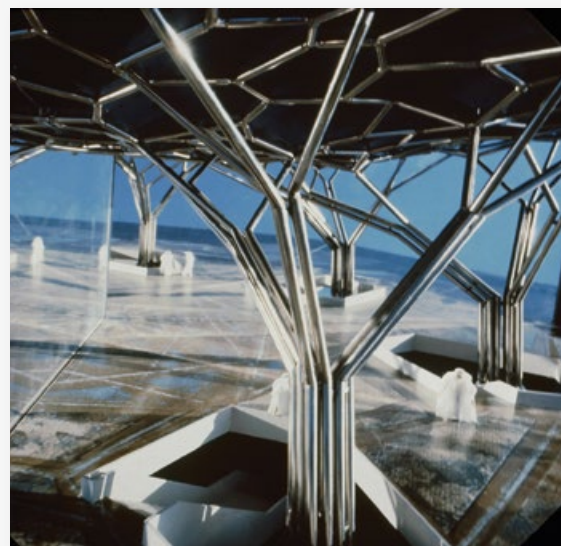


GMP Architekten,  
Stuttgart Airport Terminal 1,  
Stuttgart,  
1991

The tree-like structure of the airport terminal interior demonstrates the portability of robust ideas based on parametric variability.

Rolf Gutbrod, Frei Otto,  
BuroHappold and  
Ove Arup and Partners,  
Kings Office,  
Council of Ministers,  
Majlis al Shura,  
Riyadh,  
Saudi Arabia,  
1979

Model showing the support pillars of the six-angle gridshell of this unbuilt proposal.



*et al* in the 1960s. By being declared a 'style', Parametricism has oxygenated contemporary architectural fixation beyond 'starchitecture' with the necessary polemical oomph to get everyone sharpening their metaphorical pen nibs if not their swords. The nature of the manifesto as a catalyst to push matters forward segues neatly into a dissection of Theo van Doesburg's 'Towards a Plastic Architecture' manifesto of 1924 that aligns so closely to the subsequent introduction of computational design into contemporary architecture.<sup>3</sup>

In a nutshell, Van Doesburg calls for a parametrically variable ('plastic') architecture in all but name. In Proposition 1 he rails against style: 'Instead of taking as a model earlier types of style and, in so doing, imitating earlier styles, it is necessary to pose the problem of architecture completely afresh.' In Proposition 2 he elaborates: 'The new architecture is elementary, that is, it is developed from the elements of building, in the widest sense. These elements, such as function, mass, plane, time, space, light, colour, material, etc., are at the same time elements of plasticism.' Here we might substitute the term 'elements' with 'variables'. Proposition 9 contends: 'Space and time. The new architecture takes account not only of space, but also of time as an accent of architecture. The unity

of time and space gives the appearance of architecture a new and completely plastic aspect (four-dimensional temporal and spatial plastic aspects).'

The version of Van Doesburg's manifesto appearing in Ulrich Conrads's 1970 collation of *Programs and Manifestoes on 20th-Century Architecture* includes the following extract: 'For this purpose Euclidean mathematics will be of no further use — but with the aid of calculation that is non-Euclidean and takes into account the four dimensions everything will be very easy.'<sup>4</sup> 'Easy' might not be the term that first springs to mind to any adept in today's sophisticated parametric software, but it is certainly easier now than it would have been for first Antoni Gaudí and subsequently Frei Otto with their manually executed empirical evaluations of gravity-affected form, which fascinatingly presage current preoccupations.

### **Antoni Gaudí and Frei Otto: Proto-Parametricists**

Gaudí's mid-career designs (around 1900 to 1914) bear important similarities to the work emerging from Otto's studio (especially during the 1960s and 1970s), particularly in the way both used 'flexible models' to work with 'freeform'.

We now have a generation of emerging architects who have been extraordinarily sensitised to the fundamental nature of design parameters

Reconstruction of Gaudí's hanging model for the Colònia Güell Chapel, Sagrada Família Basilica Museum, Barcelona, 1980s

This model, painstakingly reproduced by Jos Tomlow and team at 1:15 scale, provided many valuable insights into Gaudí's working methodology for this project.



They were inspired to call on gravity, one of nature's ultimate parametric design inputs, to inform rather than plan architectural form as an essential physical determinant within the design process. In terms of the Van Doesburg manifesto, gravity is a fourth-dimensional non-Euclidean parameter. The execution of Gaudí's and Otto's experiments using hanging models can be argued to be a physical call on the ultimate truth: architectural volume following the shape that gravity imposes on materials in use.

However, along every design trajectory that takes idea through to artefact there are important differences between ambition and outcome, for example the problem of the fully executed 'equilibrated design' that has veered off in a different direction than that originally 'formed' (as opposed to planned) through the hanging models. The equilibrated design is an absolute condition – something that engineers might strive for, but architects might be wary of.

Such a logical path to a design might need to be tracked differently should the design change through the imposition of competing parameters. This so-called Pareto optimisation and quest for effective parametric trade-offs is the enemy of the absolute conditions of parametric design. The significance of the similarities between Gaudí and Otto as predigital precursors for designing parametrically counters any claim that Parametricism, in itself, is merely a contemporary digital

condition. The similarities as well as the differences between the two architects are evidence of alternative flexibilities of the flexible model. Seen in this light, any concerns that parametric inputs are in fact unfriendly and non-negotiable design constraints – a design straightjacket – may be challenged without hiding behind a label and a digital design computation mask.

### **Dangerous Liaisons? (Or Architectural Practice Not as We Have Traditionally Understood It to Be?)**

Is Parametricism 2.0 a dangerous step down the road towards the destruction of the profession of architecture, or is it simply architectural practice as we know it that is at risk?

By extending the parametric inputs of architectural design to include environmental, political, social, cultural, practical, economic, theoretical, philosophical and behavioural parameters (this is not an exclusive list by any means), for the first time the architect can act as the equivalent of the operatic impresario. The range and potential impact of big data inputs necessarily displaces the architect from any earnest belief that they can continue to assume the role of sole design author.

What makes both Gaudí and Otto such exciting players in the Parametricism debate is the evidence of expanded design horizons that their experimental intensity reveals. Both gift us their deep understanding of and commitment to the rich matrix that structure and materials make together with the



Frei Otto and Günther Behnisch,  
Olympic Stadium,  
Munich,  
1972

The design strategy for the stadium sits somewhere between Gaudí's hanging model for a chapel, and the advanced high-tech options of today, demonstrating the portability of parametric approaches to translating ideas into outcomes.

Frei Otto in his studio,  
7 June 2004

Abundant evidence of Otto's experimentation on view in his studio. Empirical investigation within a fully resolved intellectual framework characterised Otto's design approach.



physical and biotechnical foundations of the natural world – at both macro- and microscopic levels. What they achieved as essential precursor agents for a digitally driven Parametricism should help convince latter-day fence-sitters that the wonderful new world of flexible design strategies, still on the cusp of fully emerging, will greatly extend their repertoire. Working parametrically across the full gamut of inputs there are abundant opportunities to enrich individual practice. To do so architects will have to find a way to embrace a computationally mediated dialogue by contributing a much broader range of parametric variables to the mix drawn from experts who are not necessarily fellow architects.

‘Embrace’ is the operative word here: thinking and creating parametrically will need to scale-up radically to the urban scale. Parametric thinking spans the minute scale and the mega. Although still out of the reach of our existing technology, we are nevertheless not so far away from the advent of the computational power necessary to convert the analytical outputs from ‘big data’ into meaningful design inputs. Directly linking data outputs to parametric inputs will help meet requirements for future megacities being all that they could be as positive places fit for all human aspirations and activity. This might have been beyond the scope of Gaudí and Otto given their respective historical, cultural and technical contexts, but they signal that it is surely ours to embrace tomorrow if not quite today. ▢

#### Notes

1. Patrik Schumacher, ‘Parametricism as Style – Parametricist Manifesto’, presented and discussed at the Dark Side Club, 11th Architecture Biennale, Venice, 2008: [www.patrikschumacher.com/Texts/Parametricism%20as%20Style.htm](http://www.patrikschumacher.com/Texts/Parametricism%20as%20Style.htm). See also Karen Cilento, ‘Parametricist Manifesto/ Patrik Schumacher’, *ArchDaily*, 16 June 2010: [www.archdaily.com/64581/parametricist-manifesto-patrik-schumacher/](http://www.archdaily.com/64581/parametricist-manifesto-patrik-schumacher/) and Patrik Schumacher, ‘Parametricism: A New Global Style for Architecture and Urban Design’, in Neil Leach (ed), *Δ Digital Cities*, July/August (no 4), 2009, pp 14–23.
2. Mark Burry, ‘Gaudí, Teratology and Kinship’, in Stephen Perrella (ed), *Δ Hypersurface Architecture*, May/June (no 3), 1998 pp 38–43.
3. Theo van Doesburg, ‘Tot een Beedende Architectuur’ (Towards a Plastic Architecture), *De Stijl*, 6 (6–7), 1924, pp 78–83.
4. Theodore van Doesburg, extracted from Proposition 9 of ‘Towards a Plastic Architecture’, 1924, in Ulrich Conrads, *Programs and Manifestoes on 20th-Century Architecture*, MIT Press (Cambridge, MA), 1970, p 79.



Antoni Gaudí,  
Colònia Güell Chapel,  
Barcelona,  
1898–1914

*left:* Detail of the hyperbolic paraboloids forming the porch ceiling above the crypt entrance. Hyperbolic paraboloids are infinitely parametrically variable surfaces and offer significant constructional advantages through their generation from straight lines as well as their structural efficiency. For the many quadrilateral mesh elements emerging from the hanging model the hyperbolic paraboloid was the obvious solution for four conjoined nonplanar straight edges emerging from the string network that formed the flexible hanging model.

*bottom:* Gaudí used naturally occurring hexagonal basalt prisms from Northern Catalunya for the principal columns. Notwithstanding the calculations made through the hanging model he nevertheless intervened during the making of the building – apparently requesting that the stonemasons make scarf cuts where the columns meet their bases.



Text © 2016 John Wiley & Sons Ltd.  
Images: pp 31, 34(r) © Images courtesy Juan María Songel, from *A Conversation with Frei Otto*, Princeton Architectural Press, New York, 2010; pp 32(l), 35 © Photo courtesy Juan María Songel; p 32(r) © Frei Otto; p 33 © Photo Mark Burry; p 34(l) © Tiia Monto. Licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license: <https://creativecommons.org/licenses/by-sa/3.0/deed.en>