Parametricism

A New Global Style for Architecture and Urban Design

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There is a global convergence in recent avant-garde architecture that justifies its designation as a new style: parametricism. It is a style rooted in digital animation techniques, its latest refinements based on advanced parametric design systems and scripting methods.

Developed over the past 15 years and now claiming hegemony within avant-garde architecture practice, it succeeds Modernism as the next long wave of systematic innovation. Parametricism finally brings to an end the transitional phase of uncertainty engendered by the crisis of Modernism and marked by a series of relatively short-lived architectural episodes that included Postmodernism, Deconstructivism and Minimalism. So pervasive is the application of its techniques that parametricism is now evidenced at all scales from architecture to interior design to large urban design. Indeed, the larger the project, the more pronounced is parametricism’s superior capacity to articulate programmatic complexity.

The urbanist potential of parametricism has been explored in a three-year research agenda at the AADRL titled ‘Parametric Urbanism’ and is demonstrated by a series of competition-winning masterplans by Zaha Hadid Architects.

Parametricism as Style

Avant-garde architecture and urbanism are going through a cycle of innovative adaptation – retooling and refashioning the discipline to meet the socioeconomic demands of the post-Fordism era. The mass society that was characterised by a universal consumption standard has evolved into the heterogeneous society of the multitude, marked by a proliferation of lifestyles and extensive work-path differentiation. It is the task of architecture and urbanism to organise and articulate the increased complexity of our post-Fordist society.

Contemporary avant-garde architecture and urbanism seek to address this societal demand via a rich panoply of parametric design techniques. However, what confronts us is a new style rather than merely a new set of techniques. The techniques in question – the employment of animation, simulation and form-finding tools, as well as parametric modelling and scripting – have inspired a new collective movement with radically new ambitions and values. In turn, this development has led to many new, systematically connected design problems that are being worked on competitively by a global network of design researchers.

Not long ago we witnessed an accelerated, cumulative build-up of virtuosity, resolution and refinement facilitated by the simultaneous development of parametric design tools and scripts that allow the precise formulation and execution of intricate correlations between elements and subsystems. The shared concepts, computational techniques, formal repertoires and tectonic logics that characterise this work are crystallising into a solid new hegemonic paradigm for architecture.
Parametricism emerges from the creative exploitation of parametric design systems in the course of articulating increasingly complex social processes and institutions. That parametric design tools themselves do not account for this profound shift in style from Modernism to parametricism is evidenced by the fact that late Modernist architects are employing parametric tools in ways which result in the maintenance of a Modernist aesthetic using parametric modelling inconspicuously to absorb complexity. The parametricist sensibility, however, pushes in the opposite direction, aiming for maximum simplification of complex systems that constitute seamless fluidity, akin to natural systems that constitute periods of revolutionary transition between styles. Styles as Design Research Programmes Avant-garde styles can be interpreted and evaluated as phases which result in the advancement of techniques such as scripting (in Mel-script or Rhino-script) and parametric modellings (with tools such as GC or DP) becoming a pervasive reality such that it is no longer possible to compete within the contemporary avant-garde architecture scene without mastering and refining them. However, the advancement of techniques should go hand in hand with the formulation of yet more ambitions and goals. The following five agendas seek to inject new aspects into the parametric paradigm and to further extend the new style’s reach:

1 Parametric inter-articulation of subsystems

The goal is to move from single system differentiation (for example, a swarm of facade components) to the scripted association of multiple subsystems – envelope, structure, internal subdivision, navigation void. The differentiation in any one system is correlated with differentiations in the other systems.

2 Parametric accentuation

Here the goal is to enhance the overall sense of organic integration by means of correlations that favour deviation amplification rather than compensatory adaptation. The associated system should accentuate the initial differentiation such that a far richer articulation is achieved and more orienting visual information made available.

3 Parametric figuration

Complex configurations in which multiple readings are latent can be constructed as a parametric model with extremely figuration-sensitive variables. Parametric variations trigger ‘gestalt-catastrophes’, that is, the quantitative modification of these parameters triggers qualitative shifts in the perceived configuration. Beyond object parameters, ambient parameters and observer parameters have to be integrated into the parametric system.

4 Parametric responsiveness

Urban and architectural environments possess an inbuilt kinetic capacity that allows those environments to reconfigure and adapt in response to prevalent occupation patterns. The real-time registration of use patterns drives the real-time kinetic adaptation. The built environment thus acquires responsive agency at different timescales.

5 Parametric urbanism – deep relationality

The assumption is that the urban massing describes a swarm formation of many buildings whereby the urban variables of mass, spacing and directionality are choreographed by scripted functions. In addition, the systematic modulatory of architectural morphologies produces powerful urban effects and facilitates field orientation. The goal is deep relationality, the total integration of the evolving built environment, from urban distribution to architectural morphology, detailed tectonic articulation and interior organisation. Thus parametric urbanism might apply parametric accentuation, parametric figuration and parametric responsiveness as tools to achieve deep relationality.

Parametricist vs Modernist Urbanism

Le Corbusier’s first theoretical statement on urbanism begins with a eulogy to the straight line and the right angle as means whereby man conquers nature. Famously, the first two paragraphs of The City of Tomorrow contrast man’s way with that of the pack donkey:

Man walks in a straight line because he has a goal and knows where he is going; he has made up his mind to reach some particular place and he goes straight to it. The pack-donkey meanders along, meditates a little in his scatter-brained and distracted fashion, he zig-zags in order to avoid larger stones, or to ease the climb, or to gain a little shade; he takes the line of least resistance.

Zaha Hadid Architects, One-North Masterplan, Singapore, 2003

Network and fabric. This masterplan for a new mixed-used urban business district in Singapore was the first of a series of radical masterplans that led to the concept of parametric urbanism and then to the general concept of parametricism.
Le Corbusier admires the urban order of the Romans and rejects our sentimental modern-day attachment to the picturesque irregularity of the medieval city: ‘The curve is ruinous, difficult and dangerous; it is a paralyzing thing.’ However, while his understanding of nature’s order was limited by the science of his day, we now have the tools to reveal the complex order of those apparently chaotic patterns by simulating their ‘material computation’. In this process, parametricist sensibility gives more credit to the ‘pack-donkey’s path’ as a form of recursive material computation than to the simplicity of clear geometries imposed in a single, sweeping gesture.

Frei Otto’s pioneering research on natural structures included work on settlement patterns. He started by focusing on the distinction/relation between occupying and connecting as the two fundamental activities involved in all processes of urbanisation. His analysis of existing patterns paralleled by analogue experiments modelling crucial features of the settlement process. In a pioneering experiment, to simulate distancing occupation he used magnets floating in water, while to model attractive occupation he used floating polystyrene chips. A more complex model integrates both distancing and attractive occupations such that the polystyrene chips cluster around the floating magnetic needles that maintain distance among themselves. The result closely resembles the typical settlement patterns found in our real urban landscapes.

With respect to processes of connection, Frei Otto distinguishes empirically three scalar levels of path networks, each with its own typical configuration: settlement path networks, territory path networks and long-distance path networks. All start as forking systems that eventually close into continuous networks. In tandem, Otto distinguishes three fundamental types of configuration: direct path networks, minimal path networks and minimising detour networks. Again, he conceives material analogues that are able to self-organise into relatively optimised solutions. To simulate minimal path networks Otto devised the soap bubble skin apparatus in which a glass plate is held over water and the minimal path system forms itself from needles. To capture the opposite end to the internal circulation. This concept of deep relationality might also operate in reverse so that, for example, the internal organisation of a major institutional building might lead to multiple entrances that in turn trigger adaptations within the urban navigation system. It is important that such laws of correlation are adhered to across sufficiently large urban stretches.

Le Corbusier realised that although ‘nature presents itself to us as a chaos … the spirit which animates Nature is a spirit of order’. However, while his understanding of nature’s order was limited by the science of his day, we now have the tools to reveal the complex order of those apparently chaotic patterns by simulating their ‘material computation’. In this process, parametricist sensibility gives more credit to the ‘pack-donkey’s path’ as a form of recursive material computation than to the simplicity of clear geometries imposed in a single, sweeping gesture.

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The Kartal-Pendik project requires the design of a sub-centre on Istanbul’s Asian side to reduce pressure on the city’s historic core. The site is being reclaimed from industrial estates and is flanked by the small grain fabric of suburban towns. Respecting the parametricist taboo on unmediated juxtapositions, the adjacent context, in particular the incoming lines of circulation, was taken as an important input for the generation of the urban geometry. Maya’s hair dynamic tool achieved a parametrically tuned bundling of the incoming paths into larger roads enclosing larger sites such that the resultant lateral path system exhibits the basic properties of Frei Otto’s minimising detour network. The longitudinal direction was imposed via a primary artery with a series of subsidiary roads running parallel. The result is a hybrid of minimising detour network and deformed grid. At the same time, Zaha Hadid Architects worked with two primary fabric typologies, towers and perimeter blocks, each conceived as a generative component or geno-type that allows for a wide range of pheno-typical variation. The towers, conceived as cross towers, were placed on the crossing points to accentuate the path network. The perimeter block inversely correlates height with parcel area so that courtyards morph into internal atria as sites get smaller and blocks get taller. Blocks split along the lines of the secondary path network, which together with the accentuating height differentiation, allows the block type to be assimilated to the cross-tower type. ‘Pseudo-towers’ are formed at some crossing points by pulling up the four corners of the four blocks that meet at such a corner.

Thus, an overall sense of continuity is achieved despite the entire process having started from two quite distinct urban typologies. In terms of global height regulation, and aside from local dependency of height on parcel size, the project correlates the conspicuous build up of height with the lateral width of the overall site. Parametricist applications thus allow the rhythm of urban peaks to index the rhythm of the widening and narrowing of the urban field. The result is an elegant, coherently differentiated cityscape that facilitates navigation through its lawful (rule-based) constitution and through the architectural accentuation of both global and local field properties.

It may well be possible to implement this design for the Kartal-Pendik project assuming the imposition of strict planning guidelines using building lines and height regulation. Political and private buy-ins are also required. Moreover, all constituencies need to be convinced that the individual restrictions placed upon all sites really deliver collective value; the unique character and coherent order of the urban field from which all players benefit from if compliance guidelines can be enforced. Ordered complexity here replaces the monotony of older planned developments and the disorienting visual chaos that marks virtually all unregulated contemporary city expansions.

To go further, in terms of the concept of deep relationality, Zaha Hadid Architects must extend its involvement from urbanism to architecture; only then can the desired accentuating correlations be intensified by involving the systematic modulation of tectonic features. For instance, in terms of the ‘calligraphy blocks’ (a third perimeter block variation that has been designed both to open up the interior of
plazas. This is achieved while maintaining total continuity between the podium-like ground fabric and the shafts of the towers.

participate in the creation of a continuous urban fabric that frames the streets and occasionally widens the street space into semi-public
courtyard, a semi-private zone is articulated via the gradient transformation between the outer and inner articulation.

exterior of the blocks is given a heavier relief than the interior. Where a block opens up and the public space flows into the private
corner is faced with the task of designing large-scale
developments of this kind, the more confident we become that the tools and strategies we are deploying under the banner of parametricism can indeed deliver something that produces a decisive surplus value when compared with the usual alternative of uncoordinated, arbitrary juxtapositions. The contemporary choice of typologies, construction options and styles is simply too wide to expect the underlying pragmatic logics to become legible. The result is a cacophony of pure difference. Parametricism is able to further coordinate pragmatic concerns and articulate them with all their rich differentiations and relevant associations while the danger of overriding real-life richness is minimised because variety and adaptiveness are written into the very genetic makeup of this revolutionary style.

close-up of cross towers. The cross towers produce the urban peaks. Through their ground-level articulation these tower complexes participate in the creation of a continuous urban fabric that frames the streets and occasionally widens the street space into semi-public plazas. This is achieved while maintaining total continuity between the podium-like ground fabric and the shafts of the towers.

Opposite: Calligraphy blocks – tectonic detail. The articulation of the facades is a function of the location within the urban field. The articulation of the blocks is given a heavier relief than the interior. Where a block opens up and the public space flows into the private:

7. Parametricism involves a conceptual shift from part-to-whole relationships to component-system relationships, system-to-system relationships and system-subsystem relationships. Parametricism prefers open systems that always remain incomplete, that is, without established wholes. As the density of associations increases, so components may become associated in multiple systems. The correlation of initially independent systems implies the formation of a new encompassing system.

8. ‘Parametric figuration’ featured in teachings at the Yale School of Architecture, the University of Applied Arts in Vienna and in the author’s studio at the AADRL.

9. ‘Parametric responsiveness’ was at the heart of our three-year design research agenda ‘Responsive Environments’ at the AADRL in London from 2001 to 2004.

10. ‘Parametric Urbanism’ is the title of our recently completed design research cycle at the AADRL, from 2005 to 2008.


15. This interpretation of styles is valid only with respect to the avant-garde phase of any style.

16. It is important to distinguish research programmes in the literal sense of institutional research plans from the meta-scientific conception of research programmes that has been introduced into the philosophy of science: whole new research traditions that are directed by a new fundamental theoretical framework. It is this latter concept that is utilised here to reinterpret the concept of style. See Imre Lakatos, The Methodology of Scientific Research Programmes, Cambridge University Press (Cambridge), 1978.

17. Ibid, p 45.

18. Within the AADRL research agenda of ‘Parametric Urbanism’ we too always started with material analogies that were then transposed into the domain of digitally simulated self-organisers.

19. Frei Otto, op cit, p 64.


21. This is what Zaha Hadid Architects imposed within the urban guidelines for the Singapore masterplan.